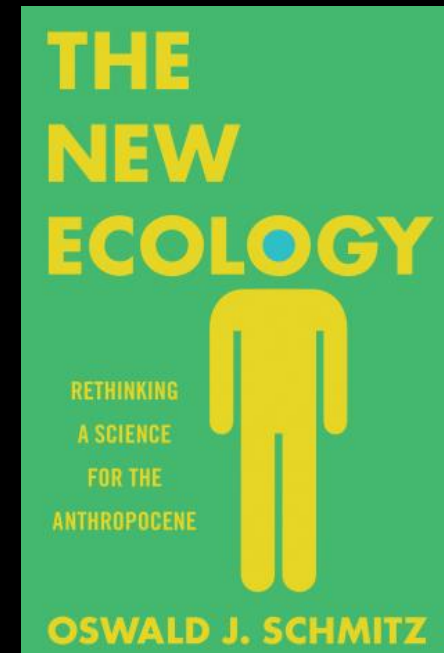
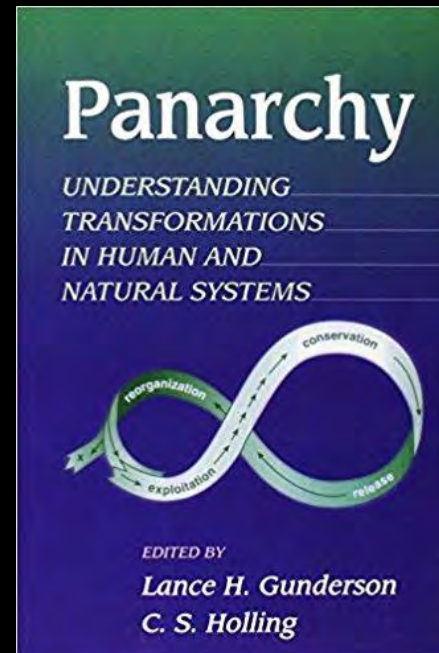
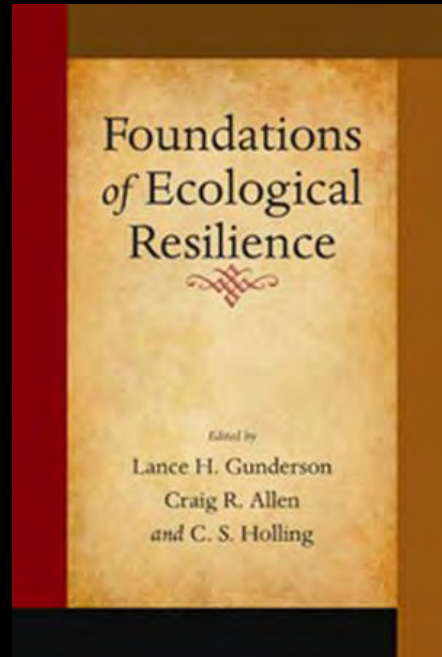
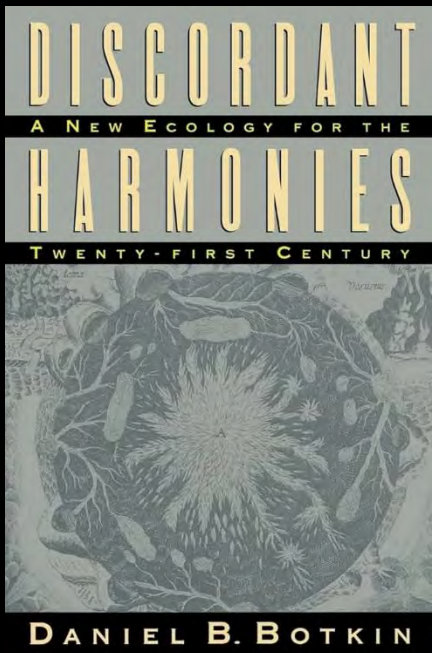




# New Nature: Discordant Harmony and Ecological Resilience

Kevin M. Anderson, Ph.D.

Austin Water – Center for Environmental Research

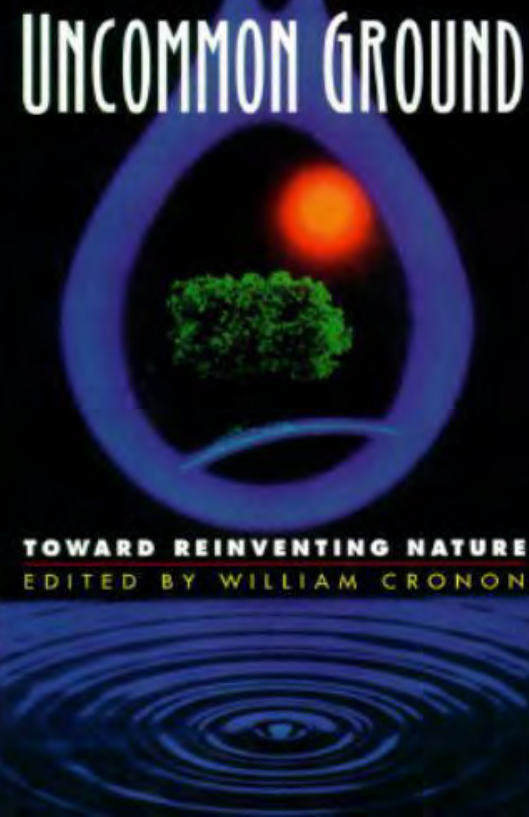


# The Full Continuum of a Natural Landscape

“We need to embrace the full continuum of a natural landscape that is also cultural, in which *the city, the suburb, the pastoral, and the wild each has its proper place*, which we permit ourselves to celebrate **without needlessly denigrating the others.**”

“The Trouble with Wilderness or, Getting Back to the Wrong Nature”  
William Cronon

*Uncommon Ground: Rethinking the Human Place in Nature*  
(1995)



# Denigration and Urban Nature

“Urban nature is not sublime...There’s too much sterility in the form of roofs and pavement, and, oddly enough, there’s also too much wildness, too many weeds and wooded borders and tangled banks, not to mention vacant lots going to brush.

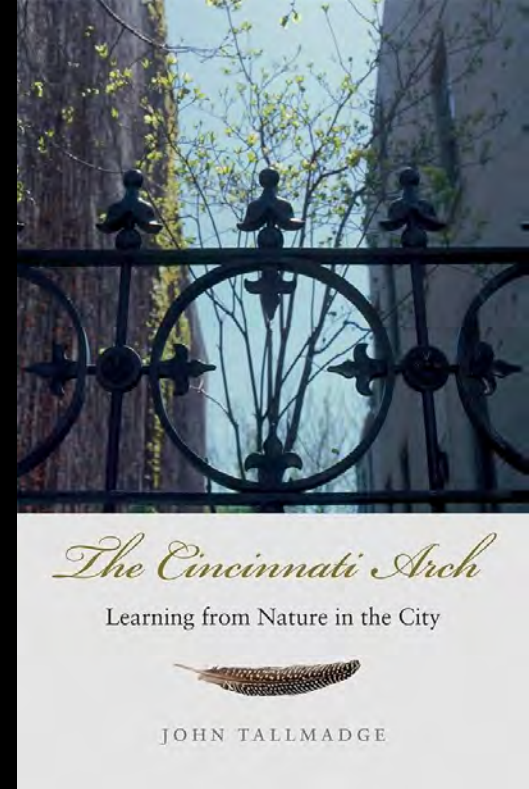
Of course, “wilderness” won’t do to describe such landscapes either. Despite the degree of wildness, there’s too much human impact, too many alien species, too few large animals to meet the legal and cultural criteria.

**The fact is that urban landscapes are just too mixed up, chaotic, and confused to fit our established notions of beauty and value in nature.**

***Maybe it’s not really nature at all, not a real ecosystem, just a bunch of weeds and exotics mixed up with human junk.”***

John Tallmadge

*The Cincinnati Arch: Learning from Nature in the City* (2004)



# The American Concepts of Nature and Urbanized America

We perceive nature filtered through a conceptual framework that prejudices its ecological and cultural value.

Wilderness



Pastoral Nature



Urban (Suburban) Nature?





## Humanized Earth

### The Lament - *The End of Nature* (1989)

"The idea of nature will not survive the new global pollution –

We have changed the atmosphere, and thus we are changing the weather, we make every spot on earth man-made and artificial.

We have deprived nature of its independence, and that is fatal to its meaning."

***"There's no such thing as nature anymore—and there is nothing except us alone"***



"Having lost its separateness, it loses its special power. Instead of being a category like God – something beyond our control – it is now a category like the defense budget or the minimum wage, a problem we must work out...one of the possible meanings of the end of nature is that God is dead."

Assumptions –

- Nature – Human Dualism – We are not part of nature.
- Permanence not Change is fundamental.

# Permanence and Change

# Learning *to* Die *in the* Anthropocene

REFLECTIONS ON THE  
**END OF A CIVILIZATION**

Roy Scranton

"Scranton draws on his experiences in Iraq to confront the grim realities of climate change. The result is a fierce and provocative book."

—Elizabeth Kolbert, author  
of *The Sixth Extinction*

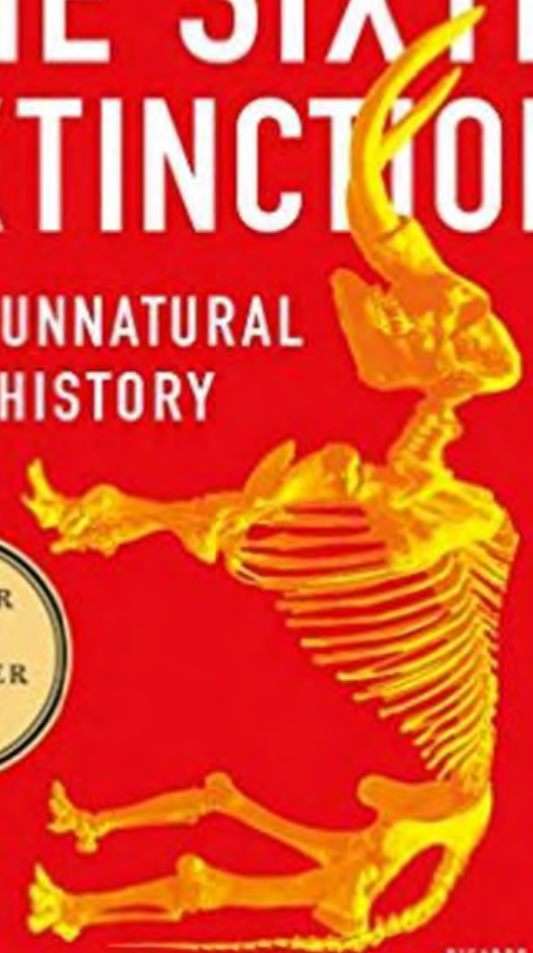


NEW YORK TIMES BESTSELLER

# THE SIXTH EXTINCTION

AN UNNATURAL  
HISTORY

WINNER  
of the  
PULITZER  
PRIZE



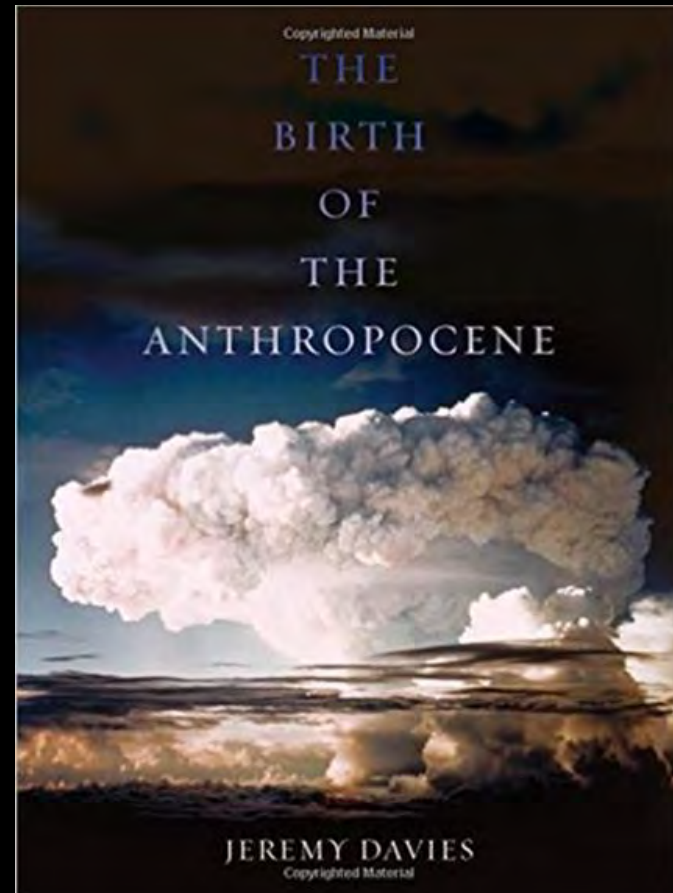
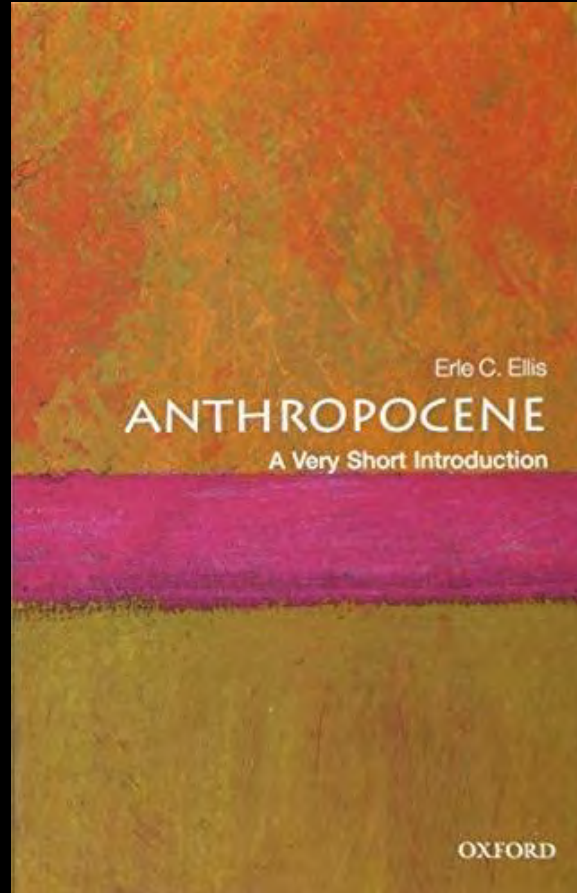
PICADOR

ELIZABETH KOLBERT

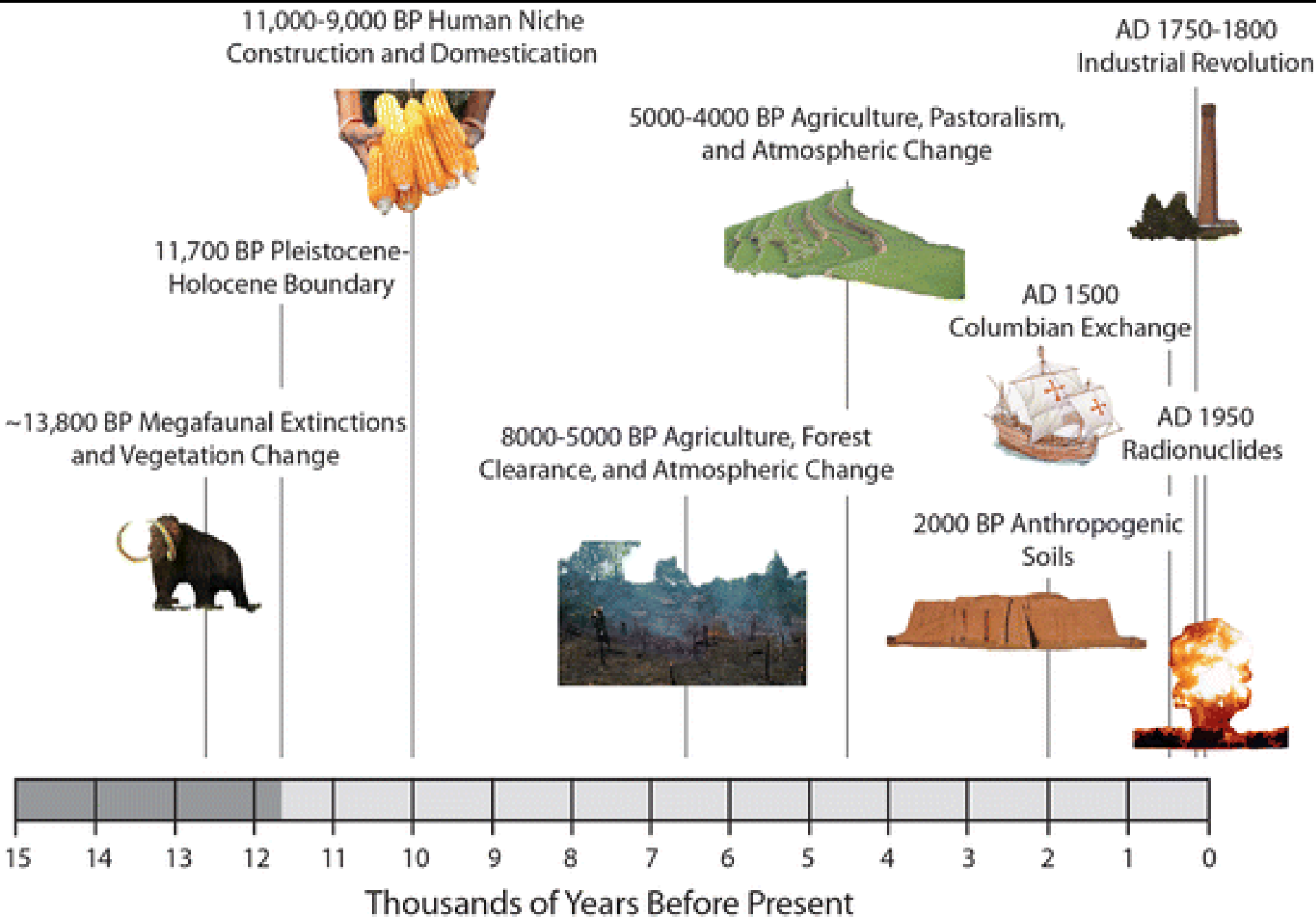
Author of *FIELD NOTES  
FROM A CATASTROPHE*

# Anthropocene – The Age of Humans

The Anthropocene is an unofficial unit of geologic time, used to describe the most recent period in Earth's history when human activity started to have a significant impact on the planet's climate and ecosystems.



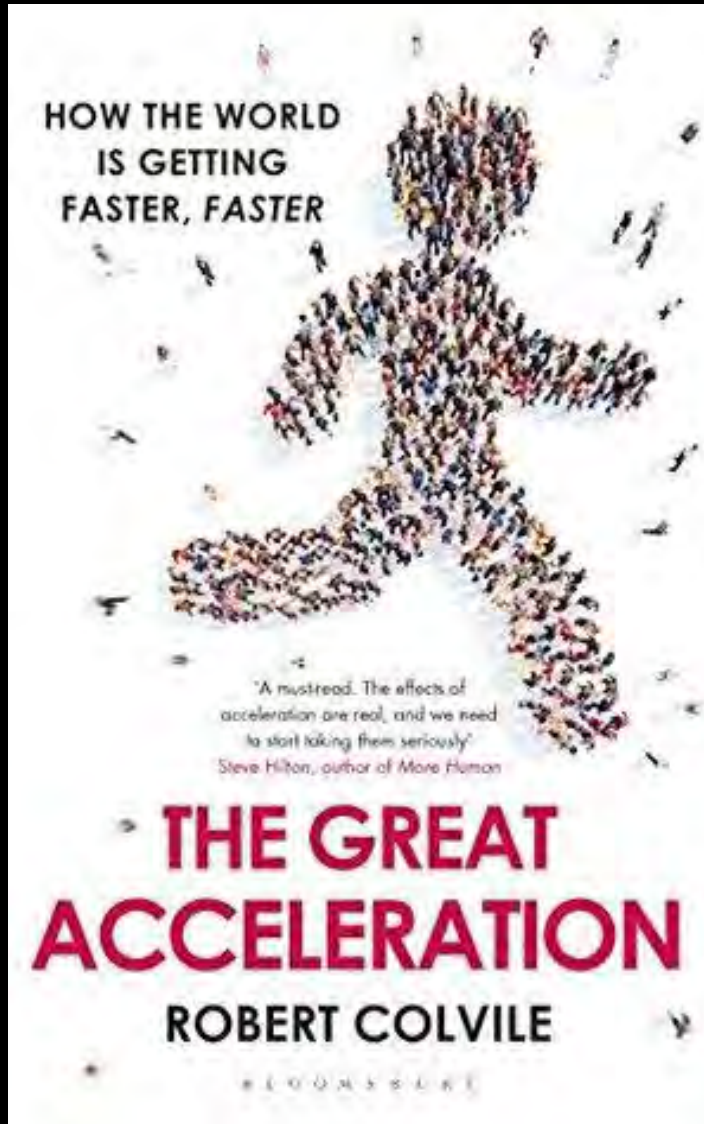
# When did the Anthropocene Begin?





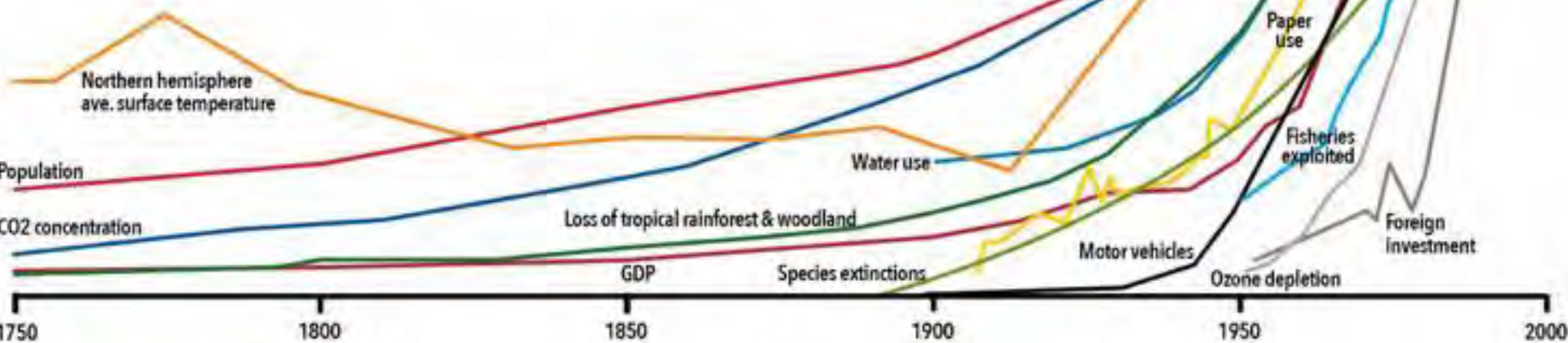
# The Great Acceleration

The dramatic, continuous and roughly simultaneous surge in growth rate across a large range of measures of human activity, first recorded in the mid-20th century and continuing to this day.



# Great Acceleration

- Population
- Real GDP
- Foreign direct investment
- Water use
- Paper production
- Fertilizer consumption
- Motor vehicles
- Primary energy use
- Telephones
- Tourism
- River dams
- McDonald's restaurants
- Atmosphere: CO2
- Atmosphere: N2O
- Atmosphere: CH4
- Atmosphere: ozone depletion
- N hemisphere surface temperature
- Loss of tropical rainforest & woodland
- Domesticated land
- Great floods
- Fisheries fully exploited
- Flood frequency
- Coastal nitrogen
- Species extinction



# Humans and Nature

# nature

THE INTERNATIONAL WEEKLY JOURNAL OF SCIENCE

## THE HUMAN EPOCH

Defining the Anthropocene PAGES 144 & 171

CONFLICT RESOLUTION

### BUILDING BRIDGES

Long-standing disputes can be fixed — in theory

PAGE 148

LINGUISTICS

### SCIENTIFICALLY SPEAKING

How English became the academic lingua franca

PAGE 154

RISK MANAGEMENT

### TAKING IT PERSONALLY

Model the growing interconnectivity of risk

PAGE 151

nature.com/nature

12 March 2015 £10

Vol 519, No. 7542



# Global Change

International Geosphere-Biosphere Programme

Issue 78 ■ March 2012

## ANTHROPOCENE

The geology of humanity



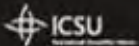
Urban expansion  
No signs of slowing

Natural catastrophes  
2011 breaks records

GLOBAL  
IGBP  
CHANGE

www.igbp.net

Earth-system science for a sustainable planet



# Concepts of American Nature

Wilderness



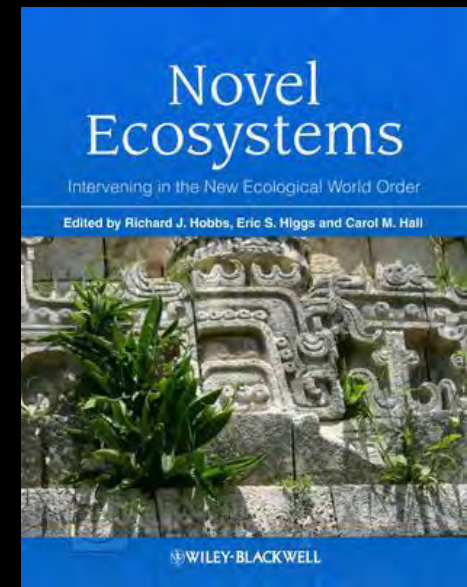
Pastoral



Urban



New



# The Full Continuum of Urban Nature – New Urban Nature

Nature flourishes through its own agency in neglected urban spaces and margins like overgrown urban creeks, vacant lots, garbage dumps, sewage ponds, unmaintained roadway and railway verges, derelict industrial tracts, abandoned buildings, crumbling walls, and other urban waste spaces.



# The Geography of Urban Wastelands

## Wastelands - whole patches

- Vacant lots
- Dumpsites
- Industrial Wasteland
  - Brownfields
  - Greenfields
  - Quarries and Gravel Pits
- Urban Infrastructure Land
  - Power plants
  - Water treatment plants
  - Reservoirs
  - Wastewater treatment plants
    - Sewage ponds
    - Constructed wetlands
  - Stormwater retention structures
- Unusable Land - bits and pieces
  - Slopes, gullies, corners, fragments

## Margins – edges and ledges

- Urban waterways
- Canals, drainage channels
- Utility corridors
- Waysides
  - road waysides
  - railway verges
- Alleys – paved, unpaved, grass
- Walkways and pathways
- Fencelines
- Walls and ledges
- Pillars and bridge abutments





© Sonja Sommerfeld / TPWD



## New Nature - Marginal Nature

“Maybe it’s not really nature at all, not a real ecosystem, just a bunch of weeds and exotics mixed up with human junk.”

What emerges in these urban wastelands is a hybrid type of nature both weedy and wild - the unintended product of human activity and Nature's unflinching opportunism, which I call **Marginal Nature**

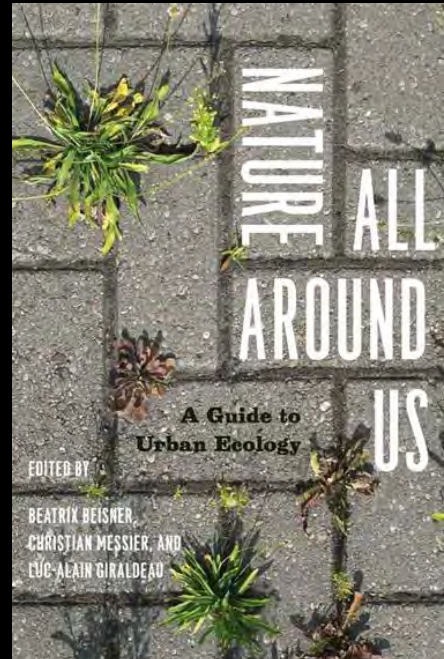
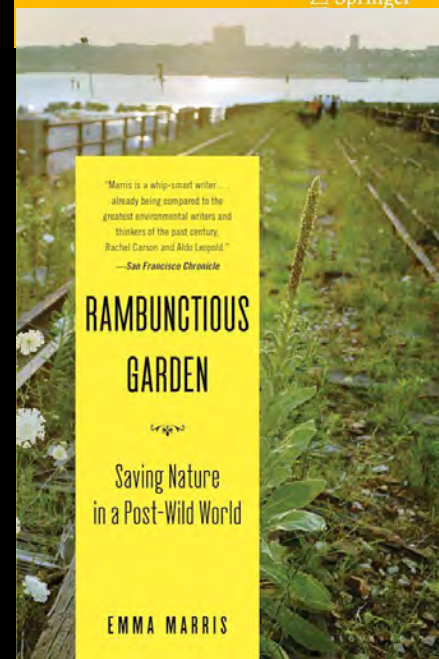
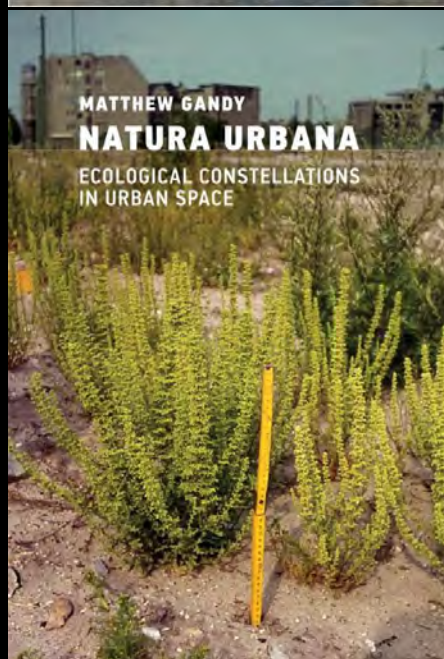
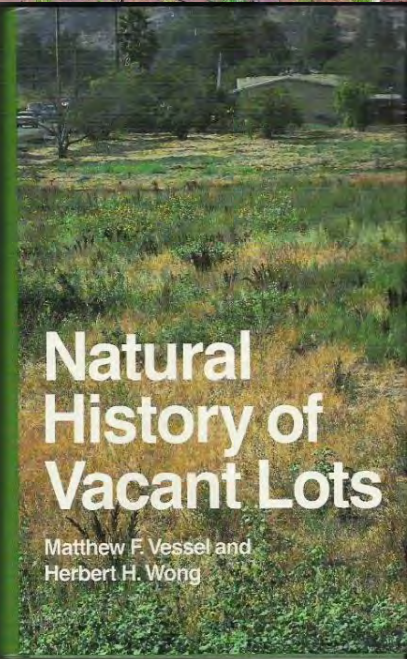
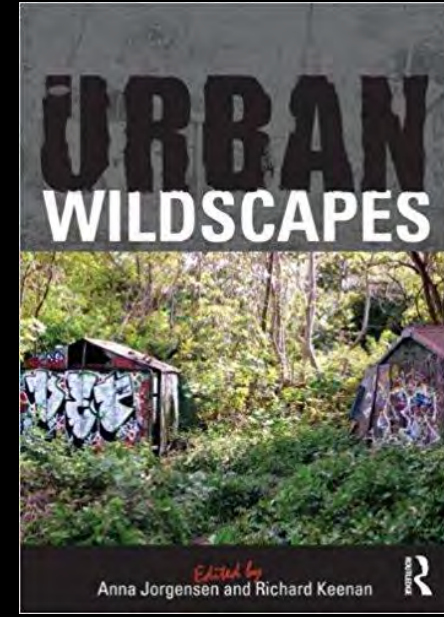
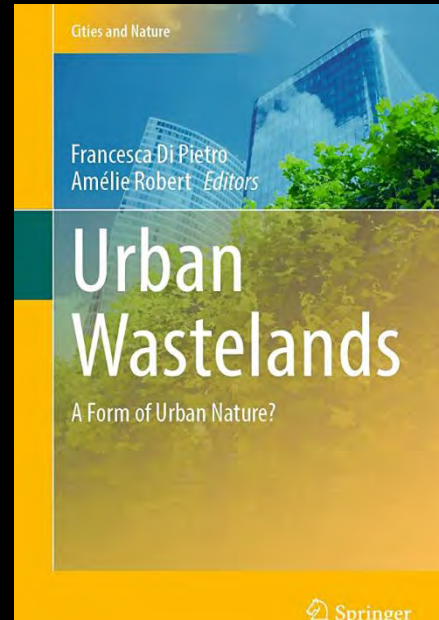
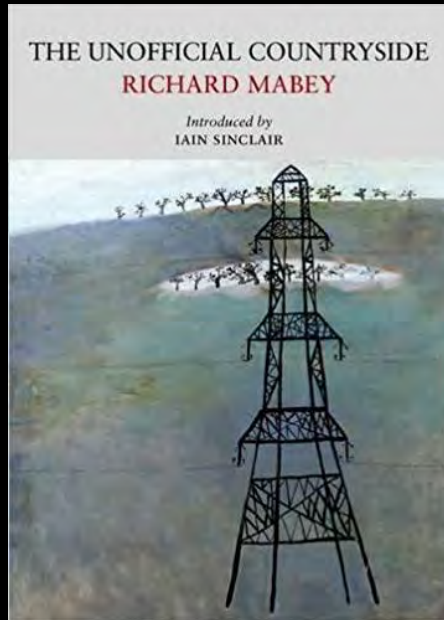
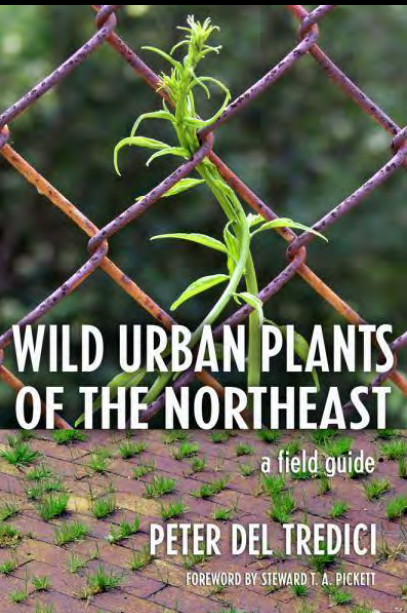
*Marginal Nature: Urban Wastelands and the Geography of Nature*

Anderson 2009 UT Geography



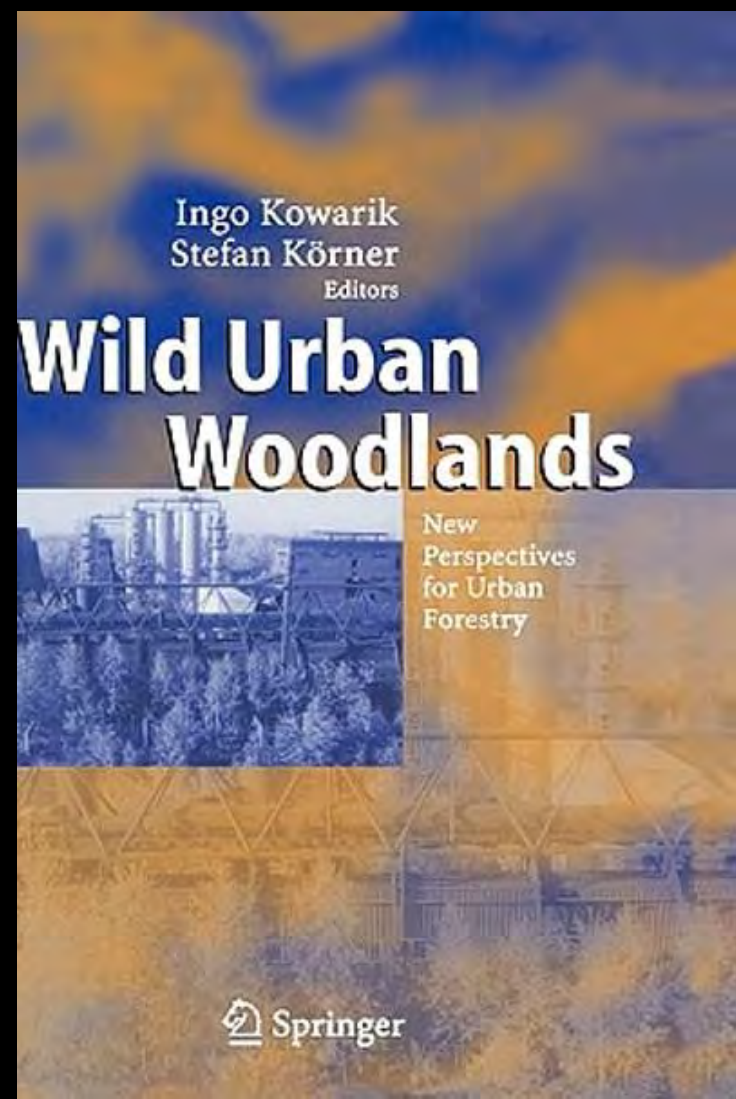


**Marginal nature in the urban landscape is neither pristine nor pastoral, but rather it is a new kind of nature whose ecological and cultural meaning is an open question.**



# The Problem of Scientific Knowledge and New Nature

## Retrospective Ecology vs. Prospective Ecology



# Retrospective Ecology, Historical Naturalness and American Ecology

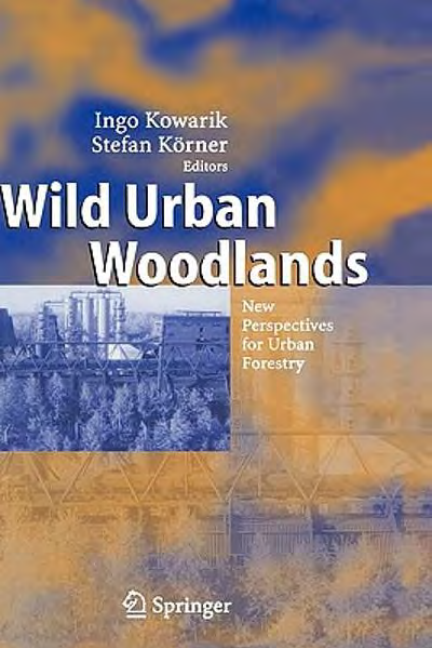
## Good Nature vs. Bad Nature

“The Mannahatta Project began in 1999, when landscape ecologist Dr. Eric Sanderson moved to New York City to work for the Wildlife Conservation Society....

*to fully appreciate the concrete landscape of streets and buildings that was his new home, he would have to ‘go back in time’ to recreate the its ecology from the ‘ground up.’*

Going back to **1609** allows us to see what New York City was *before it was a city* and to reimagine the city’s development in a way that would incorporate more of the natural cycles and processes (such as the hydrological cycle) that made the island the ecological gem that it was.”





## New Ecology – The European Perspective

### Retrospective naturalness vs. Prospective naturalness

*Wild Urban Woodlands* Ingo Kowarik (2005)

#### Retrospective Naturalness

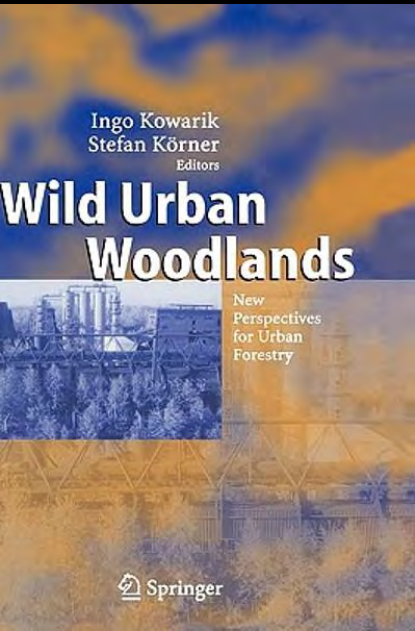
- “The point of reference is therefore, **pristine vegetation uninfluenced by humans**. Based on the cultural history of the relevant area, **the reference period may lie decades or a few millennia in the past.**”
- “remnants of pristine woodlands are **most natural** and woodlands used for forestry are at least semi-natural.”
- “the development back to nearly natural or **natural woodlands composed of historical native species can be analyzed well.**”

#### The Problem of Wild Urban Woodlands

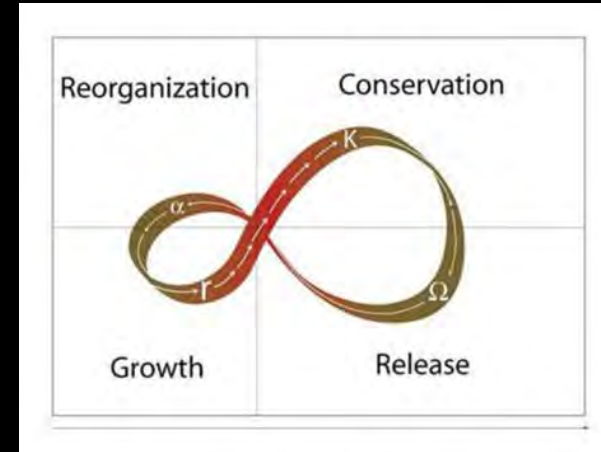
“With the evaluation of **new development of ‘wild’ urban woodlands**, however, the traditional concept of naturalness oriented toward historical comparisons runs aground.”



# Wild Urban Woodlands – Waller Creek 7<sup>th</sup> Steet Bridge



2023



2005



2009



2012



2017



# The Socioecological Earth

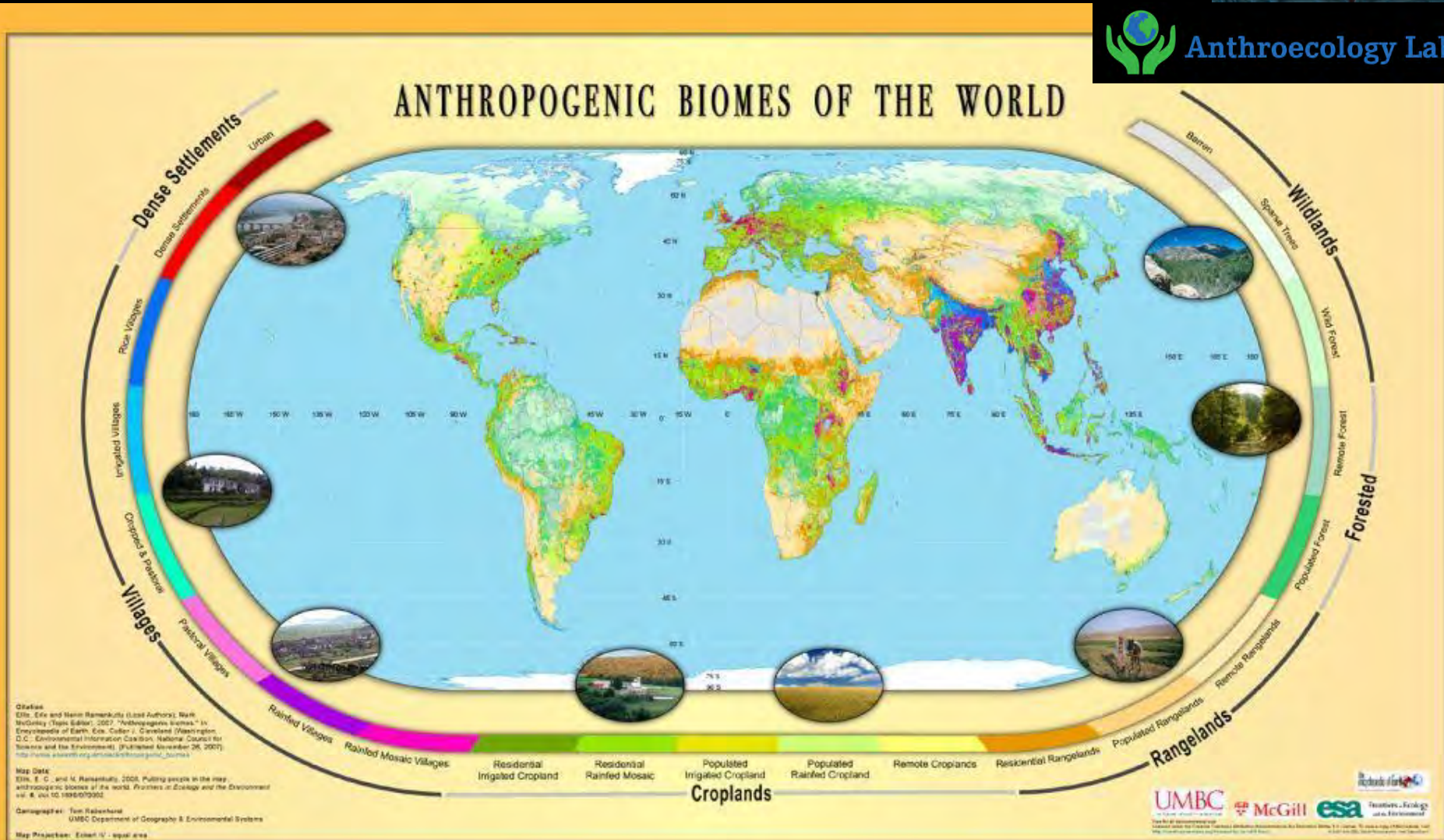
## A Coproduction of Humans and Nonhumans

# The Socioecological Earth – A Coproduction

Erle Ellis, University of Maryland

Anthropogenic Biomes ("Anthromes")

“Global ecological patterns shaped by humans”

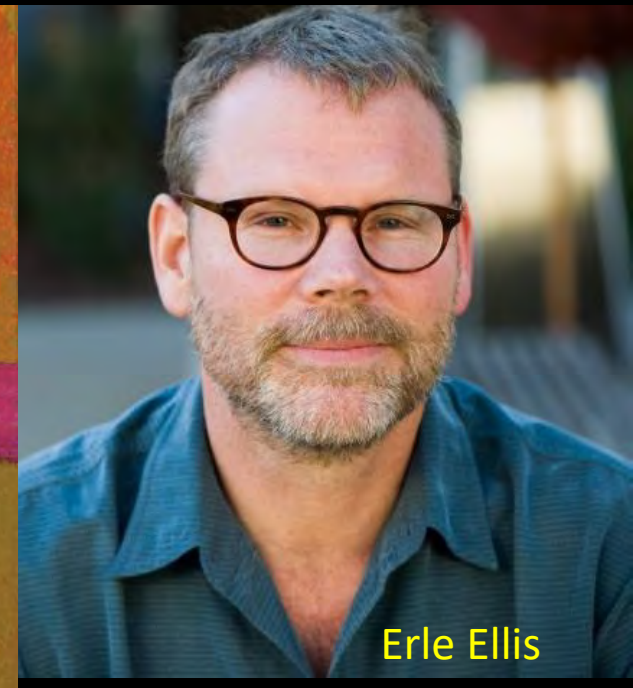
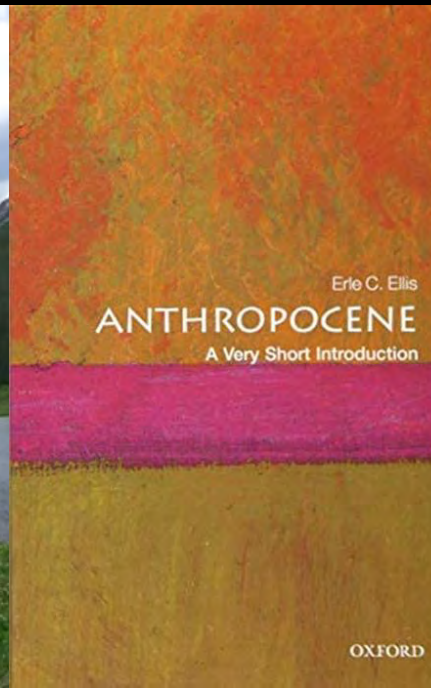


# Anthropogenic Biomes – A New Story (Myth) of Nature

“Anthropogenic biomes point to a necessary turnaround in ecological science and education, *especially for North Americans*.

Beginning with the first mention of ecology in school, the biosphere has long been depicted as being composed of natural biomes, perpetuating an outdated view of the world as ‘natural ecosystems with humans disturbing them’.

**Anthropogenic biomes tell a completely different story, one of ‘human systems, with natural ecosystems embedded within them’. This is no minor change in the story we tell our children and each other. Yet it is necessary for sustainable management of the biosphere in the 21st century.”**

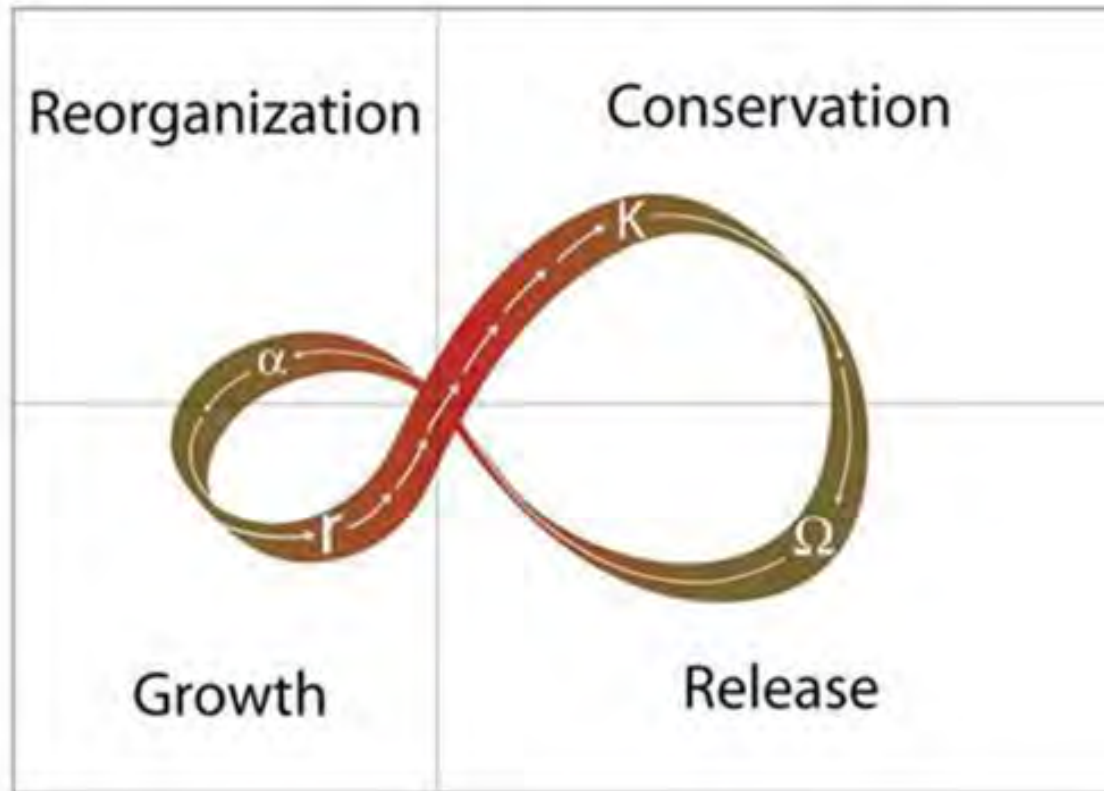




# New Nature

Myths/Narratives of Nature About How Nature Works?

A Story About Permanence and Change



# How Nature Works – Ecology’s Myths (Narratives) of Nature

“Every generation...writes its own description of the natural order, which generally reveals as much about human society and its changing concerns as it does about nature.”

*Nature’s Economy, Donald Worster*

Random



## MYTHS OF NATURE

Stable



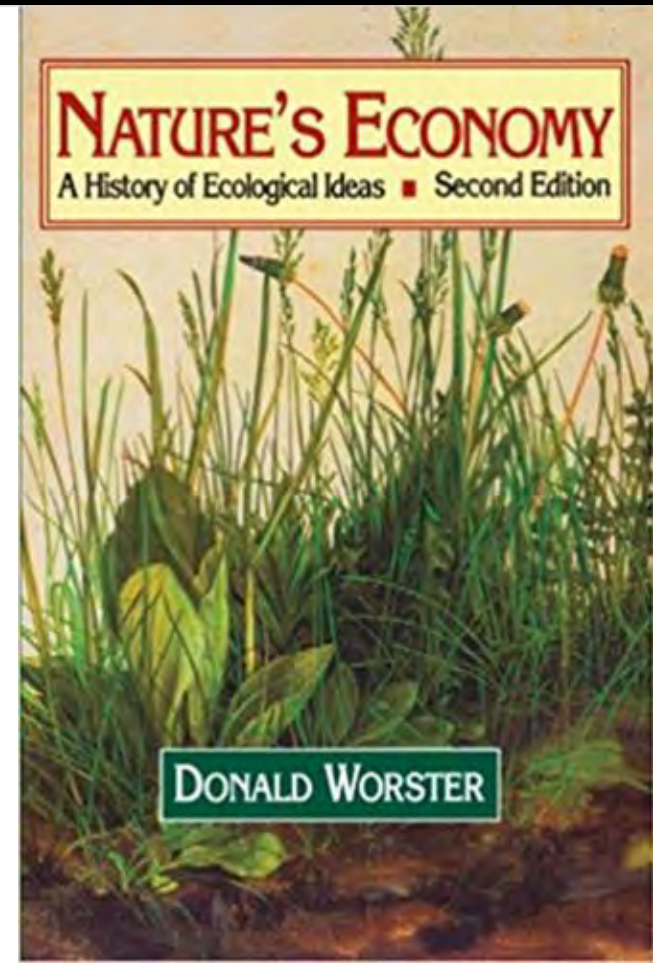
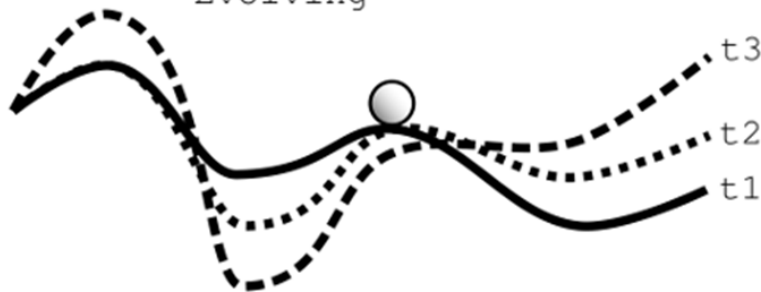
Resilient



Unstable



Evolving



# How Does Nature Work? Permanence and Change

Heraclitus 540-480BC

“No man ever steps in the same river twice.”

Everything Flows

Everything stays the same only by changing.

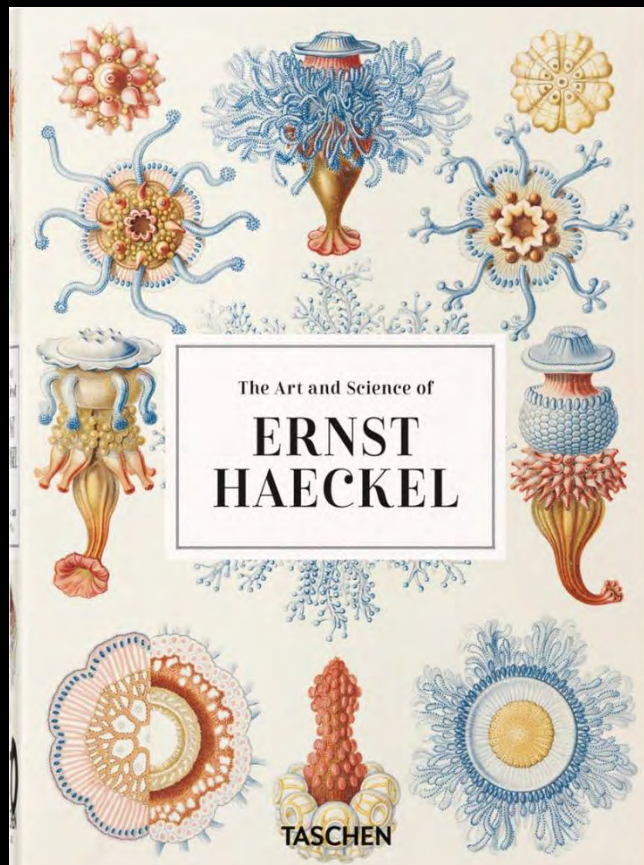
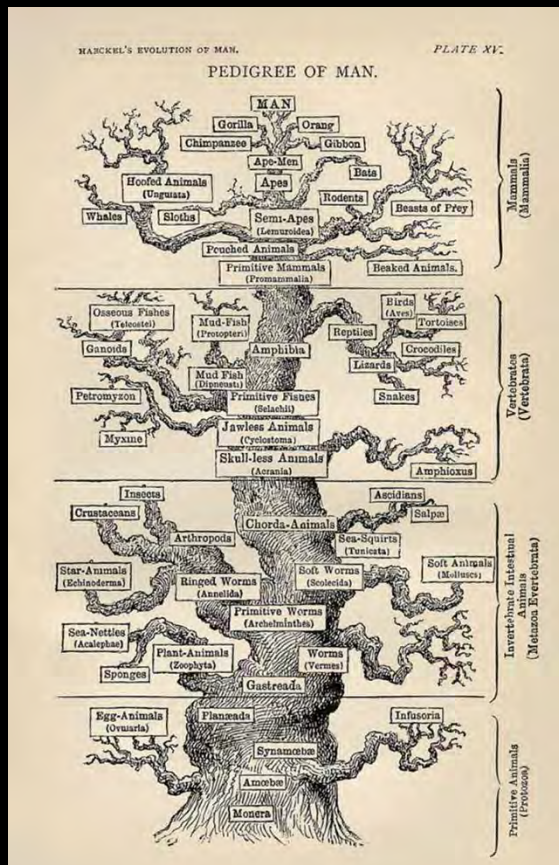
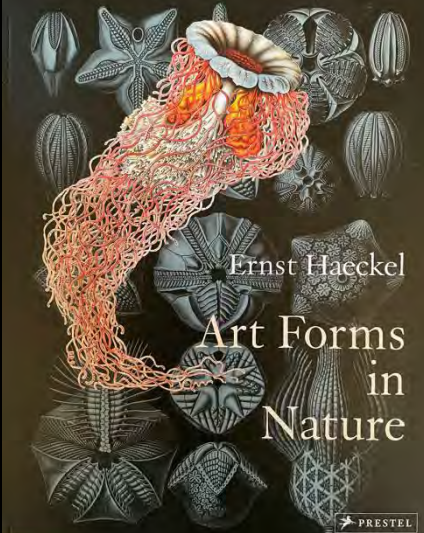
Nothing Endures But Change



# Naming a New Science - Ecology

Ernst Haeckel 1834–1919

German biologist inspired by Humboldt and Darwin described and named thousands of new species, mapped a genealogical tree relating all life forms, and coined many new terms for biology, including phylum, phylogeny, stem cell, protista...and the name of a new science – Ecology.



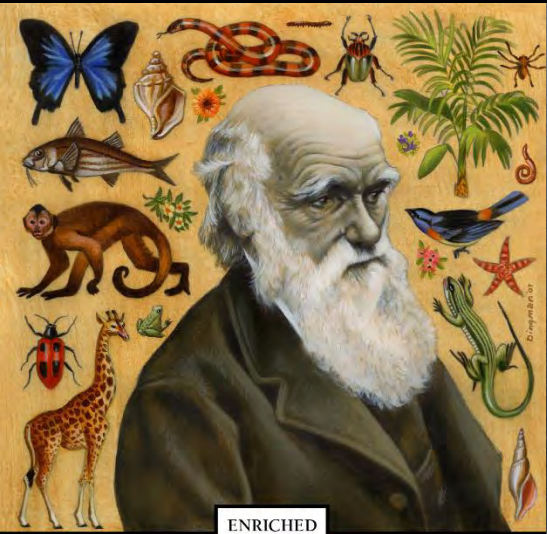
# Haeckel and Darwin

## Ecology and Biology

### Biology - How Does Life Work?

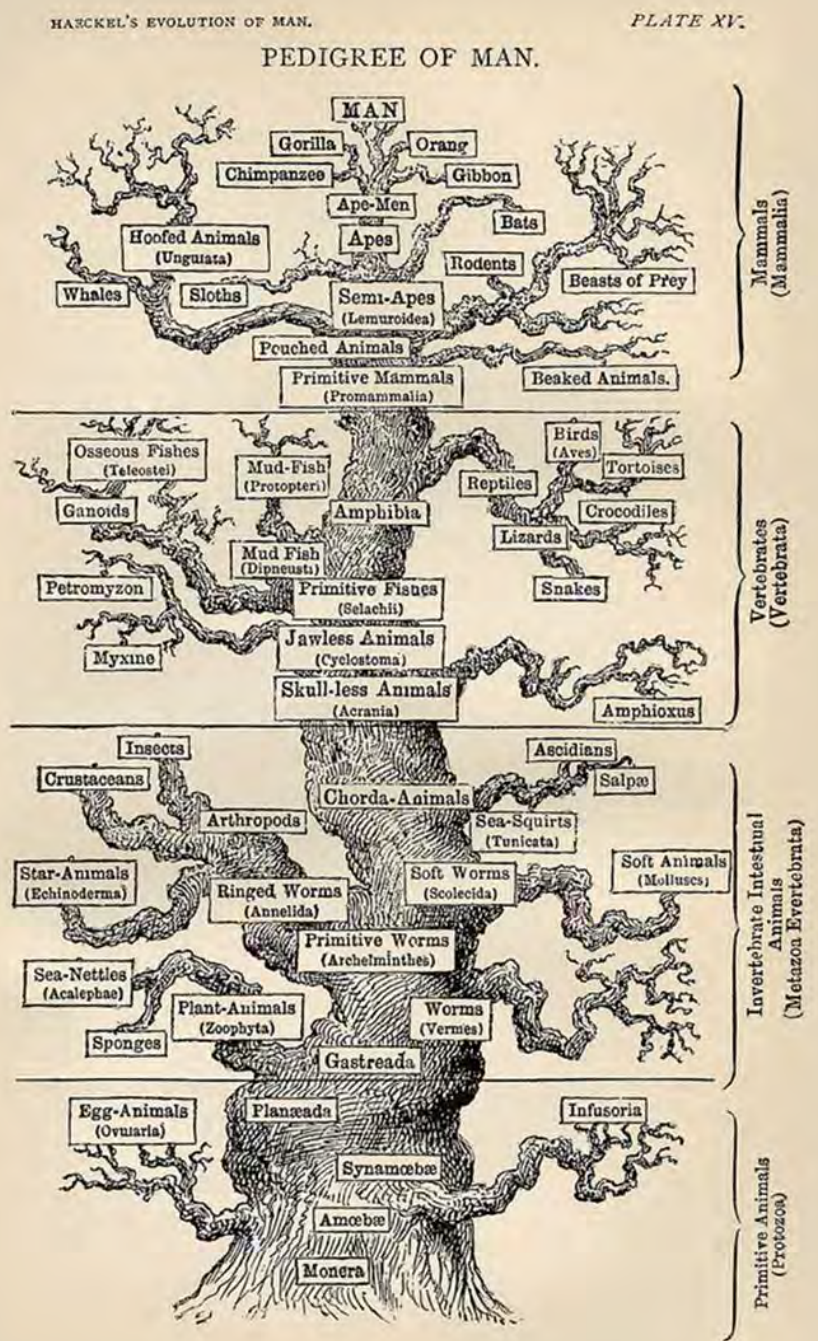
- Darwin – Life Evolves
- *On the Origin of Species by Means of Natural Selection* (1859)

### Ecology – How Does Nature Work?



ENRICHED CLASSIC

THE ORIGIN OF SPECIES  
CHARLES DARWIN



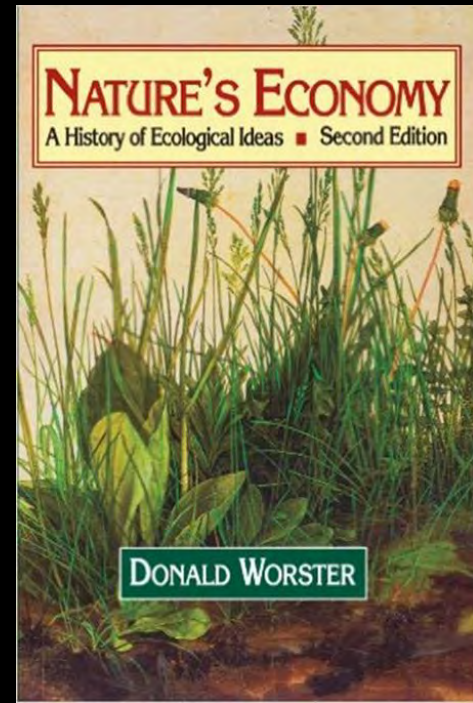
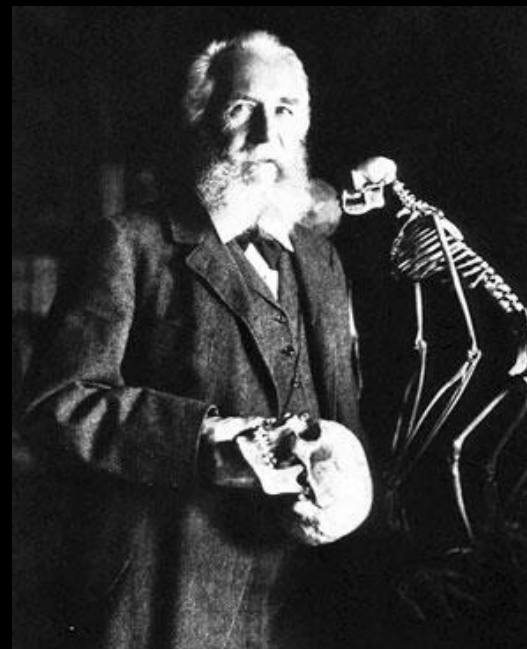
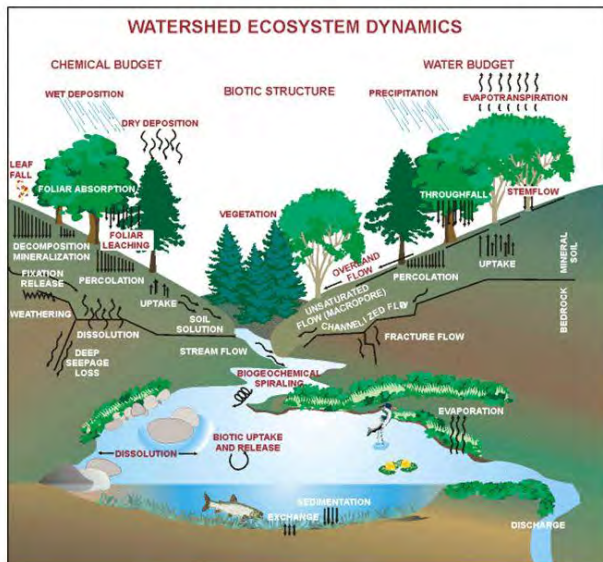
# How Does Nature Work? 1866

Ecology - The study of Life Systems [ecosystems] – the biotic and abiotic

- In 1866, Haeckel coined the word “oekologie” for a science of the “relation of the animal both to its organic as well as its inorganic environment.”
- The word comes from the Greek oikos, meaning “household,” “home,” or “place to live.” Thus, ecology deals with the organism and its environment.

“By ecology we mean *the body of knowledge concerning the economy of nature...* in a word, *ecology is the study of all those complex interrelations referred to by Darwin as the conditions of the struggle for existence.*”

## Ecosystem – Biotic and Abiotic



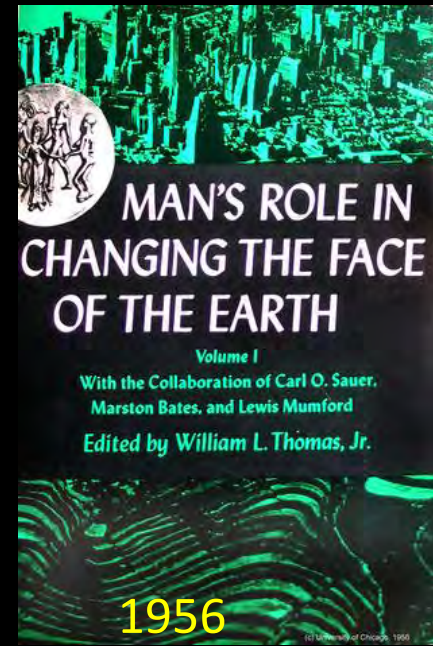
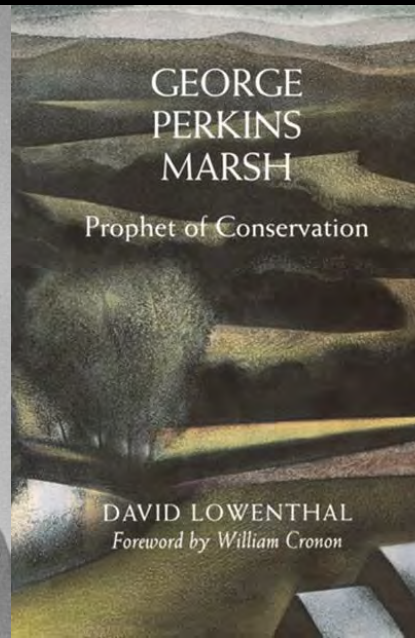
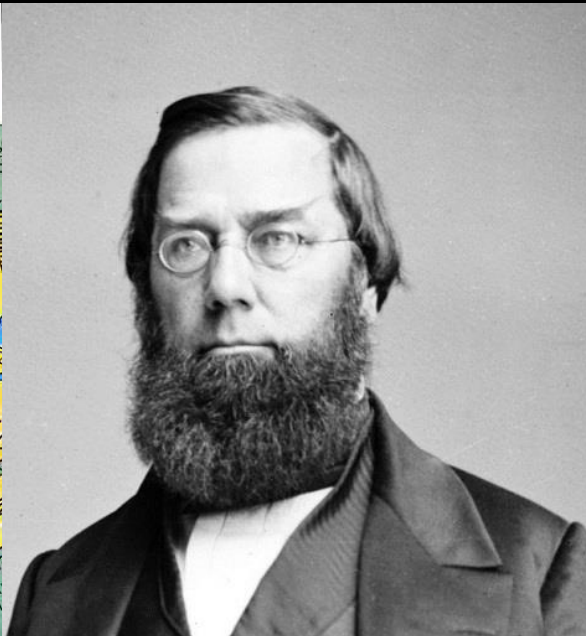
# Permanence and Change - Humans and Ecology

*Man and Nature: Physical Geography as Modified by Human Action* (1864)

George Perkins Marsh 1801-1882

"Man is everywhere a disturbing agent. Wherever he plants his foot, the harmonies of nature are turned to discord"

- Stress on the ***unforeseen and unintended consequences***, as well as the heedless greed of technological enterprise.
- Wallace Stegner - "the rudest kick in the face that American initiative, optimism and carelessness had yet received."



# Permanence and Change - Integrity and Stability

Aldo Leopold 1887-1948

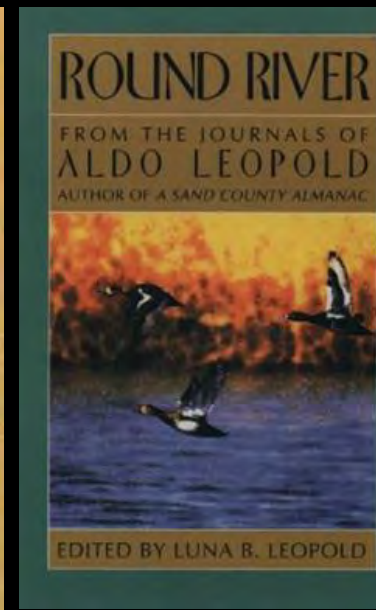
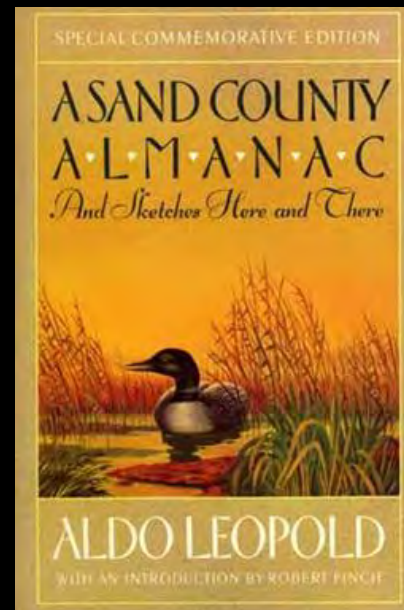
"Ecology is an infant just learning to talk, and, like other infants, is engrossed with its own coinage of big words. Its working days lie in the future."

*Round River 1941*

## The Land Ethic –The Ecological basis for Environmental Ethics?

"A thing is right when it tends to preserve the **integrity, stability, and beauty** of the biotic community. It is wrong when it tends otherwise."

*A Sand County Almanac 1948*

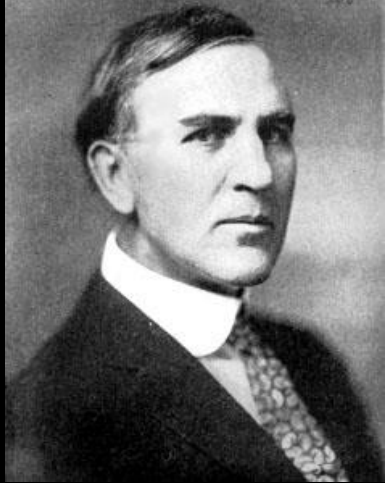
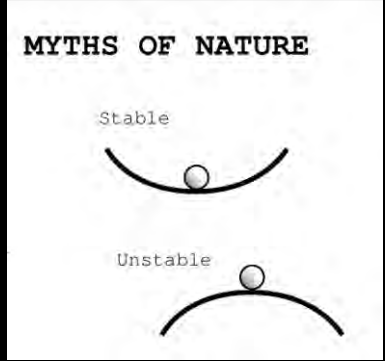
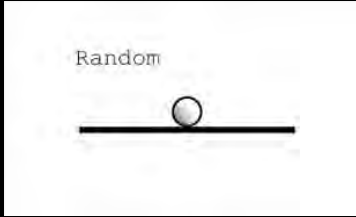




# How Does Nature Work? – Succession and Stability

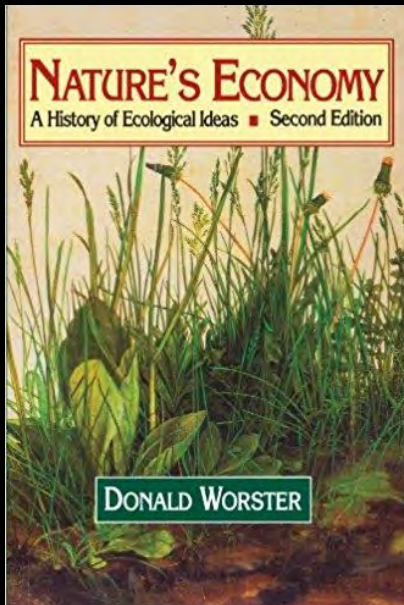
Frederic Clements 1874-1945  
*The Development and Structure of Vegetation* (1904)  
*Plant Succession* (1916)

- Vegetation is dynamic
- Succession and climax stage
- Monoclimax – any region of Earth can have only one mature stage based on climate
- Assumes a natural state with **no human interference** – **natural equilibrium**
- “Nature’s course, he contended, is not an aimless wandering to and fro but a steady flow toward **stability** that can be exactly plotted by the scientist.” Worster



Plant succession;  
an analysis of  
the development  
of vegetation

*Frederic Edward Clements*



# Stability, Trophic Levels, Invasion Ecology

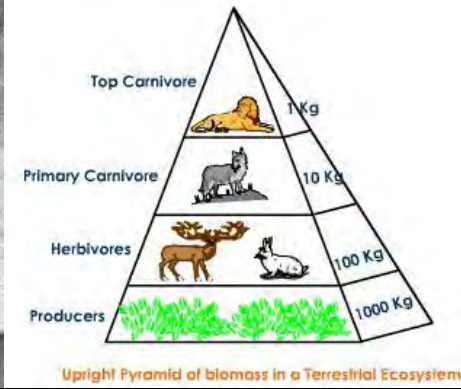
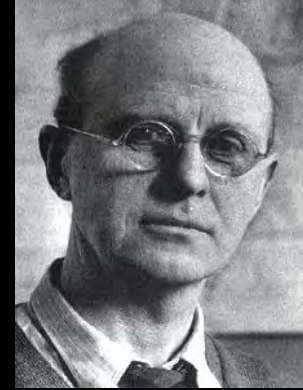
Charles Elton 1900-1991

*Animal Ecology* (1927)

- Community Structure – an economy of nature
- Food chain, food web
- Plants = producers, Animals = consumers (reducers, decomposers)
- Niche – the status or occupation of an organism in a community
- ***One species to one niche*** (competition)

*The Ecology of Invasions* (1958)

- Invasion Biology – Invasive Species
- DIH – the Diversity-Invasibility Hypothesis
- More Biodiversity Less Likely to be Invaded
- **Biodiversity = Stability** – All niches filled
- Disturbance is the prerequisite for invasion
- “Man is everywhere a disturbing agent”

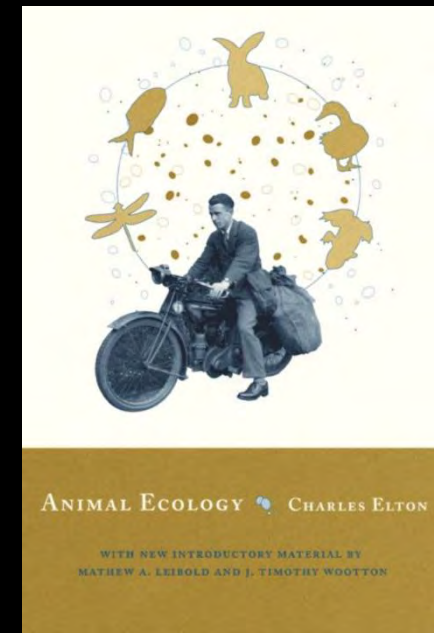
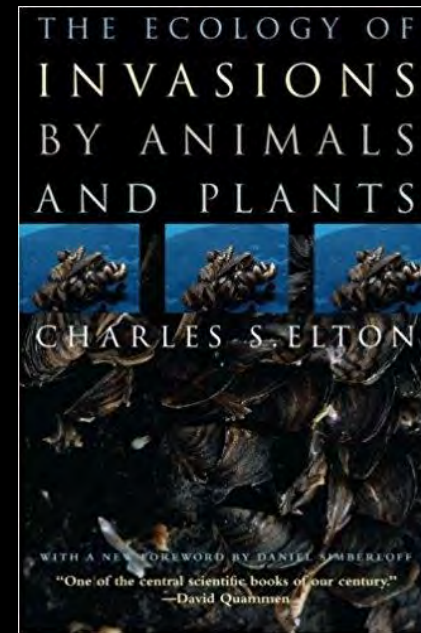


## MYTHS OF NATURE

Stable



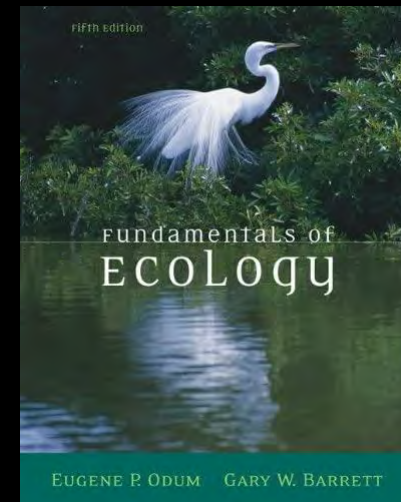
Unstable



# Ecosystem, Stability, and the Equilibrium Paradigm

Eugene Odum, *Fundamentals of Ecology* (1953)

- The law of organic nature is to bring **order and harmony** out of chaotic materials of existence
- Nature is **a series of balanced ecosystems** – the basic functional unit of ecology, and so a need for a unified theory of the ecosystem [a pond, a watershed, a meadow]
- Rather than climax stage he used “**mature ecosystem**” – the ecosystem was often disturbed but fluctuated around a single **homeostatic point = health = stability/equilibrium**
- Humans the Great Disrupters



## MYTHS OF NATURE

Stable



Unstable



By the 1960s, these scientific beliefs are questioned...

1. Is an ecosystem a reality or an abstraction?
2. Are ecosystems inherently stable?
3. How does disruption fit in?
4. How do the great disrupters – Humans - fit in?

# How Does Nature Work? – Equilibrium and Biodiversity

PRINCETON  
LANDMARKS  
IN BIOLOGY

## THE THEORY OF ISLAND BIOGEOGRAPHY



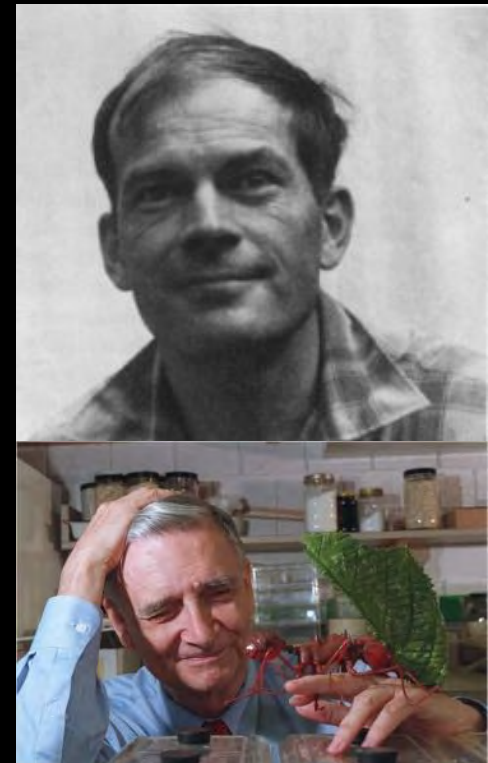
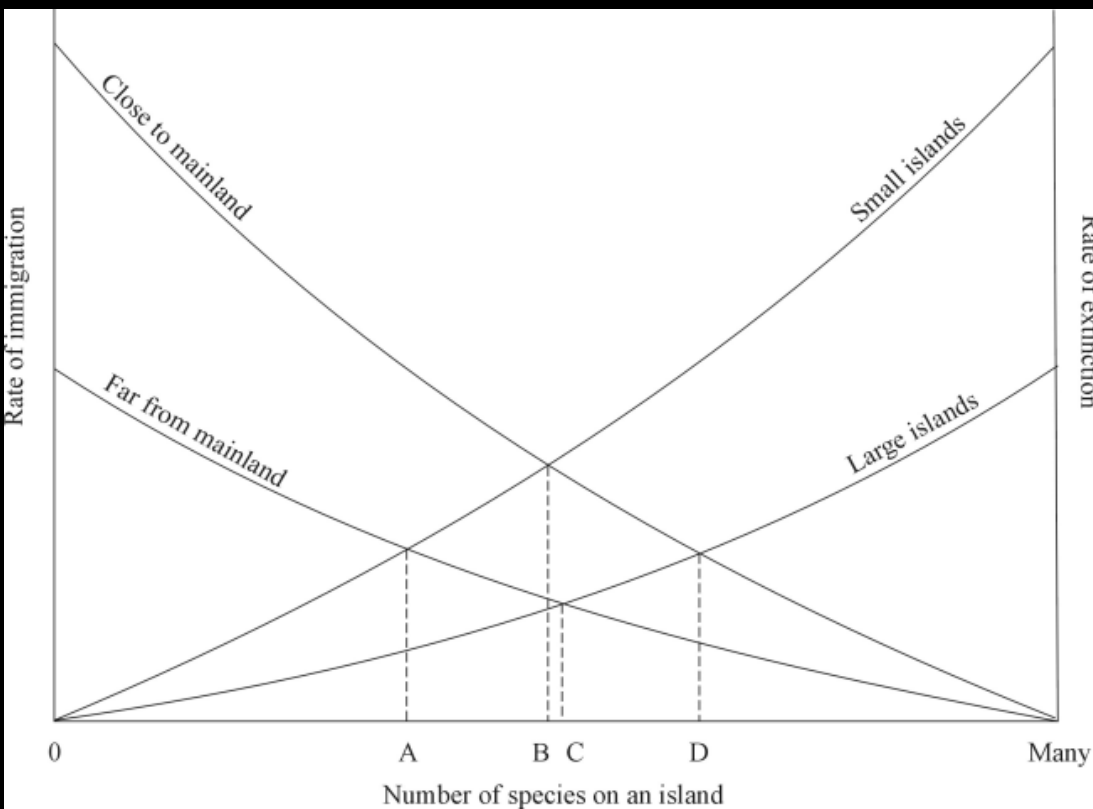
WITH A NEW PREFACE BY EDWARD O. WILSON

ROBERT H.  
MACARTHUR

EDWARD O.  
WILSON

## The Theory of Island Biogeography (1967) Robert MacArthur and Edward O. Wilson

- Mathematical modeling and islands
- Number of species always reaches **an equilibrium point** – species diversity does not continue to develop indefinitely
- New colonization must be matched by extinction
- Community structure focus rather than ecosystem



# How Does Nature Work?

## The New Ecology - No inherent stability

Robert May, *Stability and Complexity in Model Ecosystems* (1973)

- Mathematical models demonstrate **that the more species there were, the more fragile the ecosystem**
- Chaos theory and complexity, “Confronted with disturbances beyond their normal experience” complex systems like rainforests tended to crumple.

The new ecology emphasizes

- **Disequilibria**
- **Instability**
- **Chaotic fluctuations**

in ecosystems both “natural” and human impacted

If 20th-century ecology was marked by an infatuation with balance, then our era is one of **disturbance, disruption, non-equilibrium, chaos, and randomness.**

— Daniel Botkin, *Discordant Harmonies* (1990)

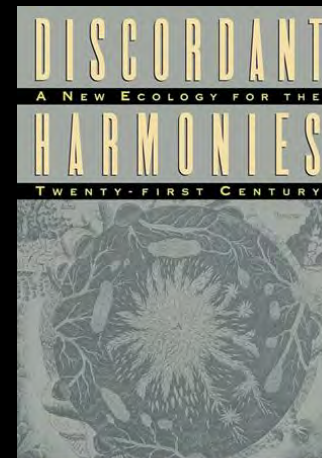
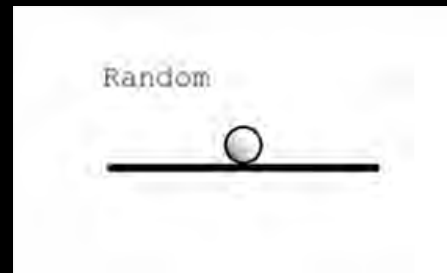
PRINCETON  
LANDMARKS  
IN BIOLOGY

STABILITY AND  
COMPLEXITY IN  
**MODEL**  
ECOSYSTEMS



WITH A NEW INTRODUCTION BY THE AUTHOR

ROBERT M.  
**MAY**



# "Resilience and stability of ecological systems" 1973

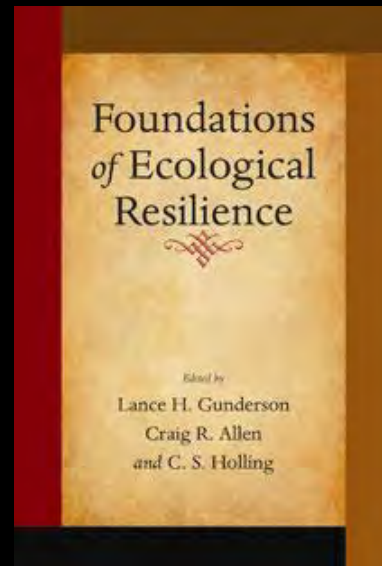
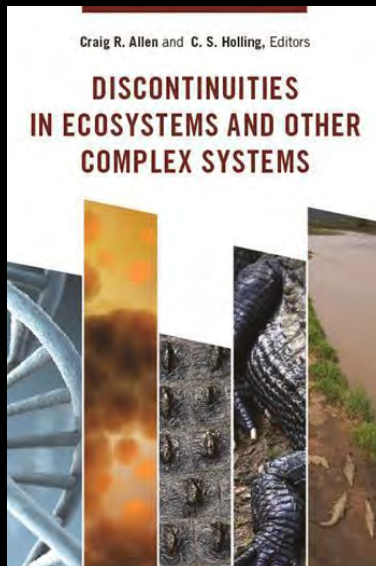


## Balance and Disequilibrium - Permanence and Change

- **The concept of resilience** in ecological systems was first introduced by the Canadian ecologist C.S. Holling in order *to describe the persistence of natural systems in the face of changes in ecosystem variables due to natural or anthropogenic causes.*
- **Resilience**, derived from its Latin roots 'to jump or leap back', is the ability to recover from or adjust easily to misfortune or change.
- Ecosystem resilience is **the capacity of an ecosystem to tolerate disturbance.**

Holling, C.S. (1973). "Resilience and stability of ecological systems"

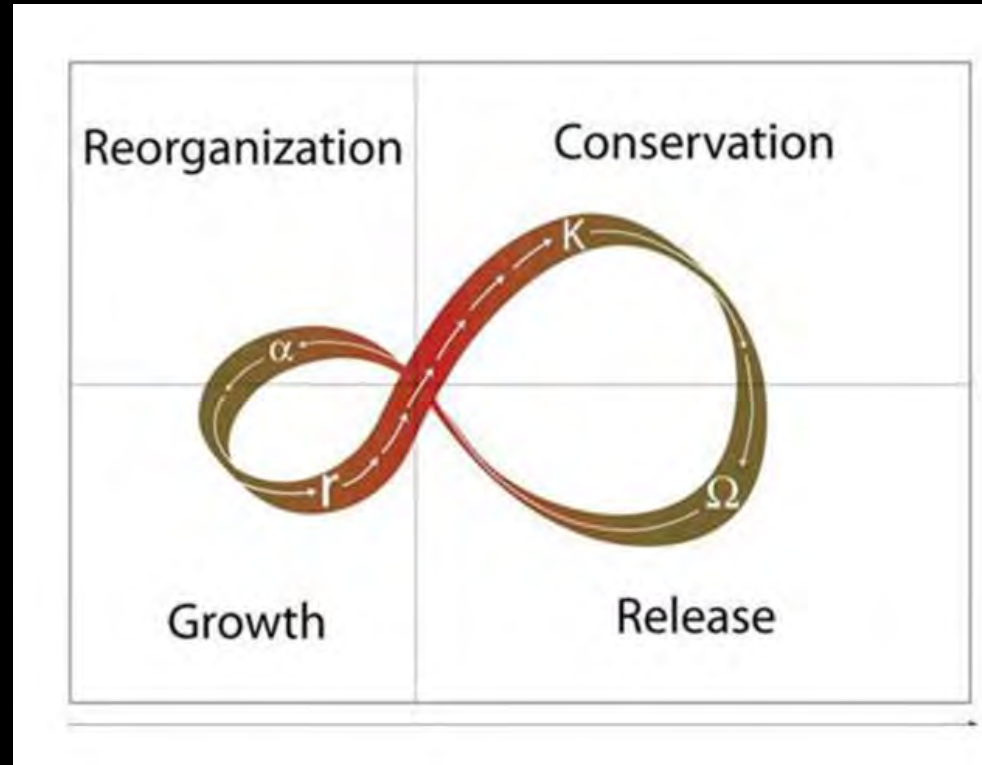
C.S. Holling 1930-2019



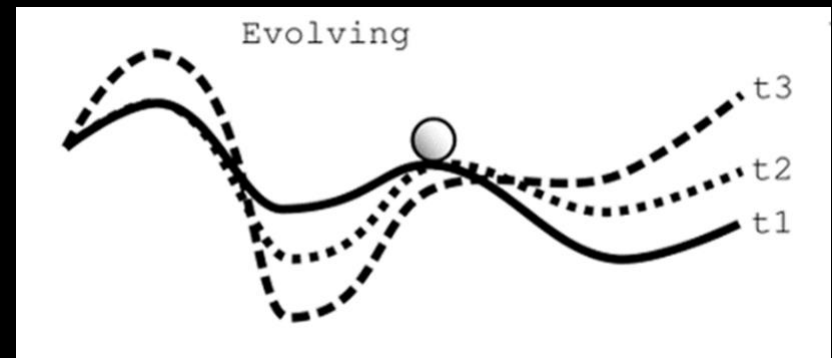
# How Does Nature Work?

## The Adaptive Cycle

- **Growth** - species and systems grow and diversify to exploit new opportunities and develop entirely new ecological ways of being.
- **Conservation** - species are tightly connected and organized, and systems “stabilize” into often hierarchically nested systems, where there is little or no room for innovation or growth.
- **Release** – where “mature” systems destabilize and collapse and become increasingly discontinuous and chaotic
- **Reorganization** – systems return in new ways, which creates a new field of conditions and possibilities for the next growth phase



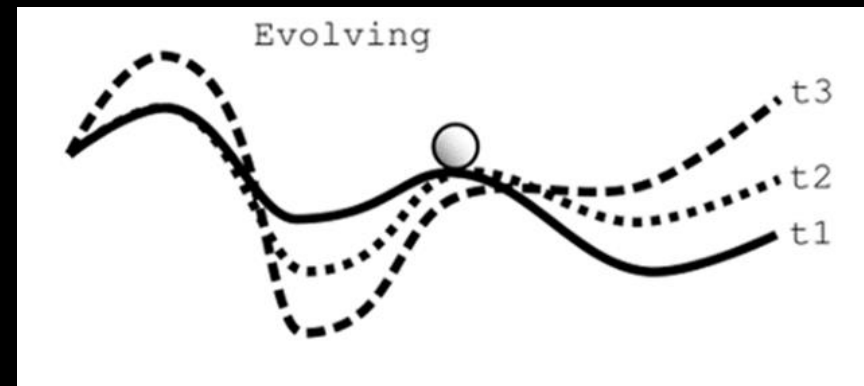
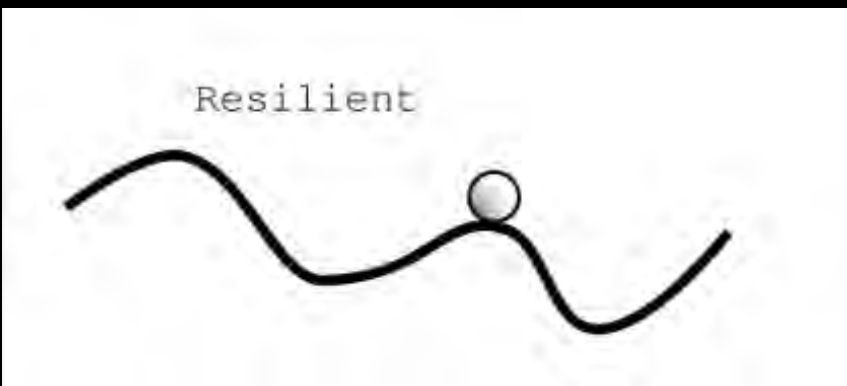
- **Incremental change** in the r and K phases, which are smooth and fairly predictable
- **Abrupt change** in the transitions from K through  $\Omega$  and  $\alpha$



# Resilience, Permanence, Change

**Ecosystem Resilience** - the ability to absorb disturbances, to be changed and then to reorganize and still have the same identity (retain the same basic structure and ways of functioning without collapsing into a qualitatively different state that is controlled by a different set of processes).

- As resilience declines the magnitude of a shock from which an ecosystem cannot recover gets smaller and smaller.
- A resilient ecosystem can **withstand shocks and rebuild itself when necessary**.



"Resilience" as applied to ecosystems has three defining characteristics:

- The amount of change the system can undergo and still retain the same controls on function and structure
- The degree to which the system is capable of self-organization
- The ability to build and increase the capacity for learning and adaptation = **Evolve**



# How does Nature work? A New Narrative of Nature

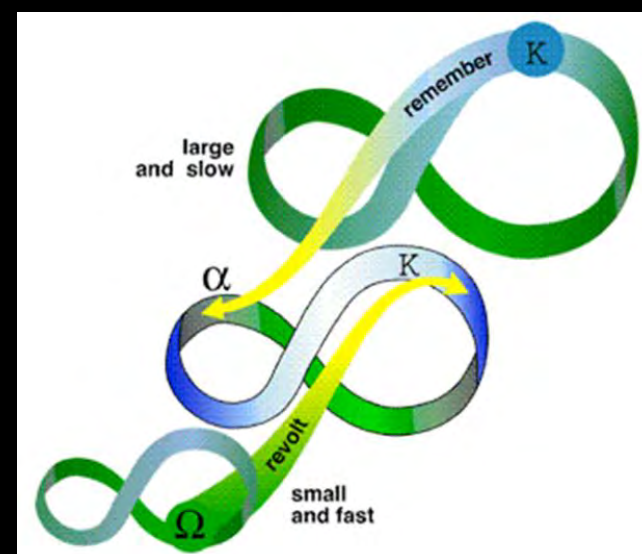
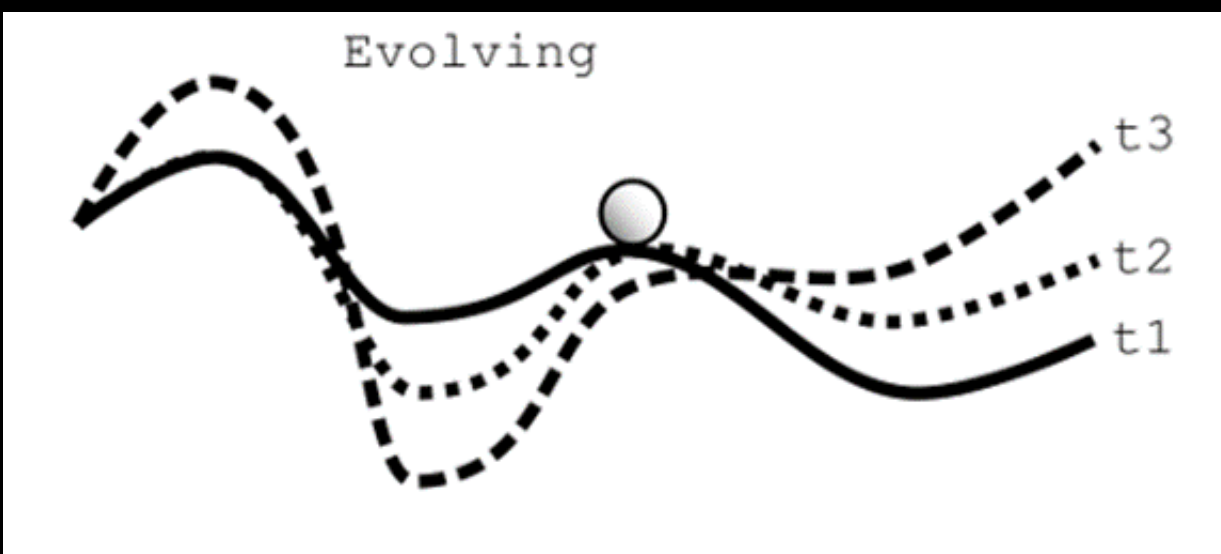
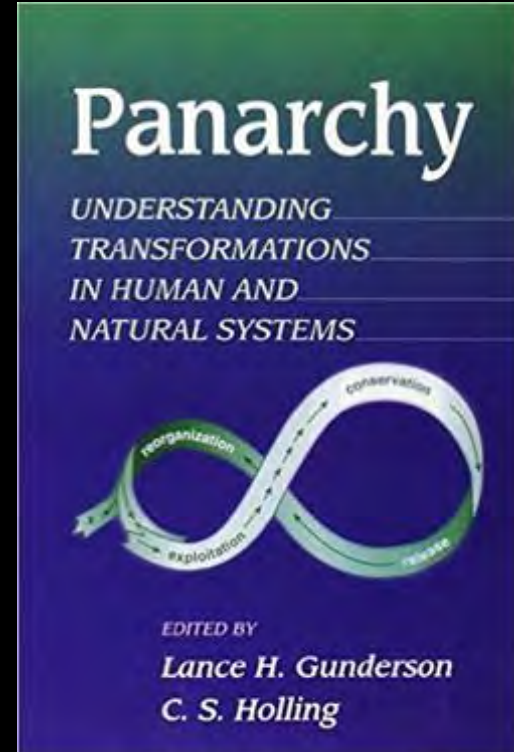
## Transformation - Evolving Nature and Panarchy

### A Narrative of Resilience and Disruptive Change

- **Panarchy is a new narrative or myth of evolving nature**
- **Pan** - the Greek god of nature and disruptive change.
- **Change is not always for the good**
- Pan has a destabilizing role – **panic, chaos, disequilibrium**

'Panarchy' is a term that "explains the evolving nature of complex adaptive systems"

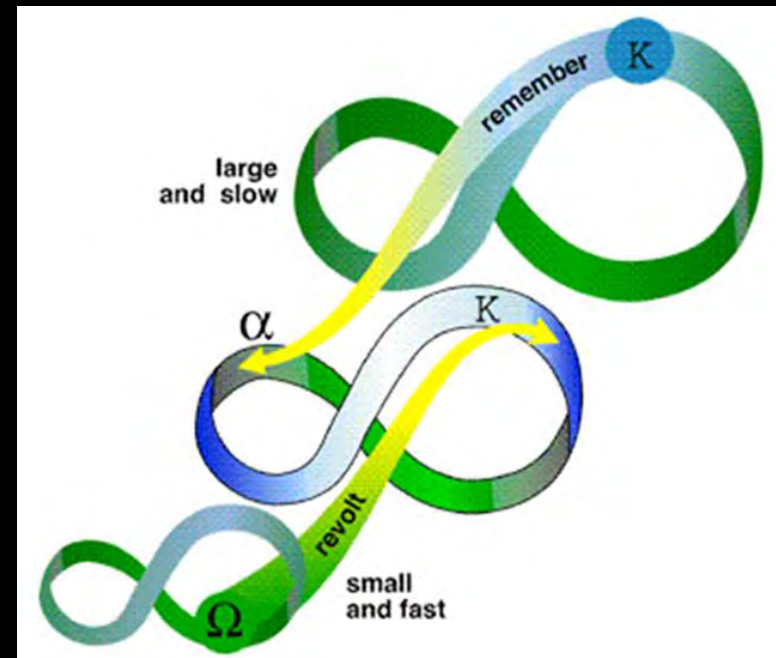
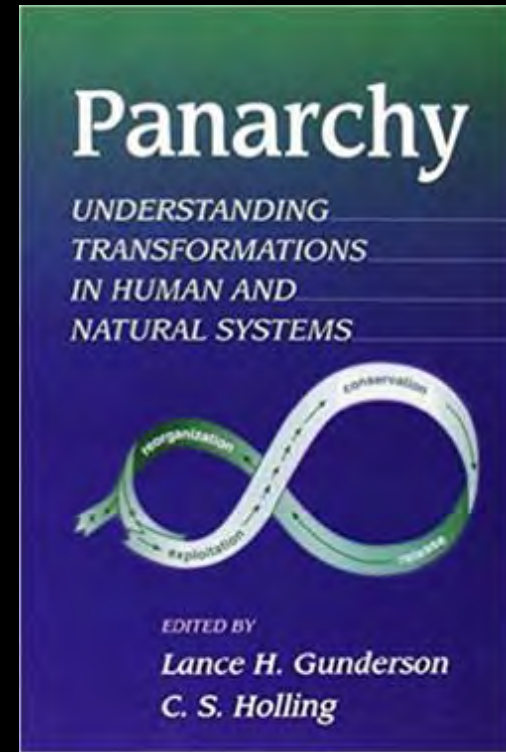
Human and Natural systems - Socioecological systems



# A Narrative of Complex Adaptive Systems

## Resilience and Adaptive Management

- **No socioecological system can be understood or managed by focusing on it at a single scale.**
- **Complexity** - All systems exist and function at **multiple scales of space, time and social organization**, and the **interactions across scales are fundamentally important** in determining the dynamics of the system at any particular focal scale.
- Ecological and social-ecological systems form **nested sets of adaptive cycles**. The larger, slower cycles generally constrain the smaller, faster ones and maintain system integrity
- **The essential focus of Panarchy is to explain the interplay between change and persistence, between the predictable and unpredictable.**



# The Balance of Nature – The End of Stability?

“The existence of a balance of nature has been a dominant part of Western philosophy since before Aristotle.

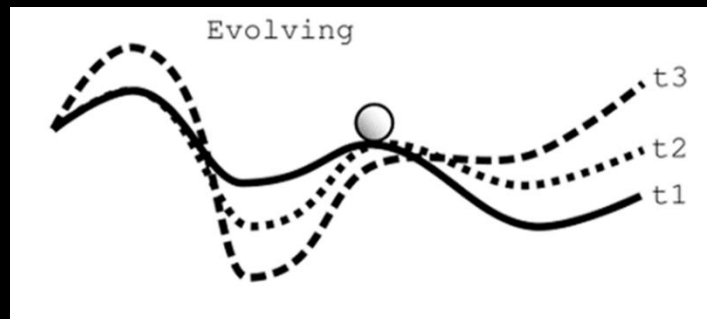
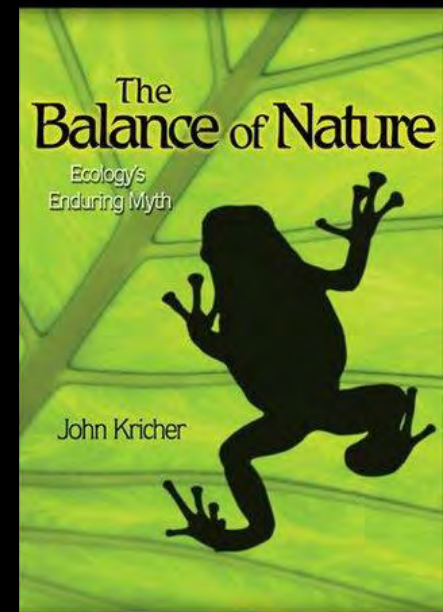
But the science of ecology and evolutionary biology together demonstrate that ***there is no balance of nature—not today and not at anytime in Earth’s long history.***

The paradigm is based on belief, not data; ***it has no scientific merit.***

***Nature is constantly in flux varying in scales of space and time,*** and most of that flux is due entirely to natural causes. At this time of extraordinary human influence on Earth’s ecosystems and biota, I argue that it is essential for humanity to understand how evolution occurs and why ecology is ***far more dynamic than static.***”

*The Balance of Nature: Ecology’s Enduring Myth* (2009)

John Kricher



# How does Nature work?

## Biotic Change - Integrity and Instability

### New Nature - Novel Ecosystems

- Assemblages of species in a given area that have not previously occurred.
- They lack historically natural analogs
- Novel ecosystems are not really all that novel, except in their species composition.

### The interplay between change and persistence

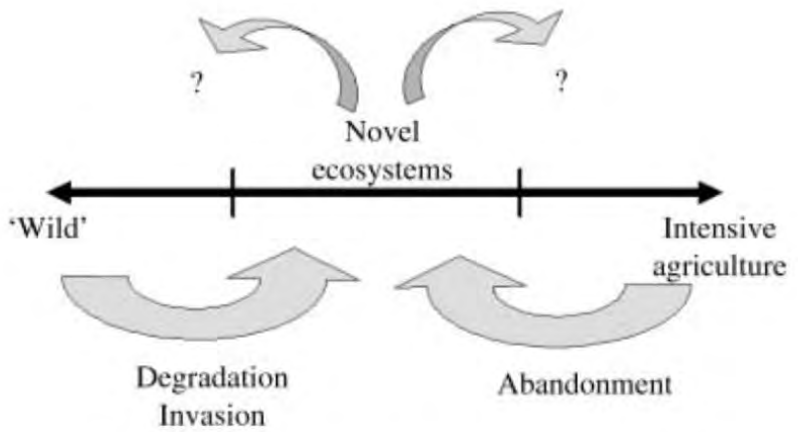
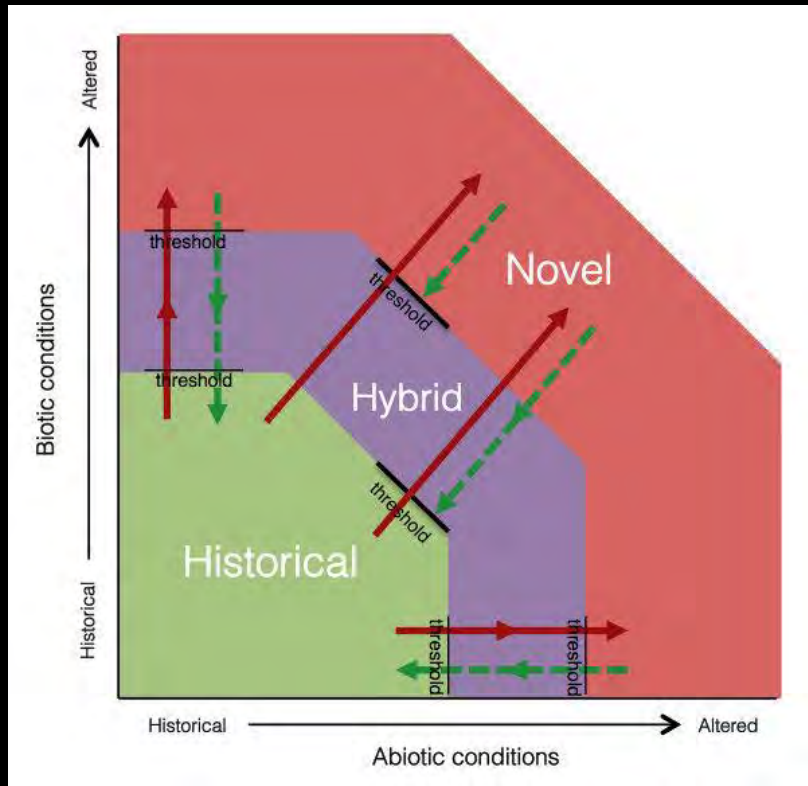
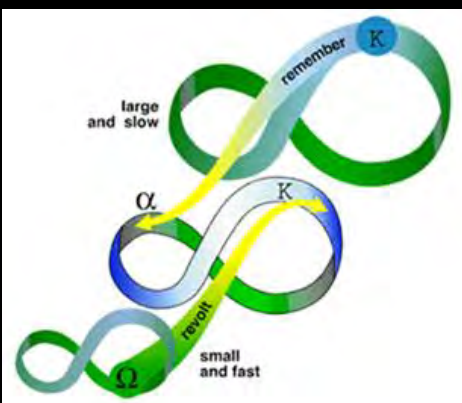
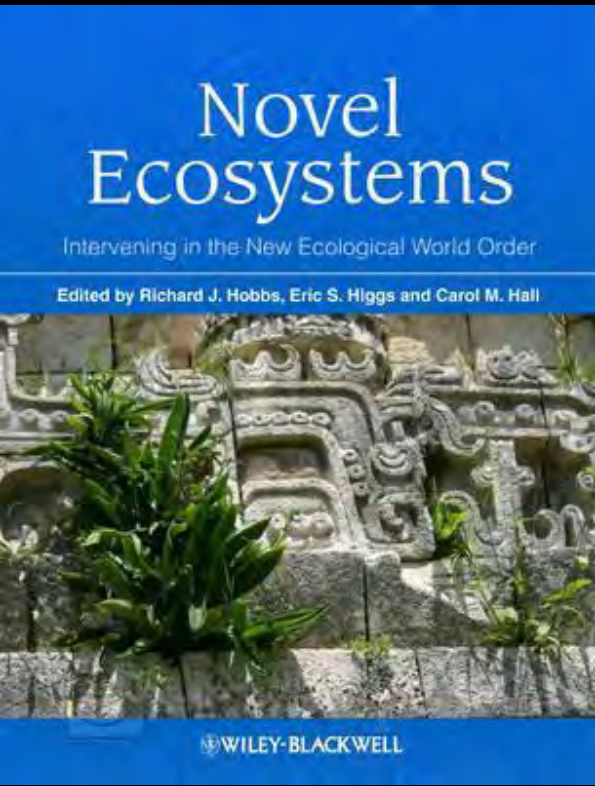
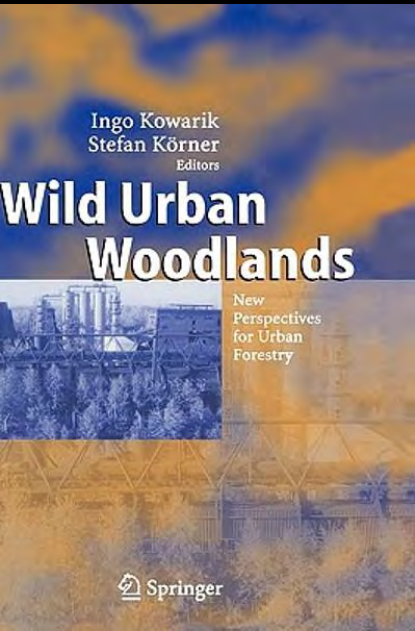


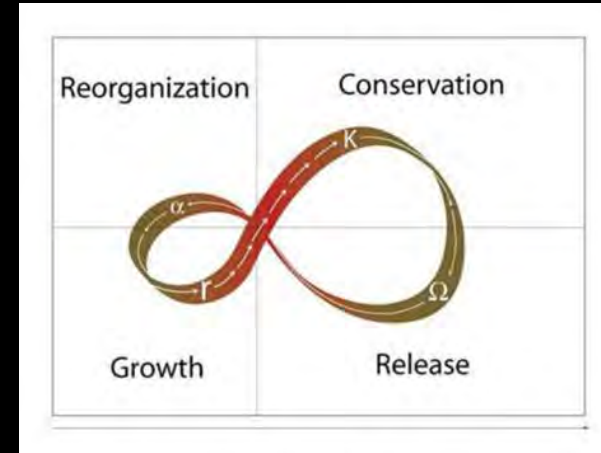
Figure 1 Novel ecosystems arise either from the degradation and invasion of 'wild' or natural/seminatural systems or from the abandonment of intensively managed systems.



# Wild Urban Woodlands – Waller Creek 7<sup>th</sup> Steet Bridge



2023



2005



2009



2012



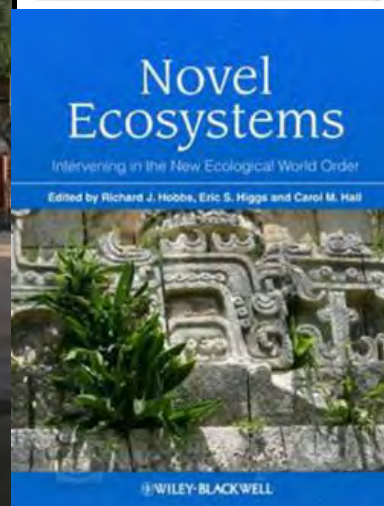
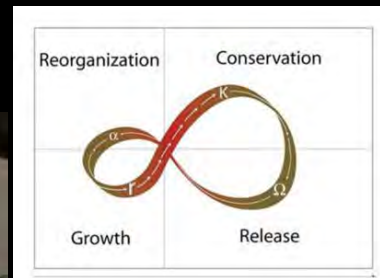
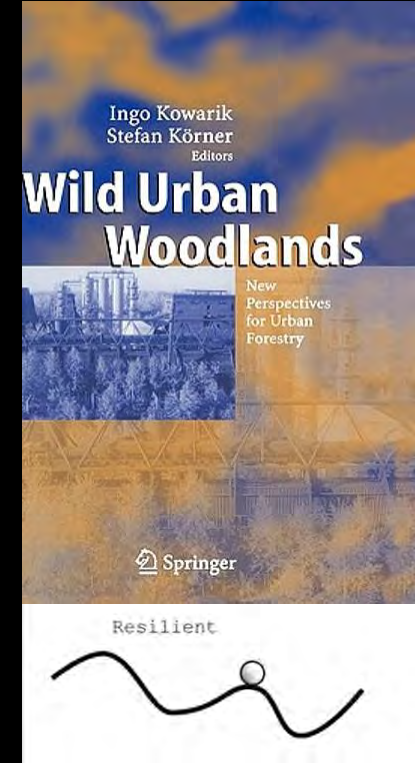
2017

# The New Ecology – How does Nature work?

## Permanence and Change = Process

“the reference point is not an original condition of a natural landscape, but rather a condition defined based on the current site potential and the greatest possible degree of self-regulation.

From this perspective, therefore, **the natural capacity for *process* is the central point, not a particular, retrospectively determined and often idealized, *picture of nature.*”**



# Narrative of New Nature - Resilience Ecology

## Managing Socioecological Systems

### Adapting to change – not a stable state

The basic concepts are:

- non-linearity, alternate regimes and thresholds
- adaptive cycles
- multiple scales and cross-scale effects - "panarchy"
- adaptability and adaptive management
- general versus specified resilience

<https://www.resalliance.org>



The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends.

Our vision is a world where the diversity of life thrives, and people act to conserve nature for its own sake and its ability to fulfill our needs and enrich our lives.



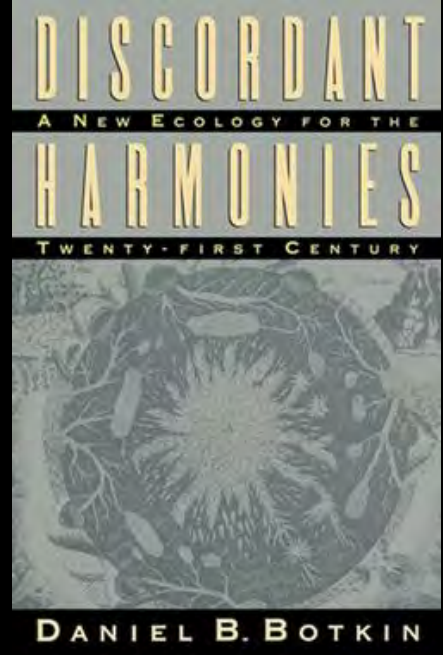
# New Nature

## New Metaphors of Change and Permanence

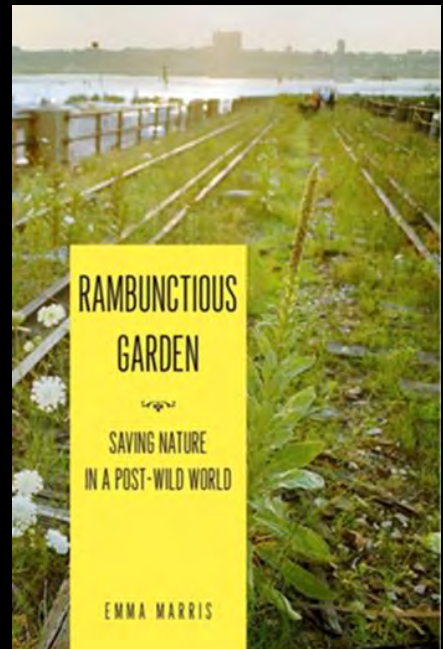
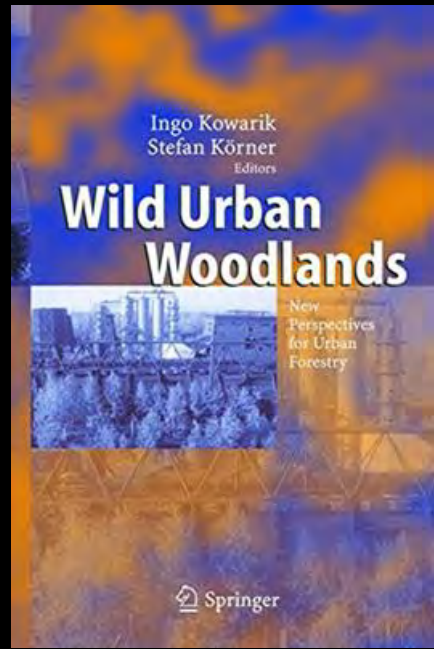
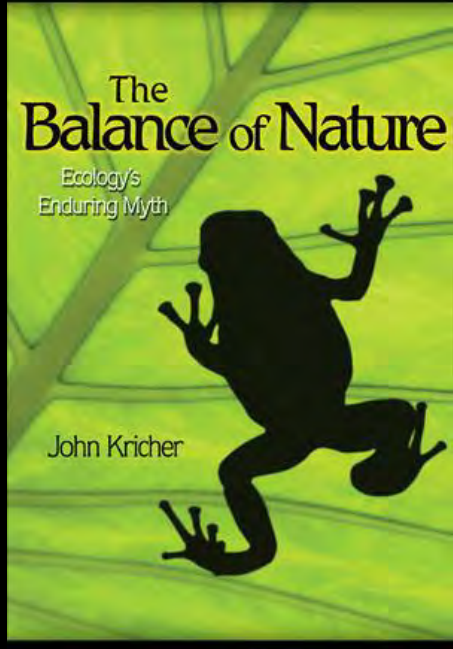
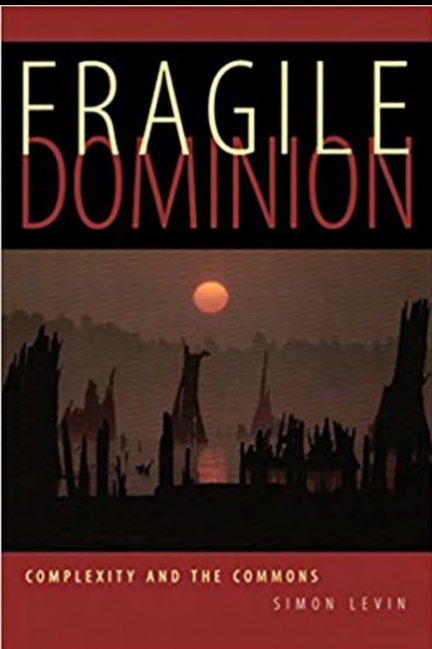
“Clearly, to abandon a belief in the constancy of undisturbed nature is psychologically uncomfortable...

The way to achieve a harmony with nature is first **to break free of old metaphors and embrace new ones** so that we can lift the veils that prevent us from accepting what we observe, and then to make use of technology to study life and life-support systems as they are.”

Botkin, *Discordant Harmonies*



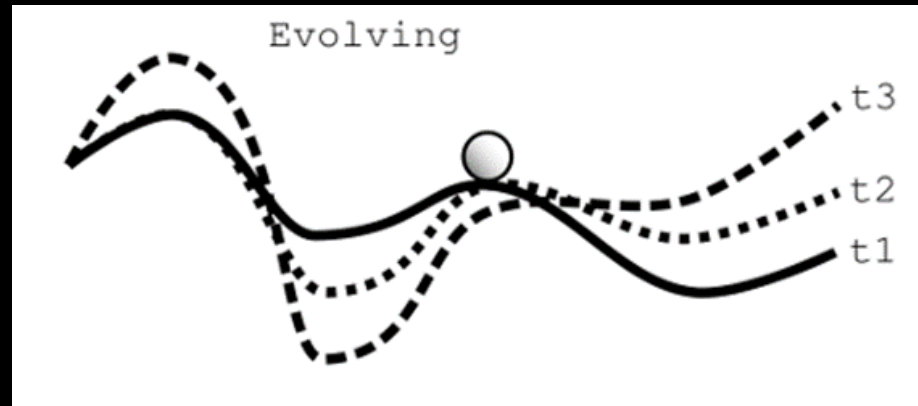
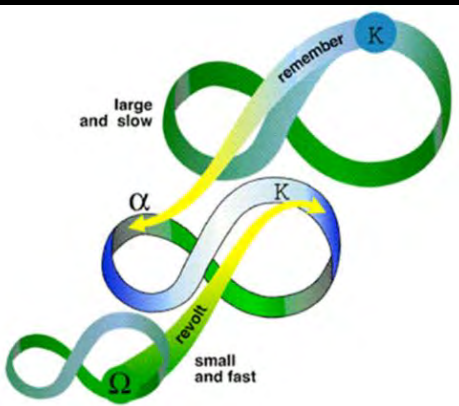
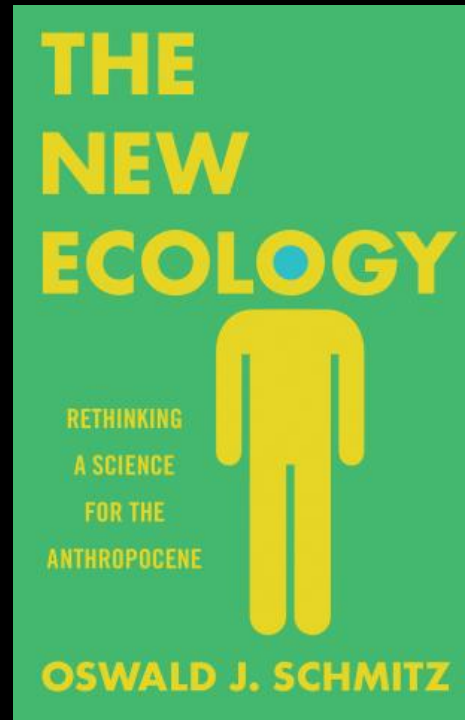
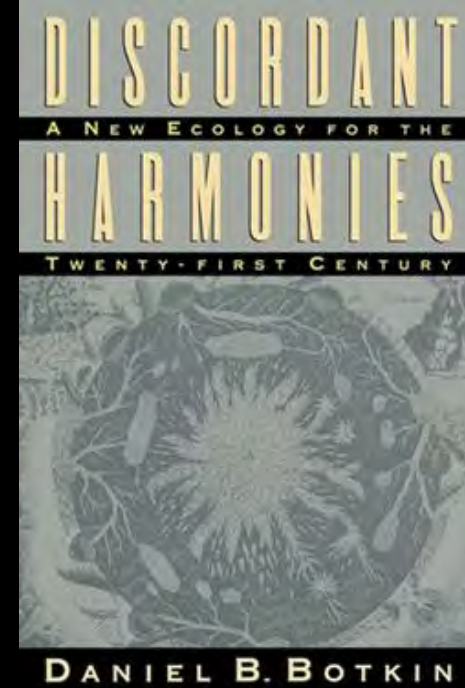
DANIEL B. BOTKIN





# Discordant Harmonies - Prescriptions for New Nature

- “Begin to observe nature as it is, not as we imagine it to be.”
- “Nature in the 21<sup>st</sup> Century will be a nature that we make; the question is the degree to which this molding will be intentional or unintentional, desirable or undesirable.”
- “If nature in the twenty-first century will be a nature that we make, then the guide to action is:
  1. our knowledge of living systems and our willingness to observe them for what they are,
  2. our commitment to conserve natural areas,
  3. to recognize the limits of our actions, and
  4. to understand the roles of metaphor and myths in our perceptions of our surroundings.” Botkin



# Concepts of American Nature

Wilderness



Pastoral



Urban



New

