

# THE NATURALNESS OF BIOLOGICAL INVASIONS:

CULTURAL PERCEPTIONS AND  
ECOLOGICAL REALITIES OF  
BIOLOGICAL INVASIONS

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# THE BOTTOM LINE

- Biological invasions are natural and necessary for the persistence of species in the real, non-steady-state world.
- The idea that biological invasiveness is always bad is connected to the old idea of steady-state nature, nature in a balance.
- In most cases, introductions by people of exotic species into new habitats have had detrimental effects on biodiversity, but not always.
- Don't evaluate invasive species as a moralistic issue, but on a case by case basis.
- **IN GENERAL, DON'T INTRODUCE SPECIES INTO NEW HABITATS.**

# BIOLOGICAL INVASIONS CONUNDRUMS

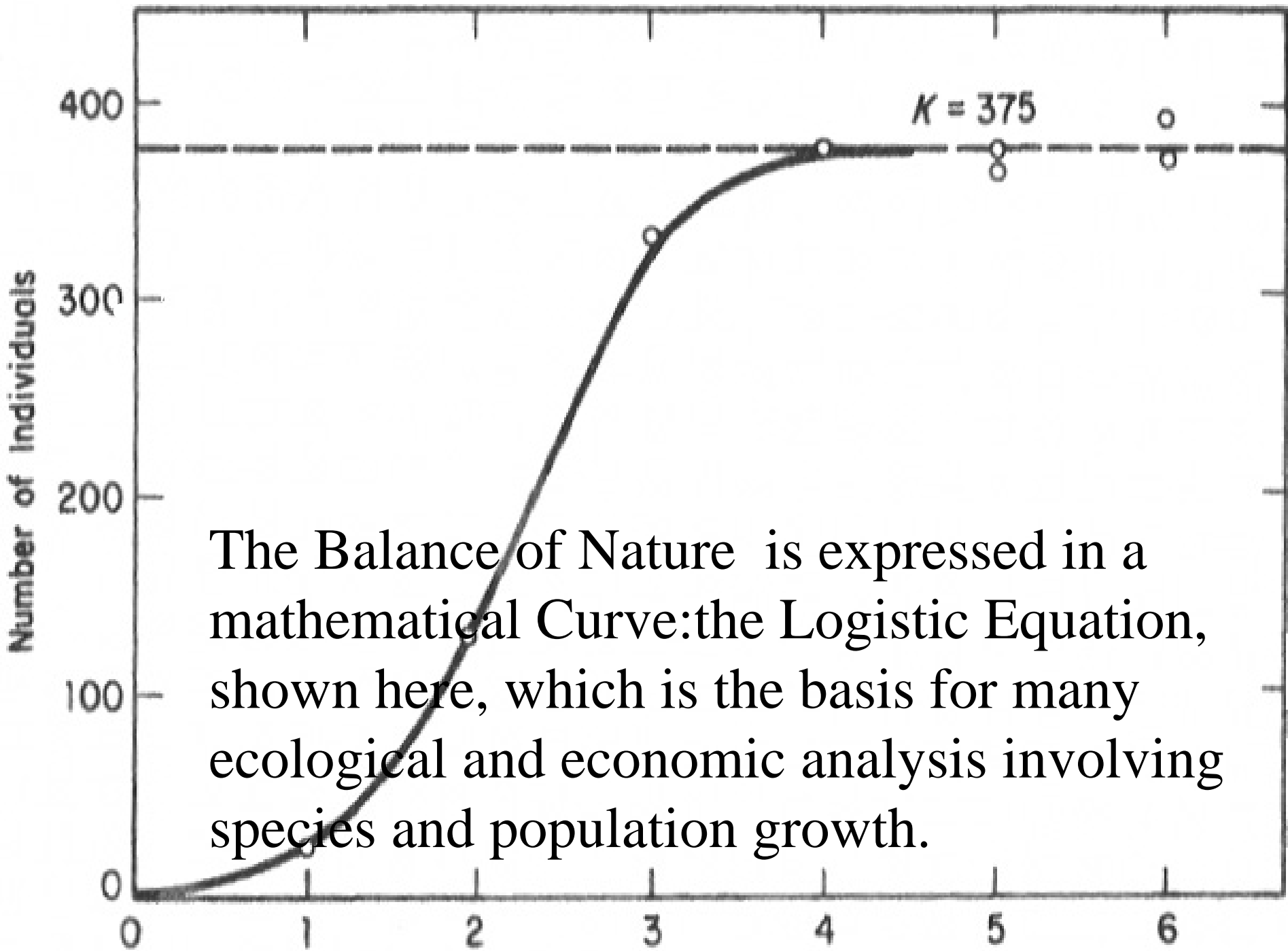
- Biological invasions are natural and necessary for the persistence of life on Earth, but some of the worse threats to biological diversity are from biological invasions.
- One can either preserve a “natural” condition, or one can preserve natural processes, but not both. The preservation of natural processes requires change.

# People like many introduced species and benefit from them.

- For example, think about Van Gogh's famous painting, *Wheat Fields*. It is of crops none of which are native to France, yet everyone wants the crops and the view of them painted by Van Gogh is considered beautiful.
- In an economic analysis, we have to take into account popular beliefs and valuation of nature, as well as direct costs and benefits.

# THE OLD BELIEF: NATURE AS STEADY-STATE

- It was once believed, both among scientists and in prescientific history in Western thought, that nature undisturbed was in a steady state --- there was a balance of nature.
- If this were true, then biological invasions would be unnatural, and management of biological invasions would be simple: prevent them or, if that failed, eliminate the invaders and restore the “natural” steady state.
- In developing economic forecasting methods, watch out for many standard ecological models, as they are often steady-state and contradicted by data.



The Balance of Nature is expressed in a mathematical Curve:the Logistic Equation, shown here, which is the basis for many ecological and economic analysis involving species and population growth.

# SALMON AND LANDSCAPES

Endangered species are the inverse of invasive species, but many of the concepts and lessons are the same.



# SALMON AND THE NATURALNESS OF BIOLOGICAL INVASIONS

- Do salmon always return to their natal stream?
- NO! approximately 15% of adult salmon spawn in a different stream than the one in which they were born.
- If salmon always returned to their natal stream, salmon would have gone extinct long ago.



# Salmon habitats are always changing.

- Glaciers wax and wane.
- Streams become too cold or too warm.
- Gravel beds necessary for salmon reproduction come and go.
- Geological headwall failures create new gravel but block streams.
- Water erosion removes the gravel.
- For a while, there is enough gravel but not too much.
- Then there is too little.
- Natural wildfires reset succession.
- Early successional alders are necessary for long-term salmon persistence.

# CONSEQUENCE OF REQUIRED DISTURBANCE REGIMES

- Over a long time, a stream goes in and out of service as a salmon bearing stream, because gravel is slowly eroded away, and headwall failure can overload the stream. Both situations make the stream unusable for spawning.
- Therefore, a landscape of several to many streams is necessary for long-term persistence of salmon. The requirement for temporal changes makes necessary a requirement for a large spatial scale – more than one stream



# Surtsey Island, Iceland

- 1964 scientists camping on Iceland's south coast saw the view from the shore dominated by a vertical plume of ejecta and smoke.
- 1967, the explosions ceased, new island formed 2 km<sup>2</sup>; 100m highest point
- Within weeks, with surface still warm, the small flower plant, sea rocket (*Cakile edentula*) [Mustard Family], had flowered.
- By 1967, the sea bird, Fulmars, had nested on Surtsey.

**The Cattle Egret, a bird native to Africa, migrated on its own to the New World in the 20<sup>th</sup> Century.**

# WHAT CAN WE PREDICT BEFORE A SPECIES IS INTRODUCED?

- Is the niche open or filled?
- Does the species reproduce rapidly and disperse rapidly?
- Are its habitat requirements highly specialized and available in the introduced landscape?  
(Salmon)
- Is it an early successional species? (Dune grass)
- Is it a new kind of top predator? (e.g. Burmese python in the Everglades.)
- What is the motivation for the introduction?

# WHAT CAN WE PREDICT BEFORE A SPECIES IS INTRODUCED?

- Is the niche open or filled?
  - 18<sup>th</sup> and 19<sup>th</sup> century introduction of Chinese and North America trees and shrubs into Northern Europe (open niches; generally successful).
  - 20<sup>th</sup> century repeated introduction of America grey squirrel into Great Britain (people thought it was attractive). (Niche filled. Grey squirrel is threatening native red squirrel with extinction.)

# IS THERE A WAY TO DO A CAREFUL INTRODUCTION?

- Isolated trials on islands or ecological islands (e.g. dung beetle introduced into Australia).

# WHAT TO DO ABOUT THE OLD BELIEFS?

- Terms: "disturbed" and "undisturbed," "wild" and "domesticated," "natural" and "artificial" no longer offer the clear analytical guidance we once thought they did, what sorts of replacements should we seek?
  - SET CLEAR GOALS
  - USE NATURAL CHANGES AS A GUIDE
  - REPLACE CONCEPT OF STATIC STABILITY WITH
    - RECURRENCE
    - PERSISTENCE WITHIN BOUNDS
    - FLEXIBLE GUIDELINES



# WHAT TO DO ABOUT THE OLD BELIEFS?

- SEE THE PROBLEM AS ONE OF
  - DESIGN RATHER THAN OF
  - TRUTH
- USE PERFORMANCE INDICATORS RATHER THAN RELYING ONLY ON A SET RULES

# NO MAN'S GARDEN



THOREAU

AND A  
NEW VISION FOR  
CIVILIZATION AND NATURE

Daniel B. Botkin

I discuss Thoreau's ideas in  
my recent book *No Man's  
Garden*



# THOREAU, PEOPLE AND NATURE

Thoreau explained how people and nature could be brought together.

- *“It was a relief to get back to our smooth but still varied landscape. For a permanent residence, it seemed to me that there could be no comparison between this [Concord] and wilderness, necessary as the latter is for a resource and a background, the raw material of all our civilization.”*
- *“The wilderness is simple, almost to barrenness. The partially cultivated country it is which chiefly has inspired, and will continue to inspire, the strains of poets.”* (Maine Woods p 210)

# THOREAU AND SETTLED LANDSCAPES

- *"A civilized man, using the word in the ordinary sense, with his ideas and associations, must at length pine there [in wilderness], like a cultivated plant, which clasps its fibres about a crude and undissolved mass of peat."*
- *"Perhaps our own woods and fields . . . are the perfection of parks and groves, gardens, arbors, paths, vistas, and landscapes. They are the natural consequence of what art and refinement we as a people have the common which each village possesses, its true paradise."*

# SUMMING UP

- There is no single, perfect, “natural” state, only a trajectory, spread out over space, and a persistence of conditions within certain bounds, or a recurrence of previously occupied and desirable states.
- People are part of nature, as Thoreau found, and have had effects that we view as “natural”
- Use nature as the guide to avoid Pandora’s briefcase of problems.

# Take Home Lessons

- If you are thinking about introducing an exotic species, don't do it.
- As a nation, we need strong laws and policies against casual transport of species into the U. S.
- The criterion is not naturalness but the 8 environmental values:
  - aesthetic, utilitarian, ecological, public service, spiritual, theological, moral, recreational.

# Take Home Lessons

- Natural invasions should be evaluated on a one-by-one basis
  - Is the American prairie no longer natural because the Cattle egret is there?
  - Is Paul Martin right, that the only natural America is 10,000 years ago, and we should introduce African Elephants to replace the lost Mastodons and Mammoths?