



Invasive Species: a real, but largely ignored threat to environmental security

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Presentation Outline

- Types of Invasive Species Problems
- Magnitude of Economic Impacts
- Ecological Dynamics
- Range of Control Mechanism
- Research and Regulatory Challenges

Types of Invasive Species Problems

➤ Valued Resources

➤ Coastal Waters/Estuaries

- Finfish
- Shellfish
- Birds

➤ Interior Lands and Waterways

- Forests
- Rangelands,
- Agricultural Crops (vegetables, fruits, nuts)
- Wildlife and Fisheries

➤ Disease Agents

- Native species and domestic crop disease vectors
- Domestic and wildlife disease vectors
- Human Disease Vectors

Qualitatively an Impact?



Kerry Britton, USDA Forest Service, www.invasive.org

UGA0002156

South Africa invasions dates to the 1600s

- Cape of Good Hope -- a major replenishment stop for European ships sailing to and from the East brought invasive alien plants from Australia, Central and South America
- Listed invaders: 117 well established plus 84 emerging
 - Various trees, scramblers, and brambles have spread into the semi-arid savannas, alluvial plains, and seasonal watercourses.
 - major aquatic invasive species that occur over large areas
 - hyacinth (*Eichhornia crassipes*)
 - water lettuce (*Pistia stratiotes*),
 - Kariba weed (*Salvinia molesta*),
 - parrot's feather (*Myriophyllum aquaticum*) and
 - red water fern (*Azolla filiculoides*)

Naomi Mczeke ASTM Symposium 2005

Magnitude and speed of Impacts

Palmyra -- equatorial atoll ~1,500 km south of Honolulu owned by The Nature Conservancy

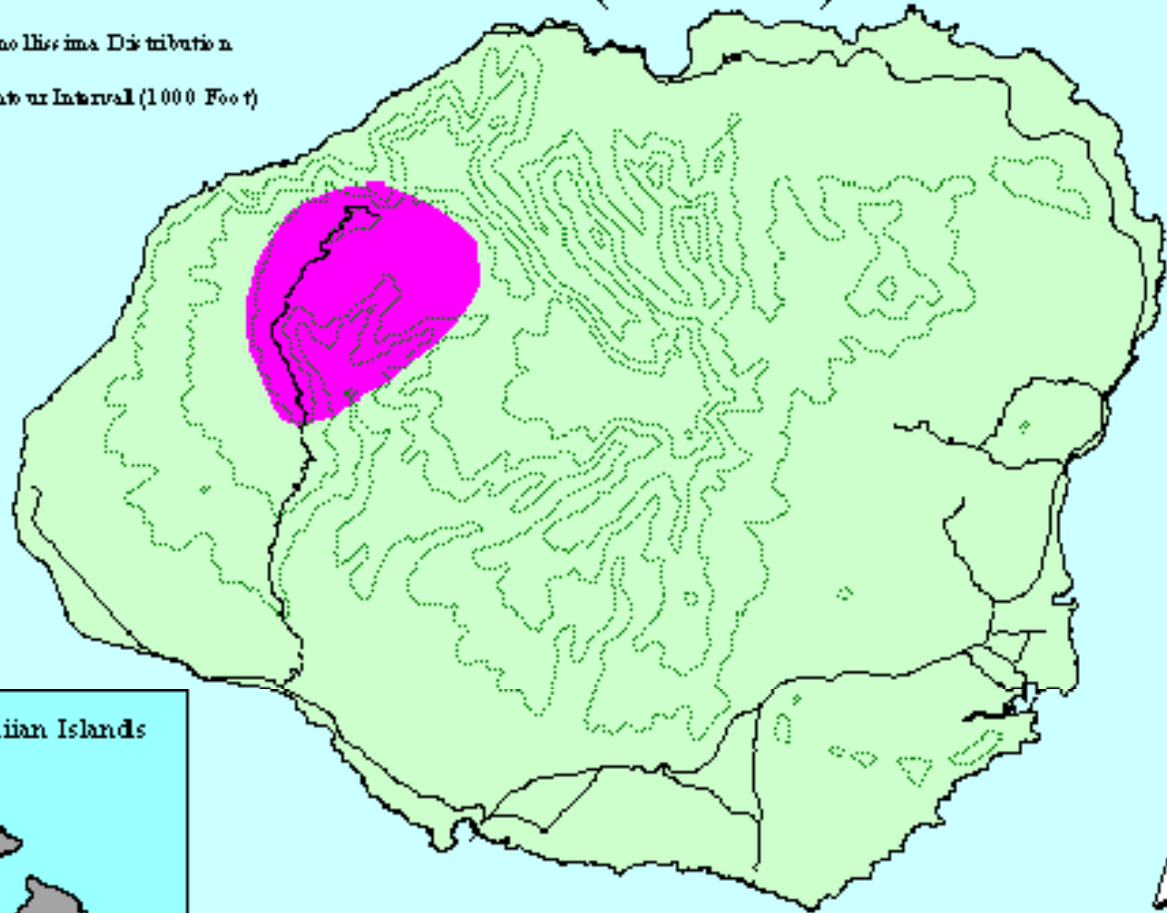
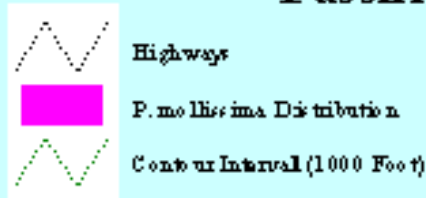
- Seabirds nest or roost among Pisonia trees
- Alien ants were noticed in 2002
- 10 months later trees were heavily infested with two species of scale insects tended by the ants
- Within a year there were large gaps in the forest where trees had died due to defoliation by the scale

Pacific Islands Ecosystems at Risk (PIER)




Passiflora mollissima -- smothers the forest canopy when
Photo by C.W. Smith

Passiflora mollissima Estimated Distribution on Kauai (Oct. 1995)



Prepared by the Hawaii Ecosystems at Risk Project (11/96)

Magnitude of Economic Impacts

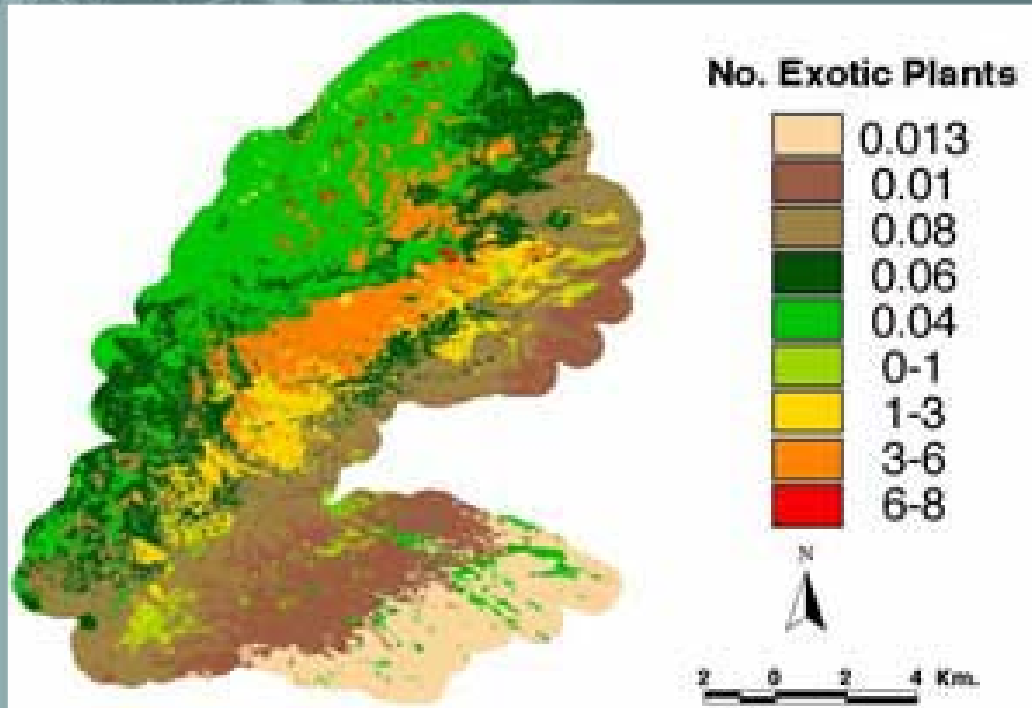


Female ALHB use mouthparts to cut slits into wood to lay eggs. Photo by USDA Animal and Plant Health Inspection Service

- 4,500 species of nonnative plants, animals, and microbes have become established in the United States, of which about 15 percent are considered harmful
- Asian gypsy moth required \$20 million for control in the States of Oregon and Washington
- Asian longhorned beetle -- Wood products, maple syrup, commercial fruit, tree nurseries, and tourist industries, valued at \$41 billion

The National Invasive Species Information Center (NISIC) 1 Feb 06
<http://www.invasivespeciesinfo.gov>

Magnitude of Economic Impacts



predicted presence of exotic, or invasive, species in a chosen location

Image credit: M.A. Kalkhan, Natural Resource Ecology Laboratory, Colorado State University, Ft. Collins

displacement of local animal and plant life by invasive species annually inflicts >\$US138 billion in damage on the U.S. Cornell University study

Ecological Dynamics -- Stochasticity

- Stochastic nature of ecological systems
 - certain uncertainties are certain

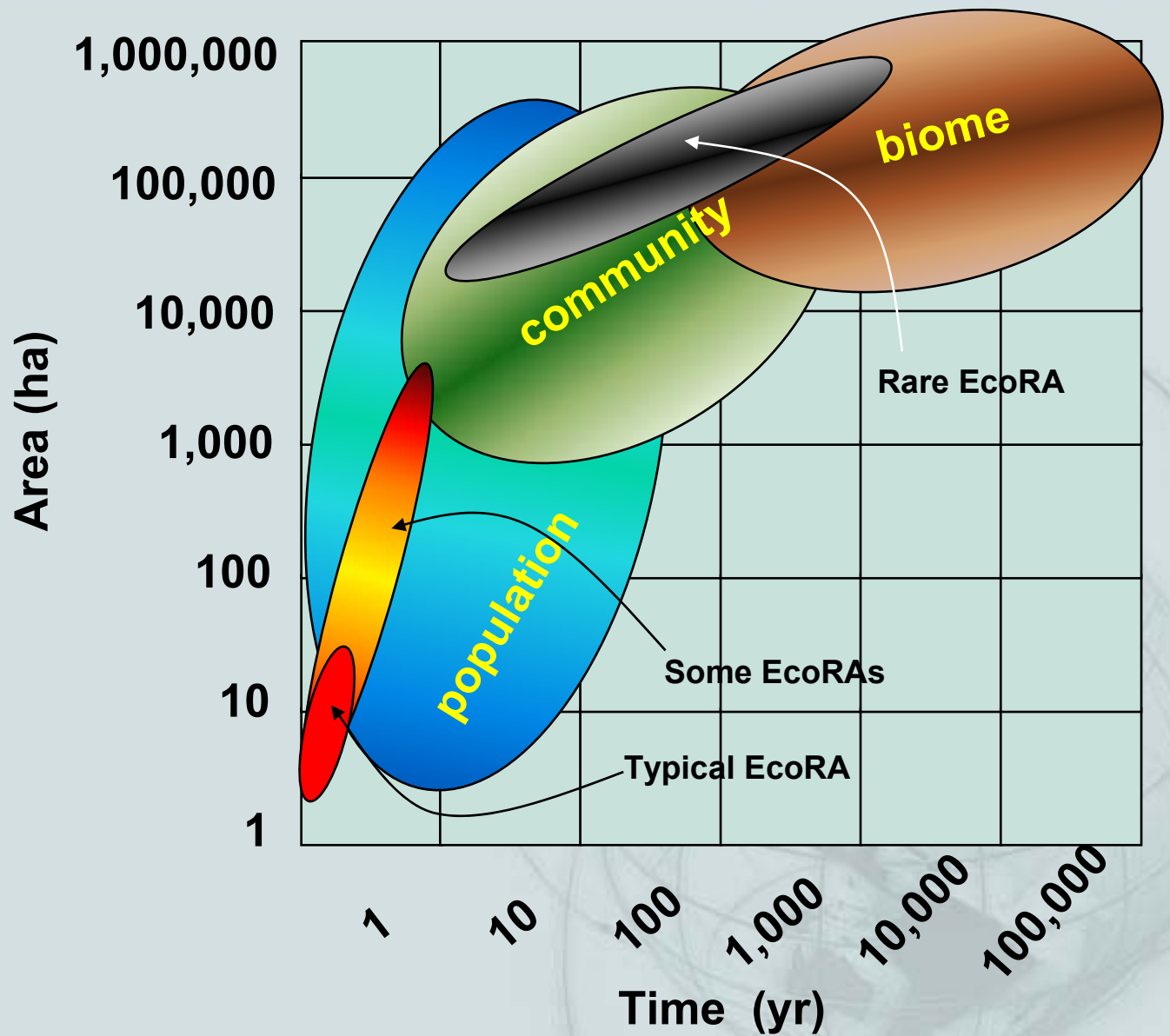


- Invasive species establishment is a probability
- Adverse consequences due to establishment is also a probability

- Species A has a 0.001% chance of establishment per introduction event
- If established, Species A has a 5 % chance of expanding its range
- Species A has a 10% chance of impacting a valued resource.

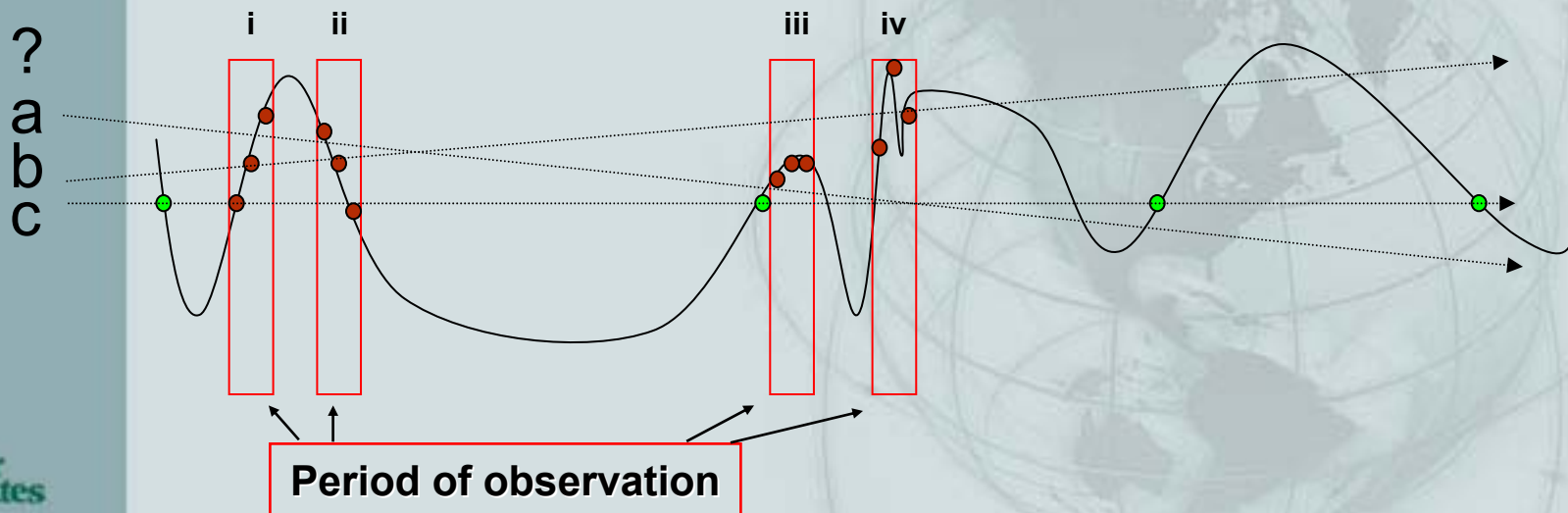


Scale – time and space



➤ time of observations

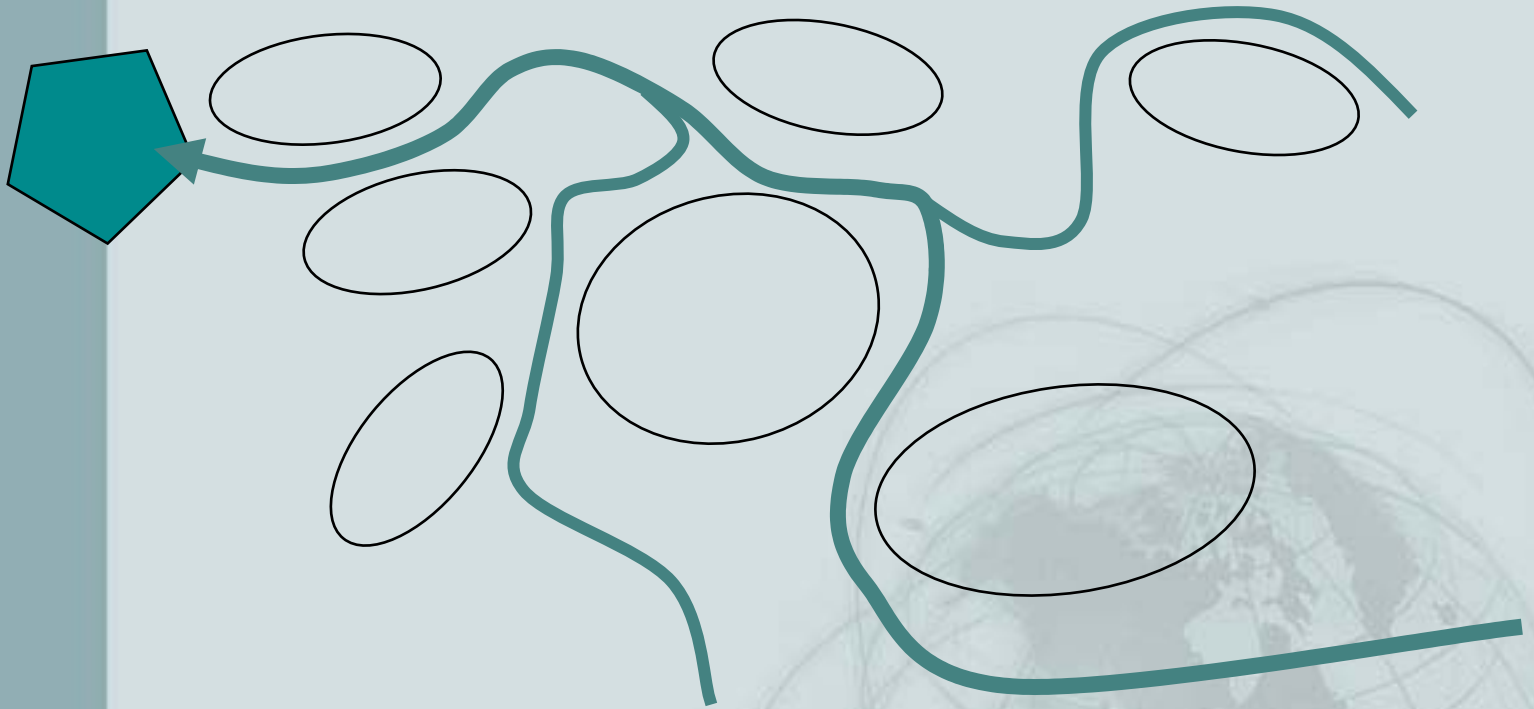
- ecological processes play out over decades, even centuries
- short-term trajectory may give false indication of long-term trend
- “fortuitous change” that coincides with one hypothesis can be misleading



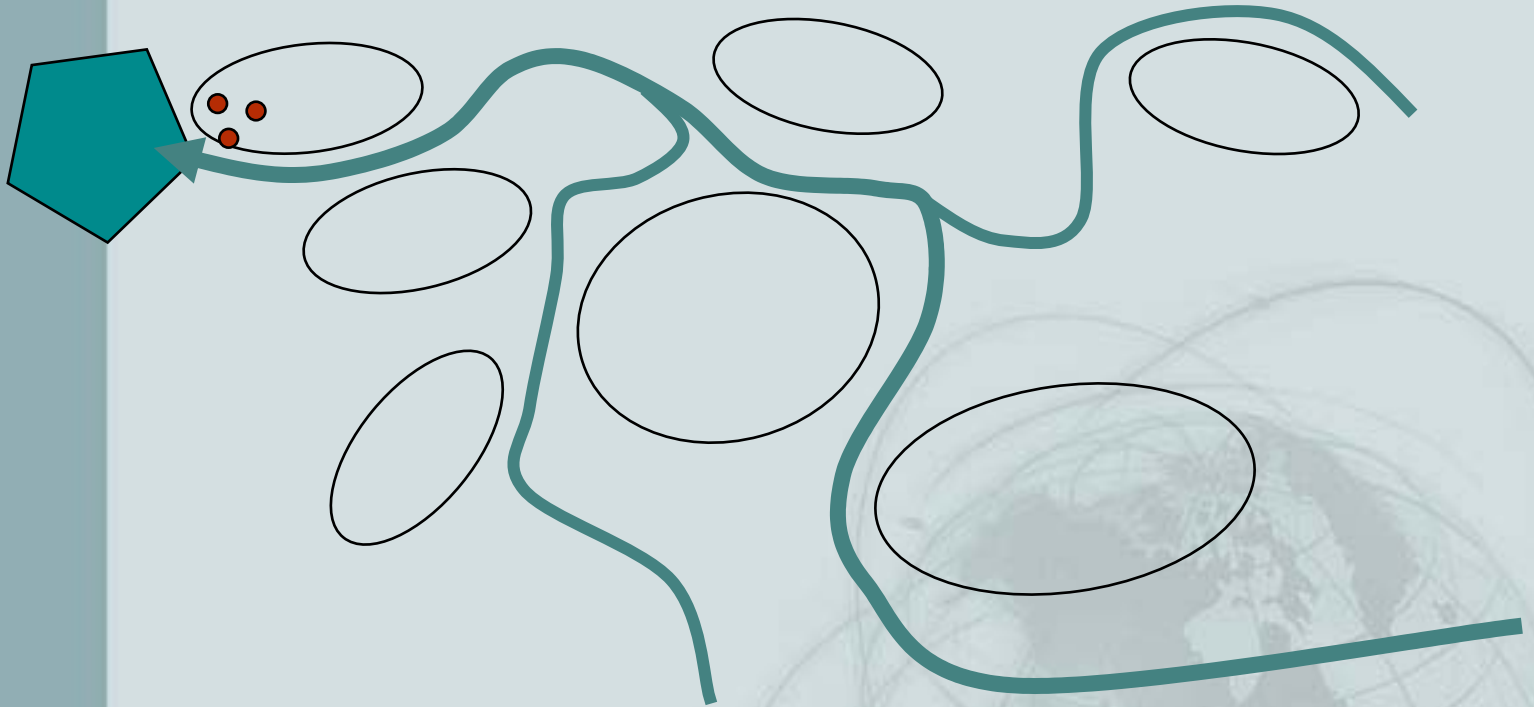
Ecological Dynamics – Properties of Invasive Species

- High fecundity
- Reproductive Flexibility
 - asexual + sexual forms
 - hermaphroditic
 - gender plasticity
- Cryptic
- Genetically diverse
 - broad tolerance range
 - high acclimation potential
 - facile “hitch-hiker”
 - "The notion has always been that these organisms are spreading because they've escaped their natural enemies, but the problem is that they're following their natural enemies." Mark Hay, an ecologist at Georgia Tech By Dennis O'Brien SUN REPORTER Originally published March 10, 2006
- Pleomorphic (including mimicry)

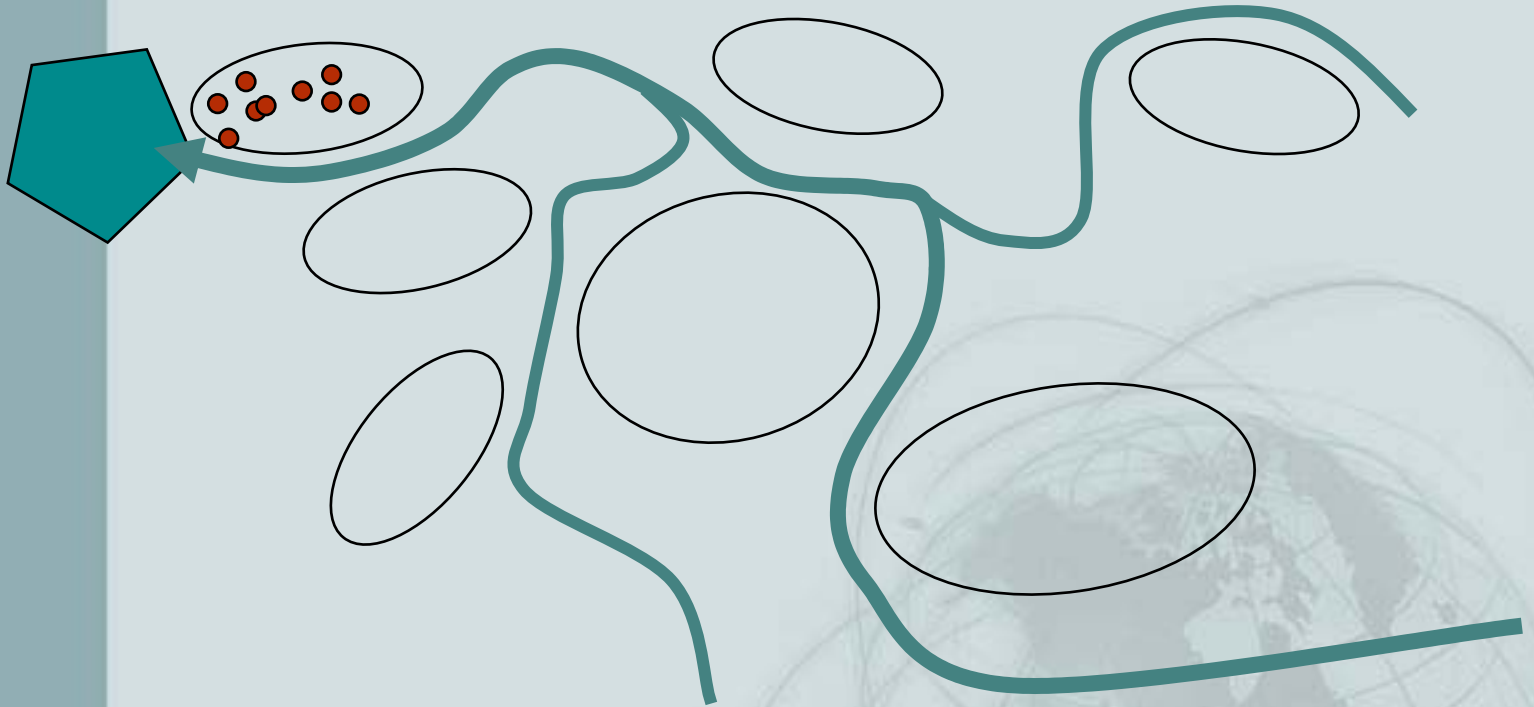
Ecological Dynamics – Populations-1



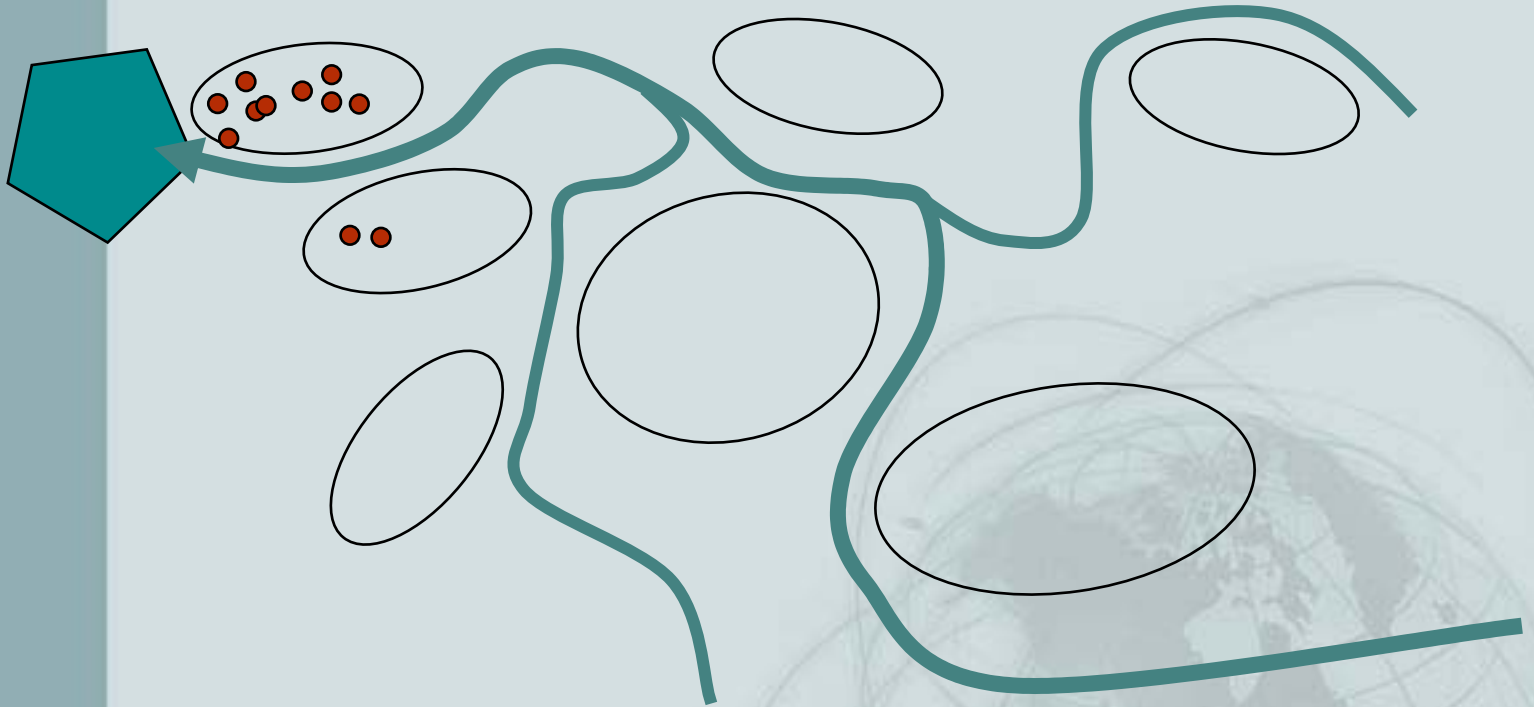
Ecological Dynamics – Populations-1



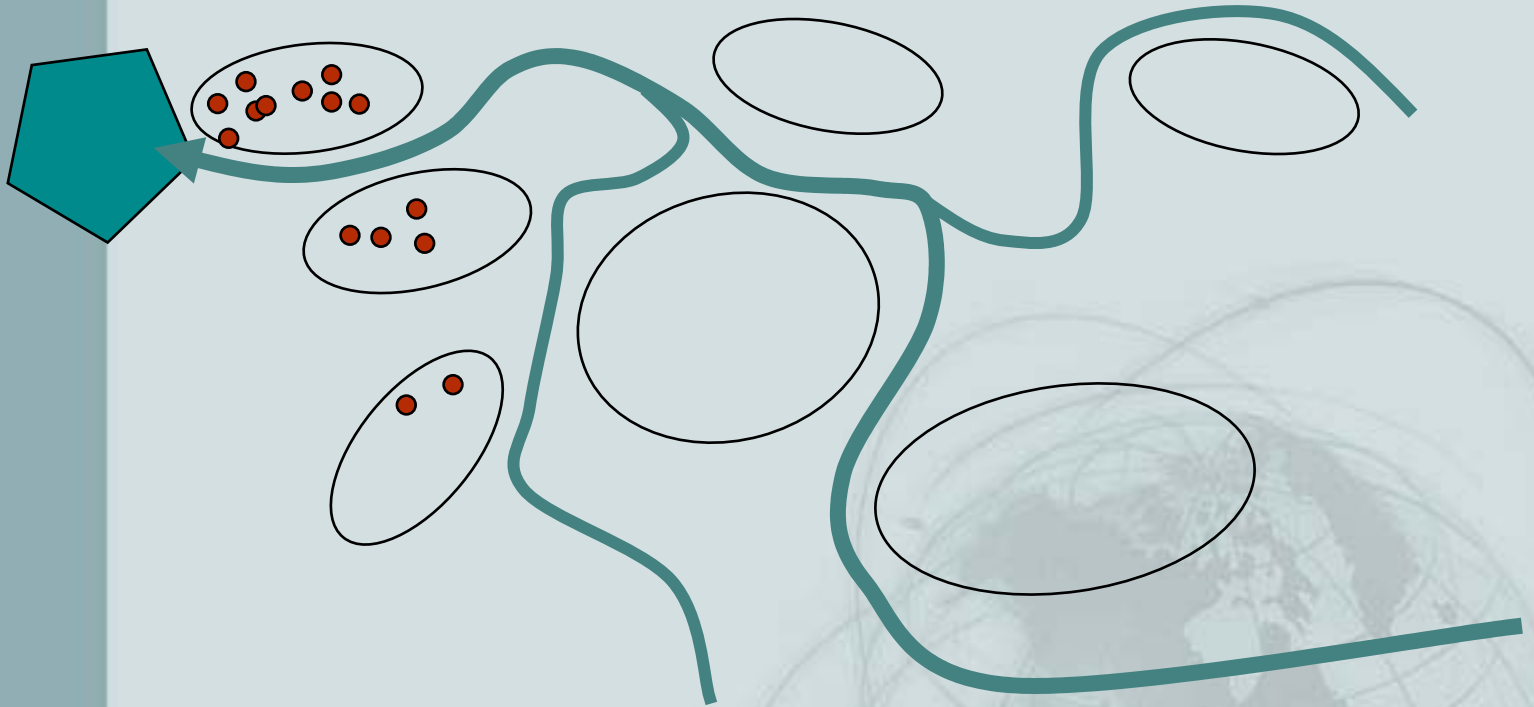
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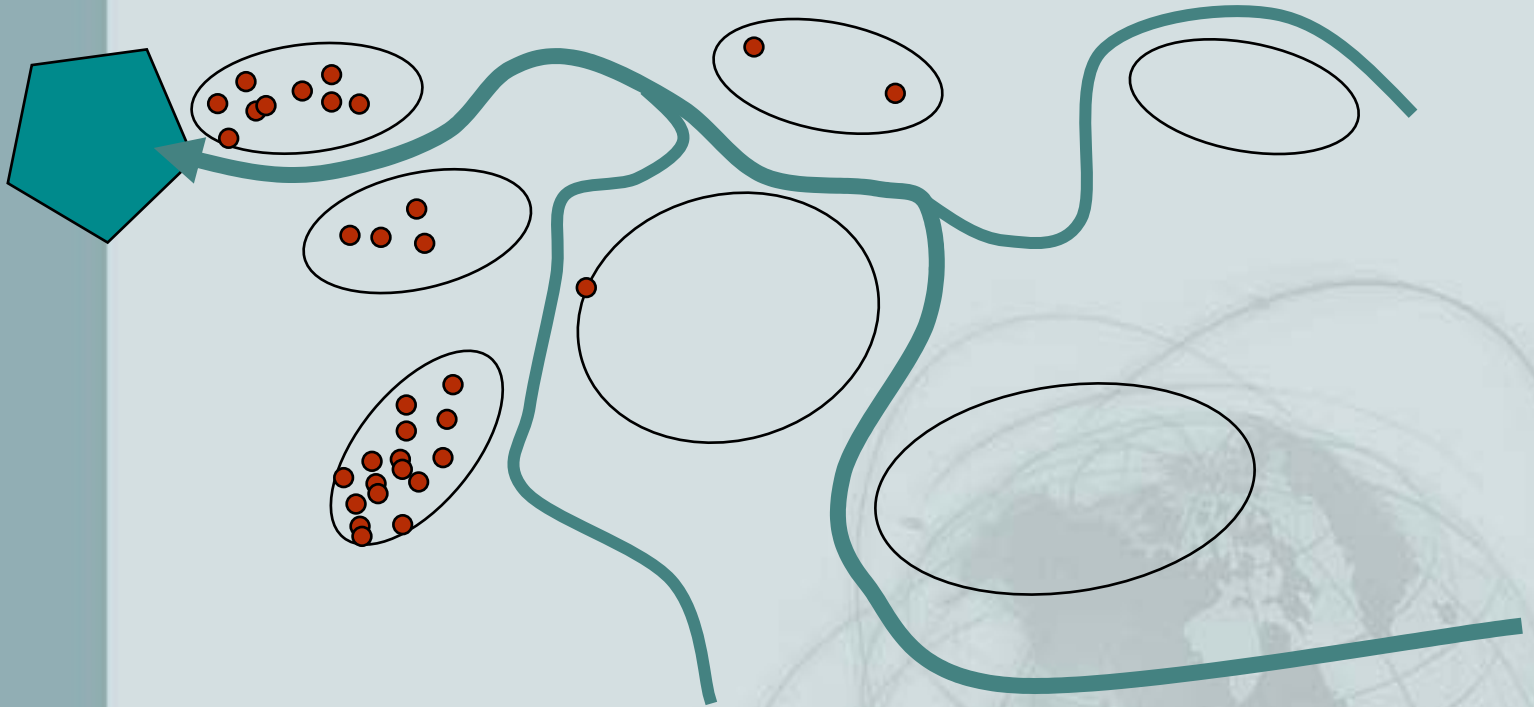
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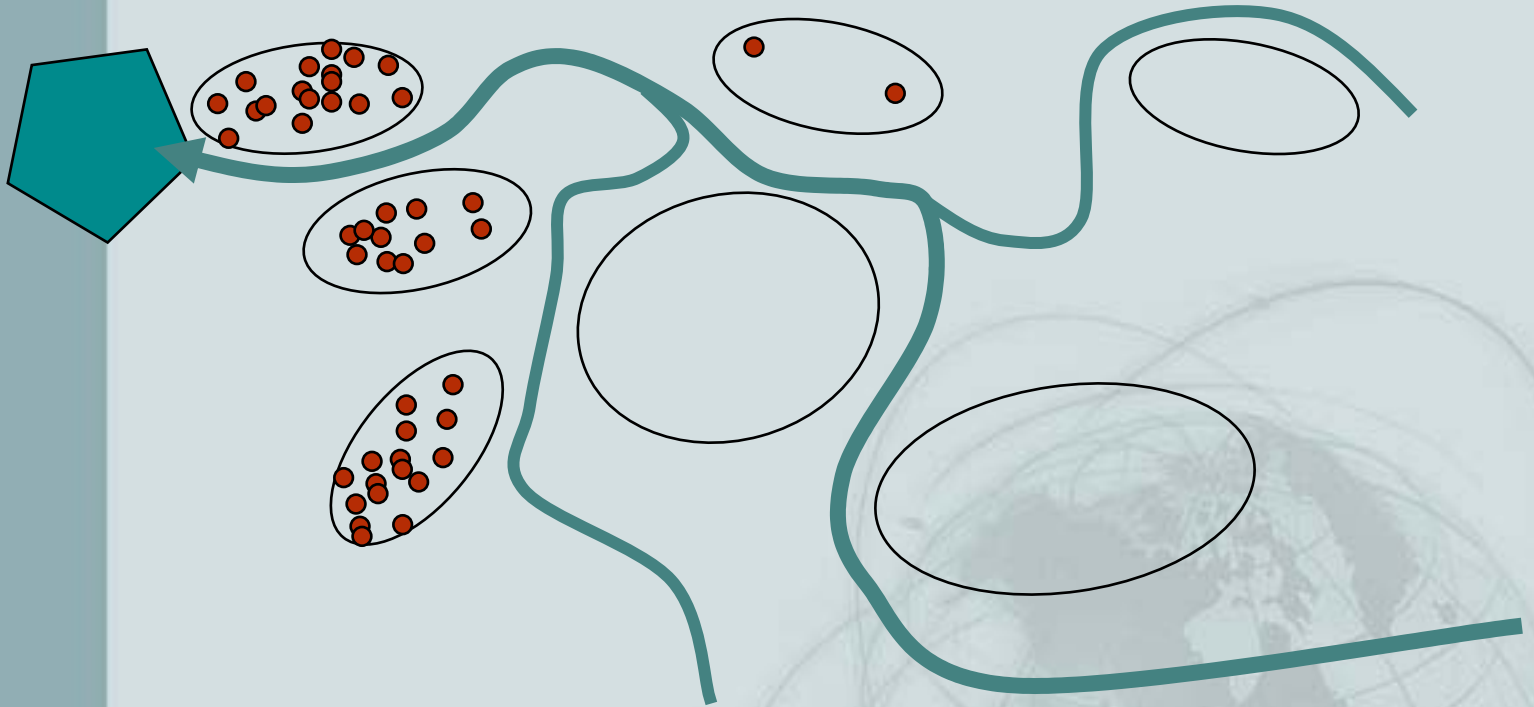
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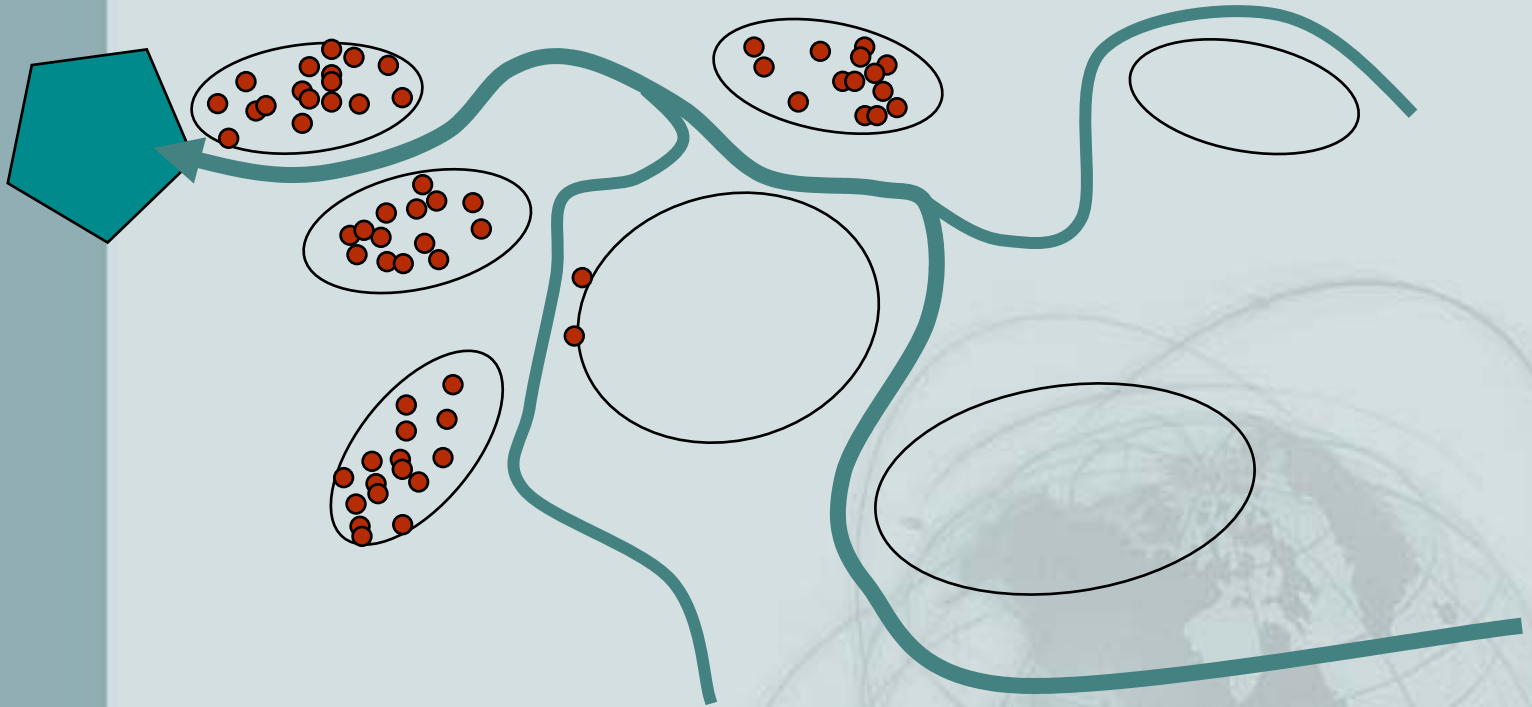
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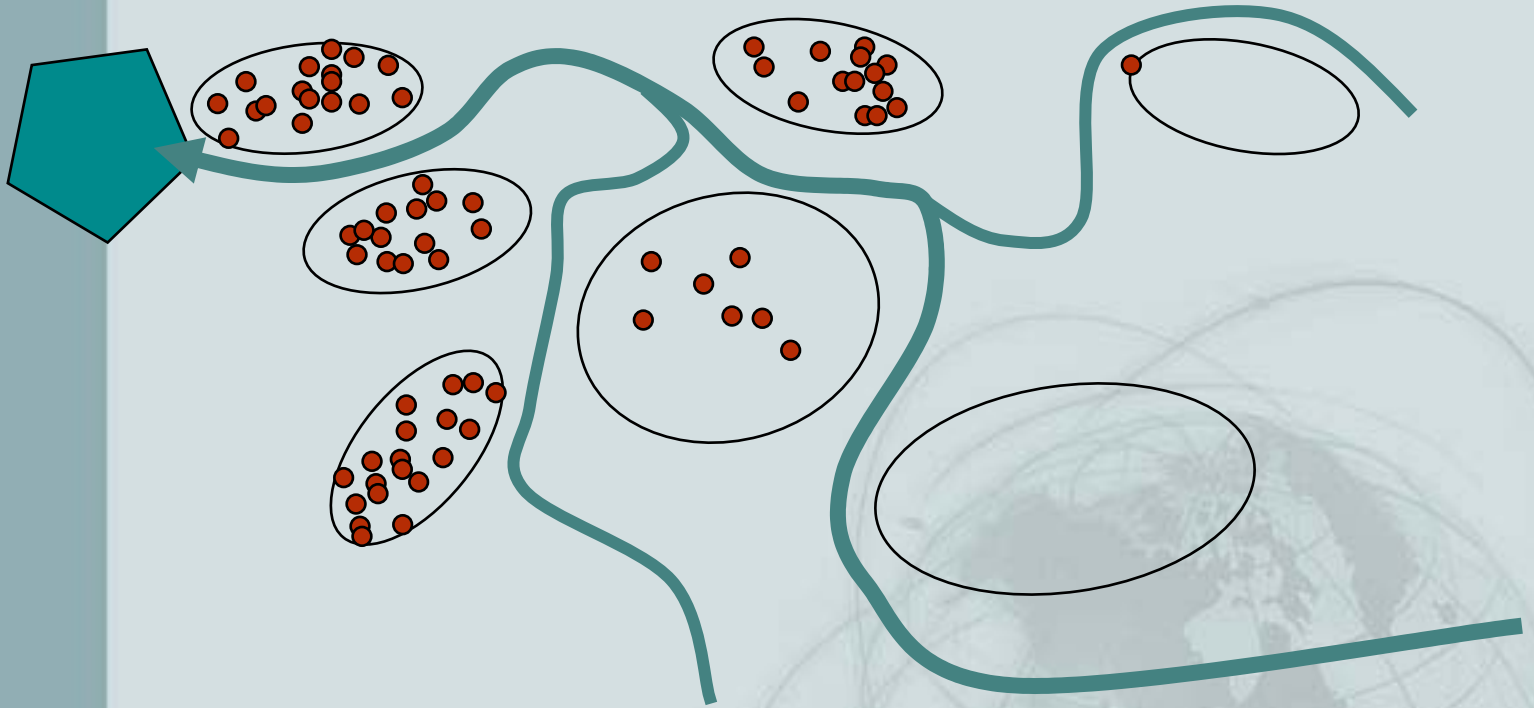
Ecological Dynamics – Populations



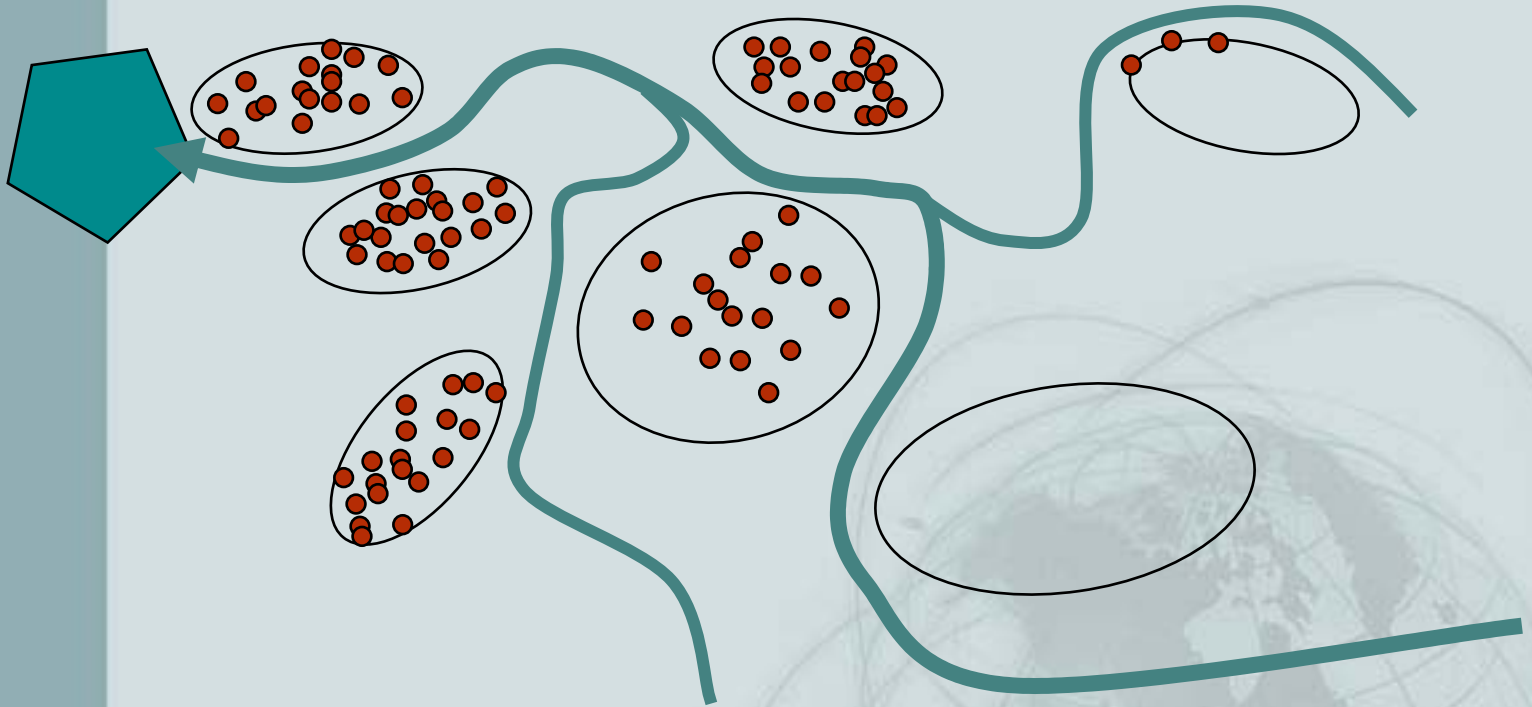
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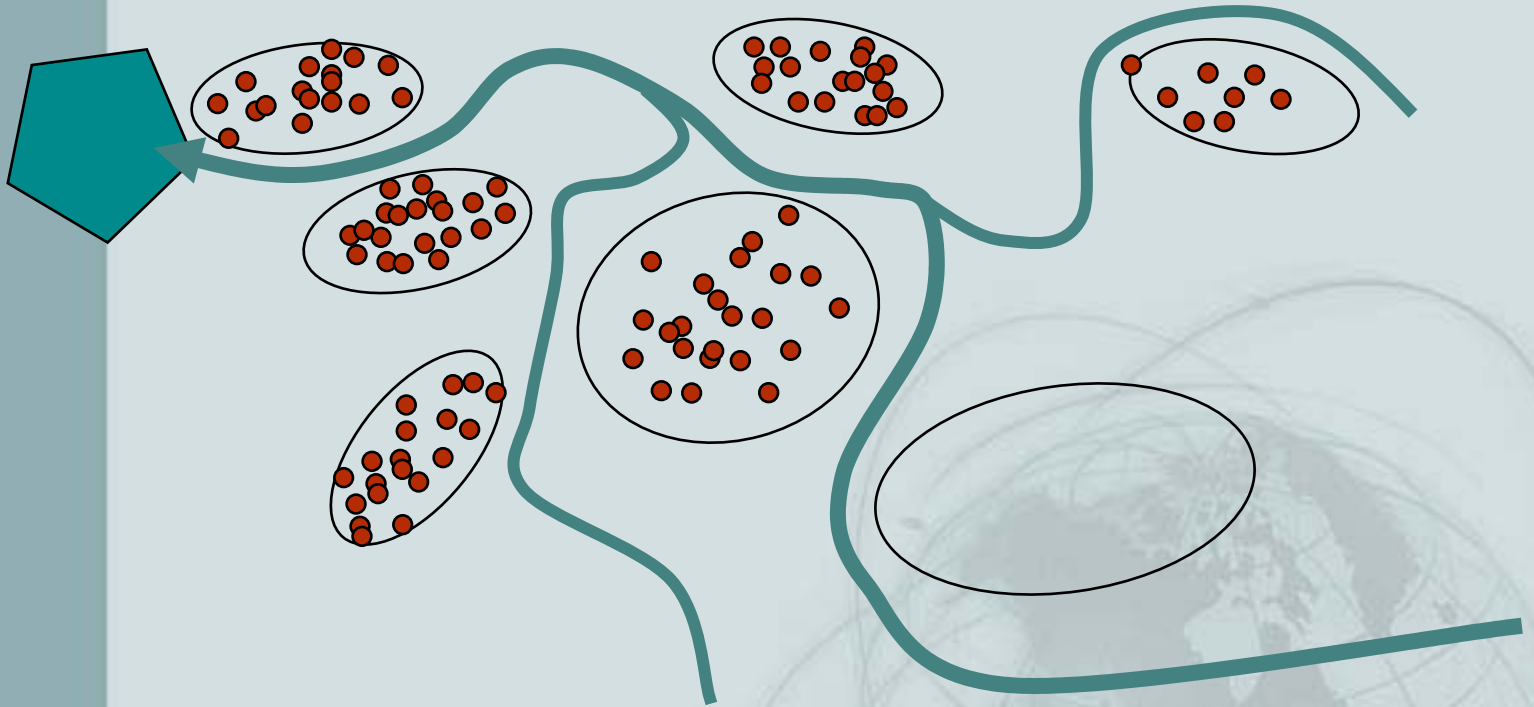
Ecological Dynamics – Populations



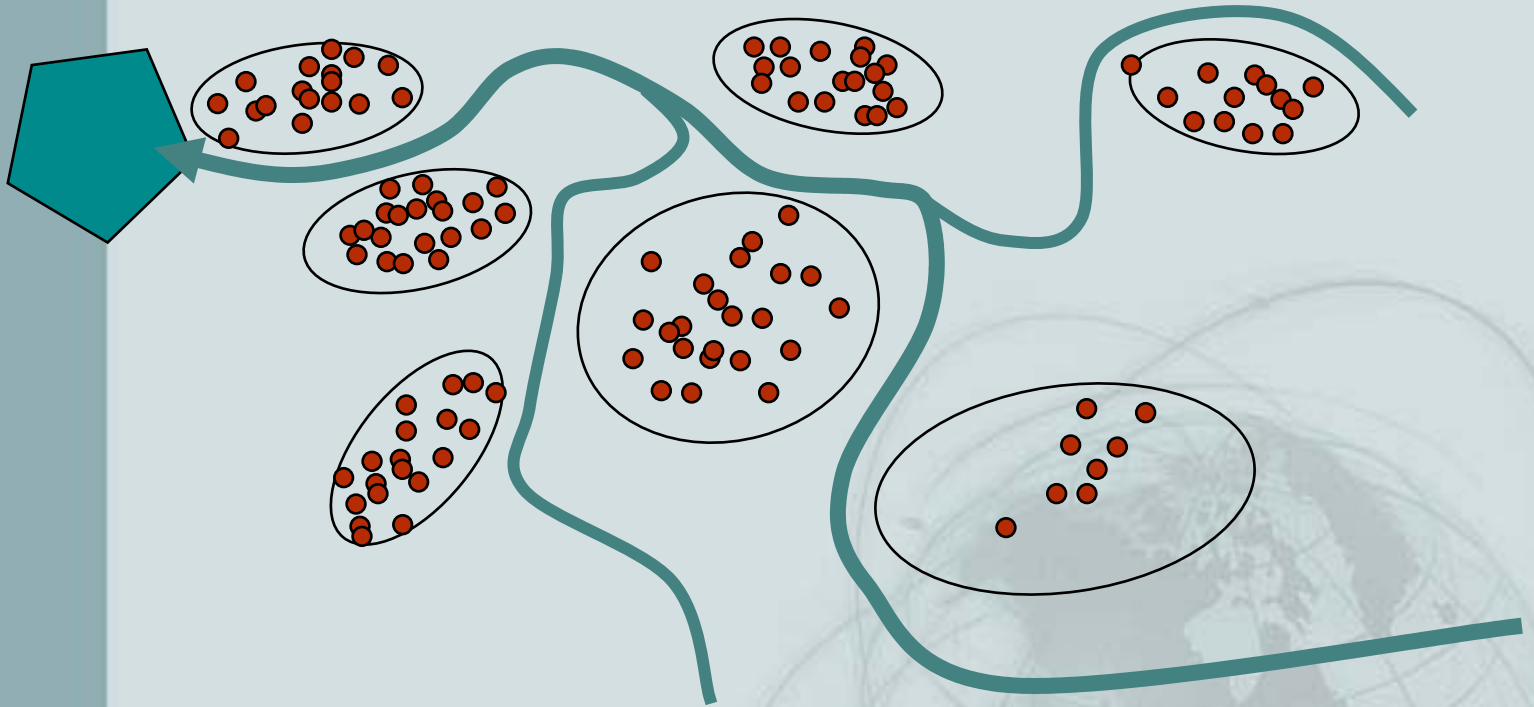
Ecological Dynamics – Populations-1



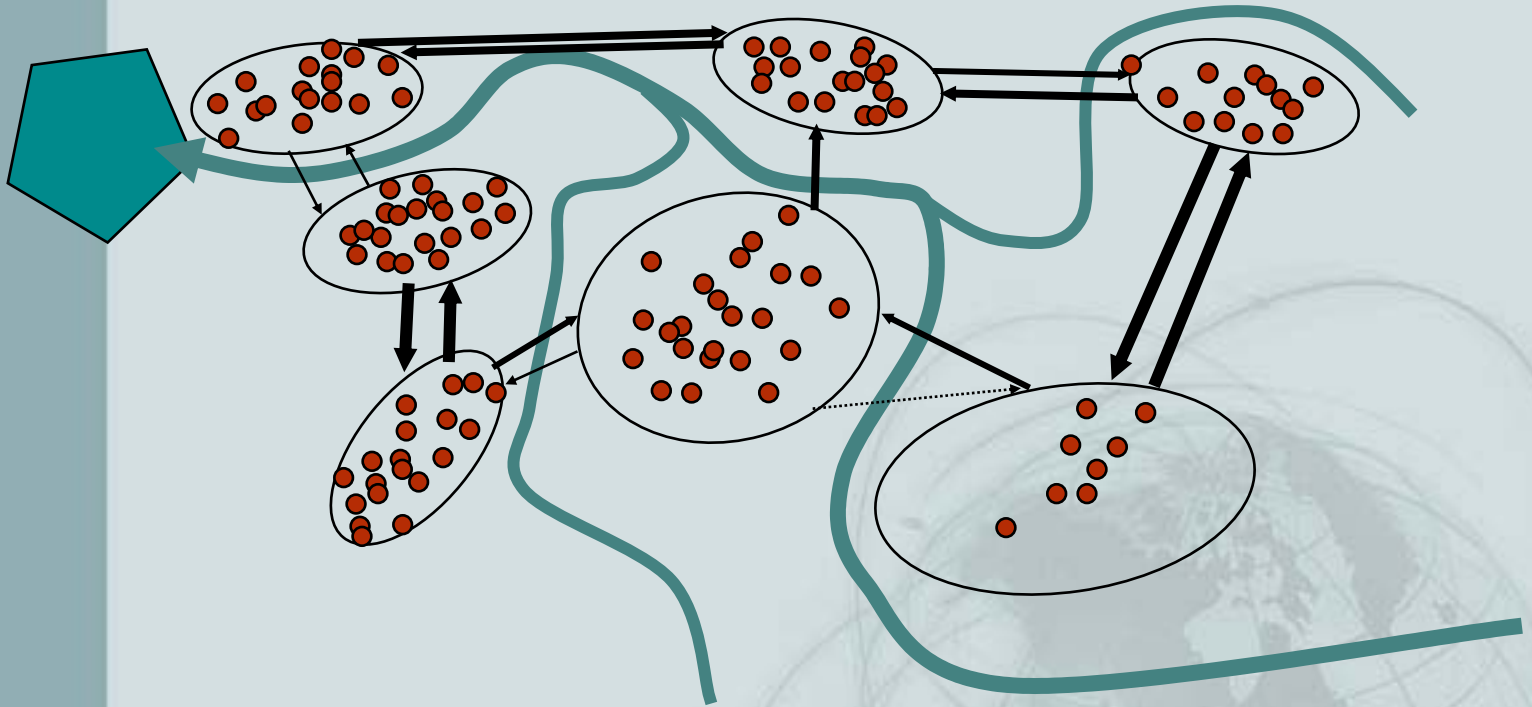
Ecological Dynamics – Populations-1



Ecological Dynamics – Populations-1



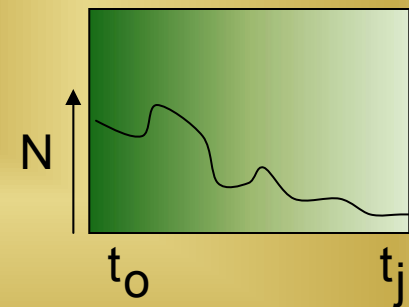
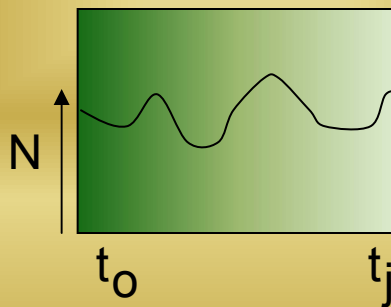
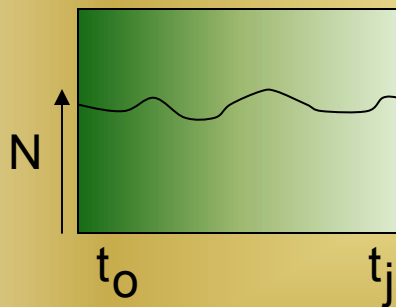
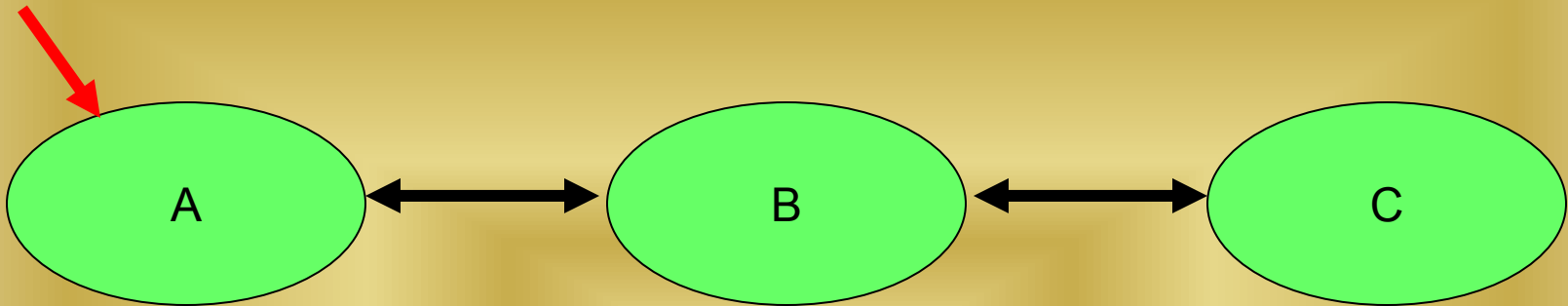
Ecological Dynamics – Populations-2



Ecological Dynamics – Populations-3

Metapopulation consequences

stressor



Adapted from:

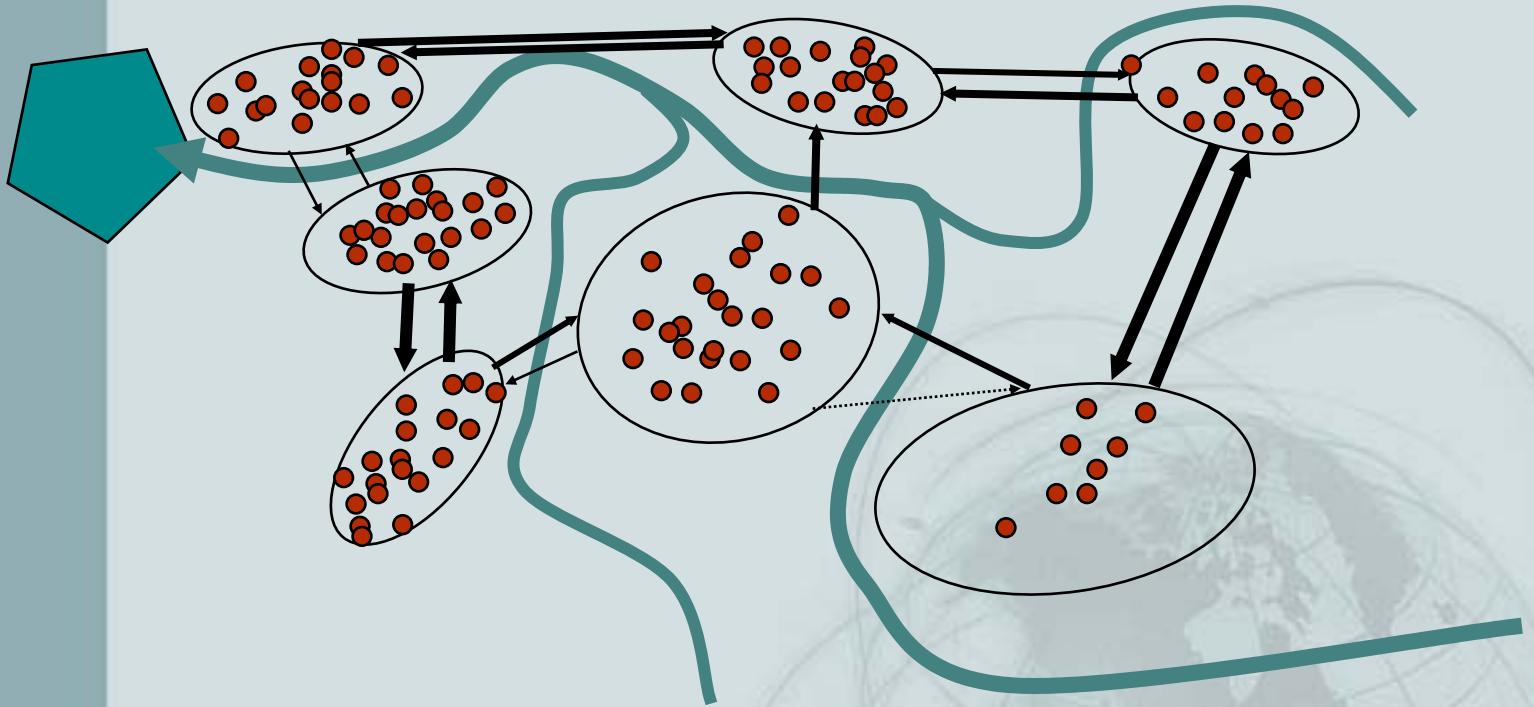
Spromberg, J. A., B. M. Johns and W. G. Landis. 1998. *Environ. Toxicol. Chem.* 17:1640-1649

Macovsky, Louis-A Test of the Action at a Distance Hypothesis using Insect Metapopulations (Dr. Landis-Huxley College). 1999

Range of Control Mechanism

- Banned Entry
 - Restricted entry
 - Containment
 - Quarantine
 - Eradication
- } Inspections/Fines

Eradication dilemma -- source control?



Research and Regulatory Challenges -- Documentation

➤ Forestry Department - Food and Agriculture Organization of the United Nations

Forest Health & Biosecurity Working Papers The status of invasiveness of forest tree species outside their natural habitat: a global review and discussion paper

by
K.A. Haysom and S.T. Murphy
CABI Bioscience
December 2003

 **Forestry Department**
Food and Agriculture Organization of the United Nations

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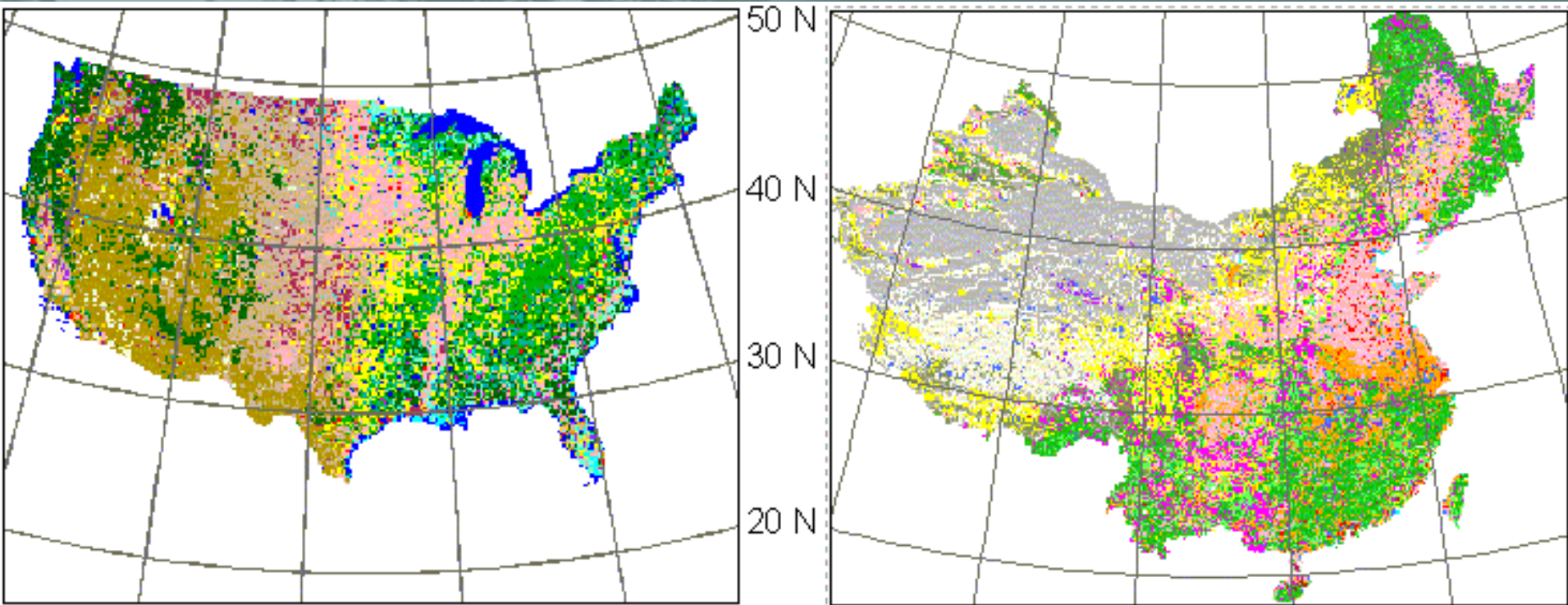
Forest Bioscience Development Services Working Paper 156/03
Forest Resources Division FAO, Rome, Italy
Forestry Department

➤ <http://www.fao.org/forestry/forestry.asp>.

(95 records found)

- Ecoregion conservation in Cambodia, Lao PDR and Viet Nam
- Inter-institutional initiative for biodiversity conservation, Pampas Region, Argentina
- Accidental and intentional introduction of exotic species in the Black Sea
- Alien Invasive Species and agriculture in Turkey
- Alien Invasive Species in Israel
- Alien organisms in Germany
- Alien species that threaten ecosystems, habitats or species (alien birds species in Lebanon, Alien insect species in Lebanon)
- *Ambrosia artemisiifolia* L. -- China
- Case-studies from marine environment, introduction to the Baltic Sea and the Swedish West Coast
- Case-study on the Black Striped Mussel-- *Australia*
- Consequences of invasion of a predatory cladoceran. Report for International Council for the Exploration of the Sea--*Estonia*

Modelling



demonstrate utility predictive modeling, remote sensing, and GIS to predict future distribution of selected invasive species from China that are invasive in the U.S. and from the U.S. that are invasive in China

Research and Regulatory Challenges

- Basic Ecology
- Standard methods (ASTM Draft Standard Guide for Conducting Hazard Assessment-Critical Control Point (HACCP) Evaluations)



[Designation: WK7844: Draft ASTM standard on HACCP (1 Dec 05)]

- Multilateral agreements
- Preventative actions
- Flexibility to adjust to new information

