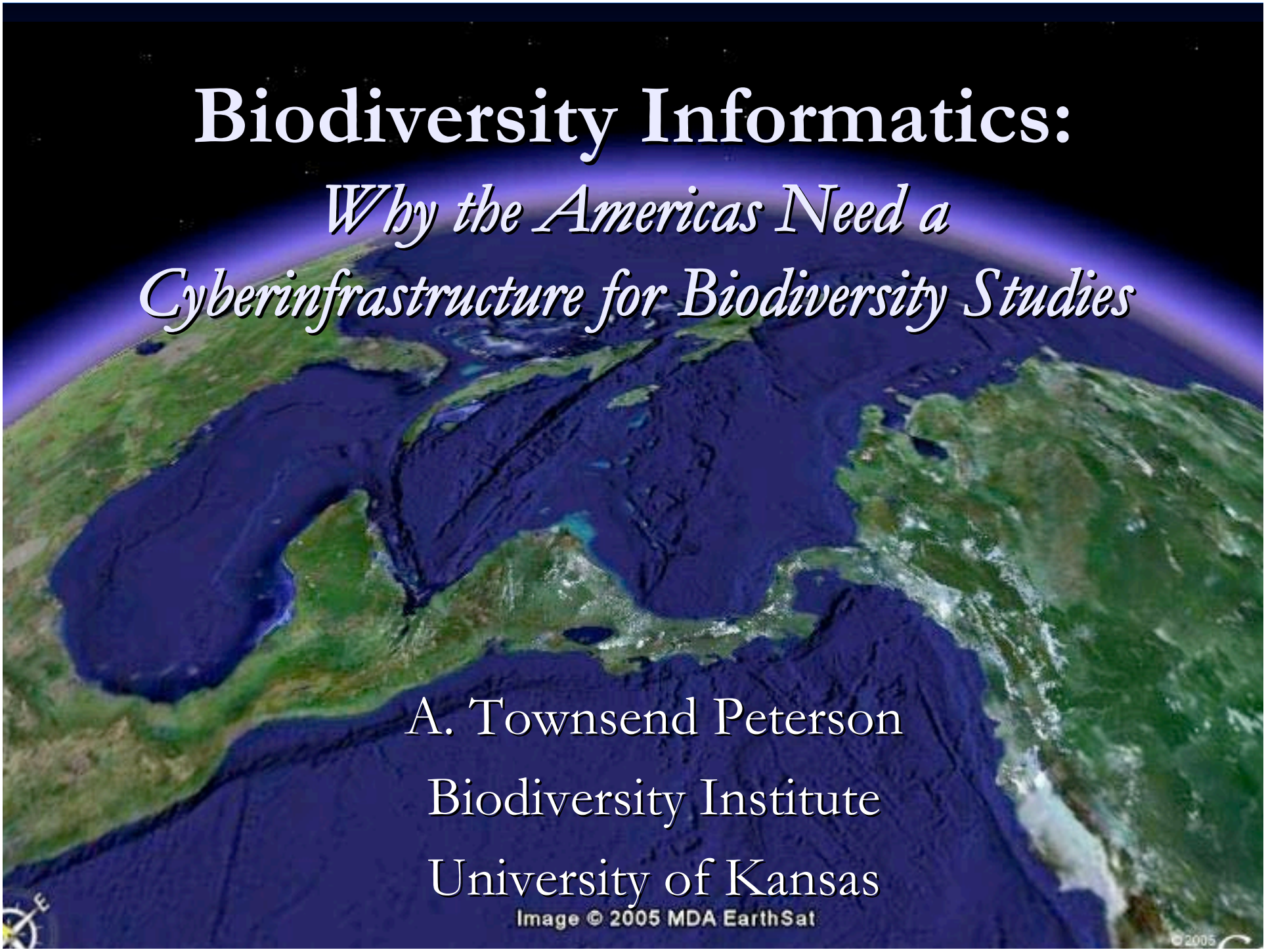

Biodiversity Informatics:
Why the Americas Need a
Cyberinfrastructure for Biodiversity Studies
A. Townsend Peterson
Biodiversity Institute
University of Kansas
Image © 2005 MDA EarthSat

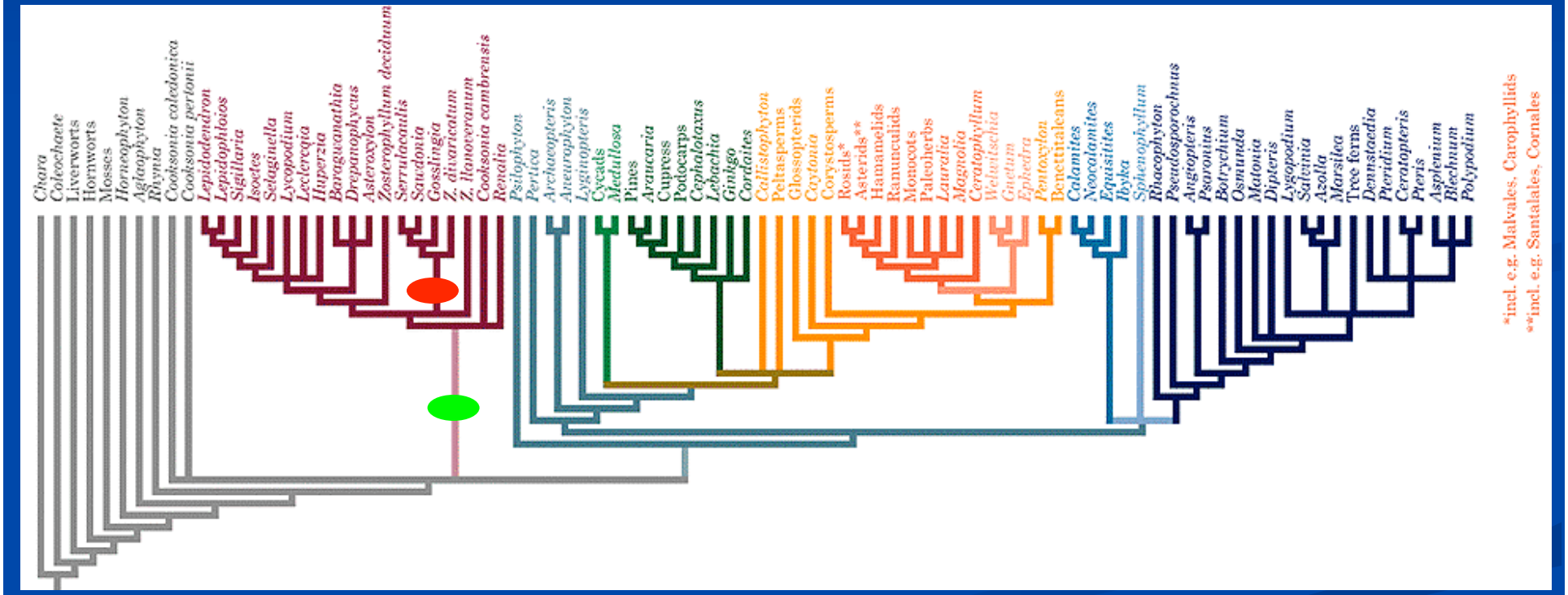
Biodiversity

- Life on Earth is the result of 4×10^9 years of evolution, and has resulted in enormous complexity, perhaps 10^7-10^8 species
- Biodiversity is everywhere and in almost everything—
  - The scientific urge to discover and describe
  - The human responsibility to protect and preserve
  - The practical necessity to deal with biodiversity
    - Agriculture, public health and epidemiology, food safety, transportation, recreation, land use planning, natural resource planning, urban planning, anthropology, archaeology, biochemistry, pharmacology, engineering, medicine, fine arts, ethnobiology, horticulture, integrated pest control, disaster planning ……

Predictivity in Biodiversity

- Biology, particularly organismal biology, is infamous for complexity, intractability—every 'rule' has been or can be broken
- Predictivity is a rare quality suggestive of a mature science … when biological principles offer extrapolative, predictable behaviors
  - Examples:
    - Phylogeny and hierarchical distribution of characters
    - Species' ecological and geographic distributions

Phylogeny and Predictivity



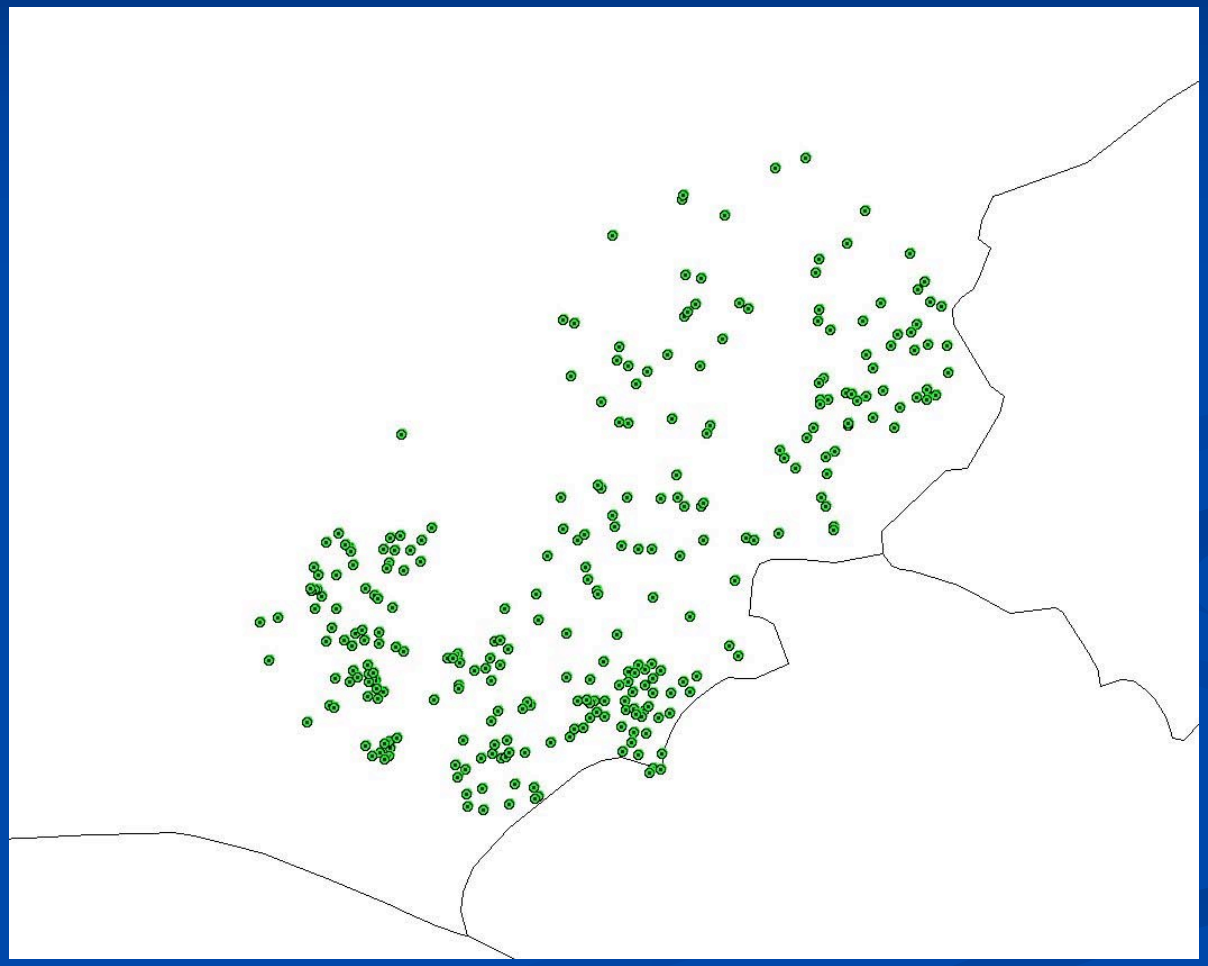
http://www.ucmp.berkeley.edu/IB181/VPL/Dir.html

Here, we explore a different kind of predictivity in biodiversity science …

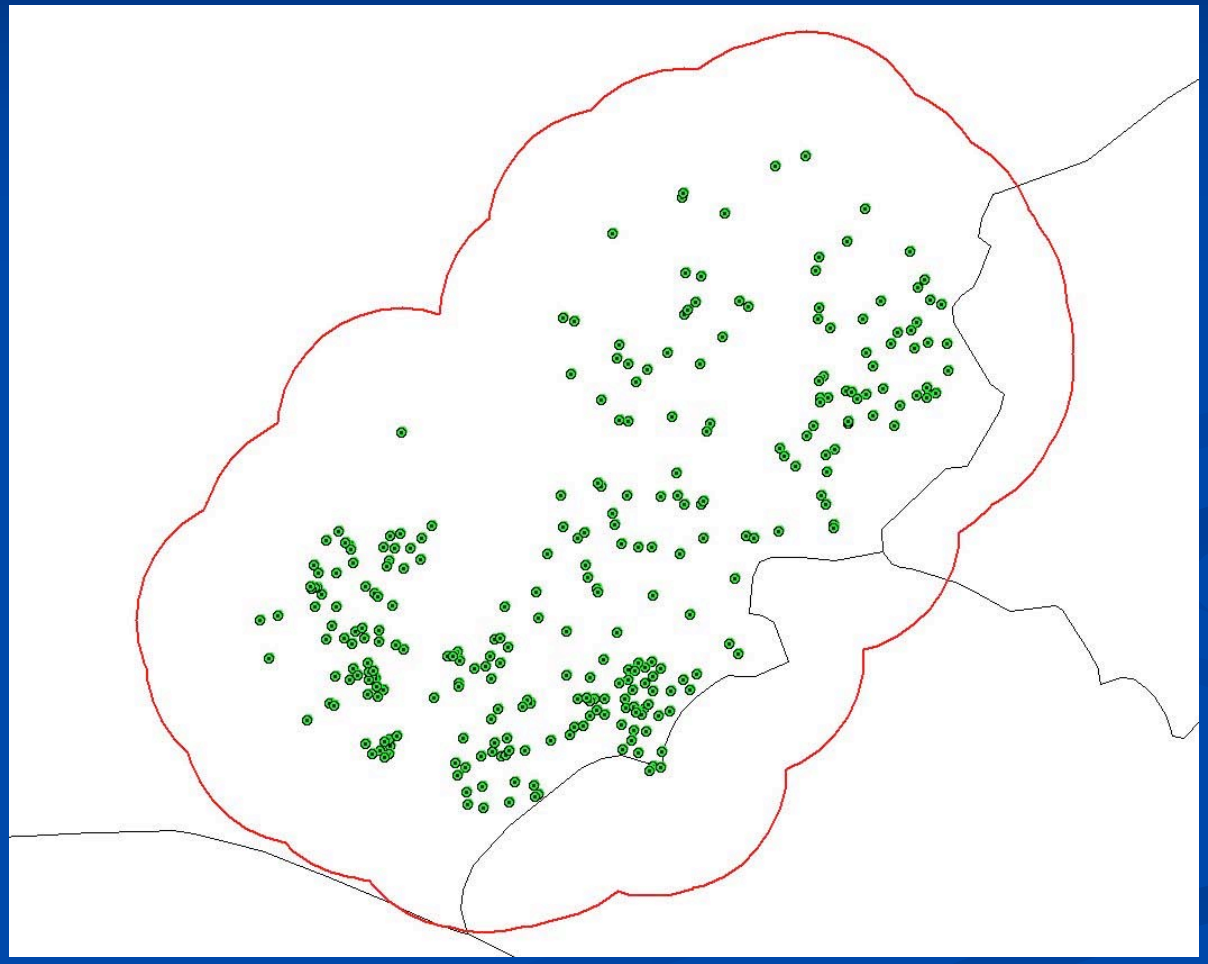
Potential geographic distributions of species can be predicted accurately based on ecological features of species' known occurrences

Triatomine Bugs in Guatemala

Detail of Sampling Area

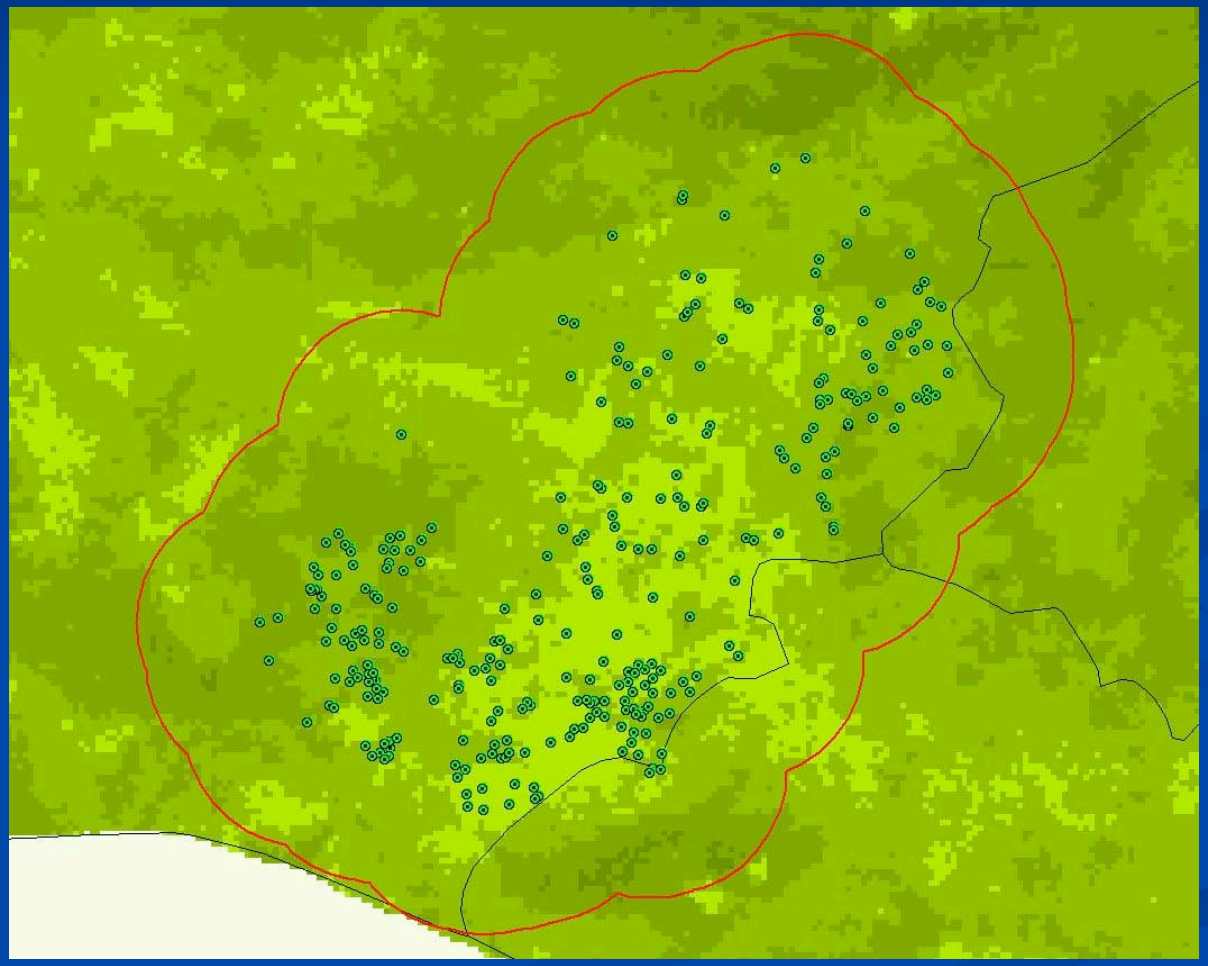


Sampling Area Buffered by 25 km



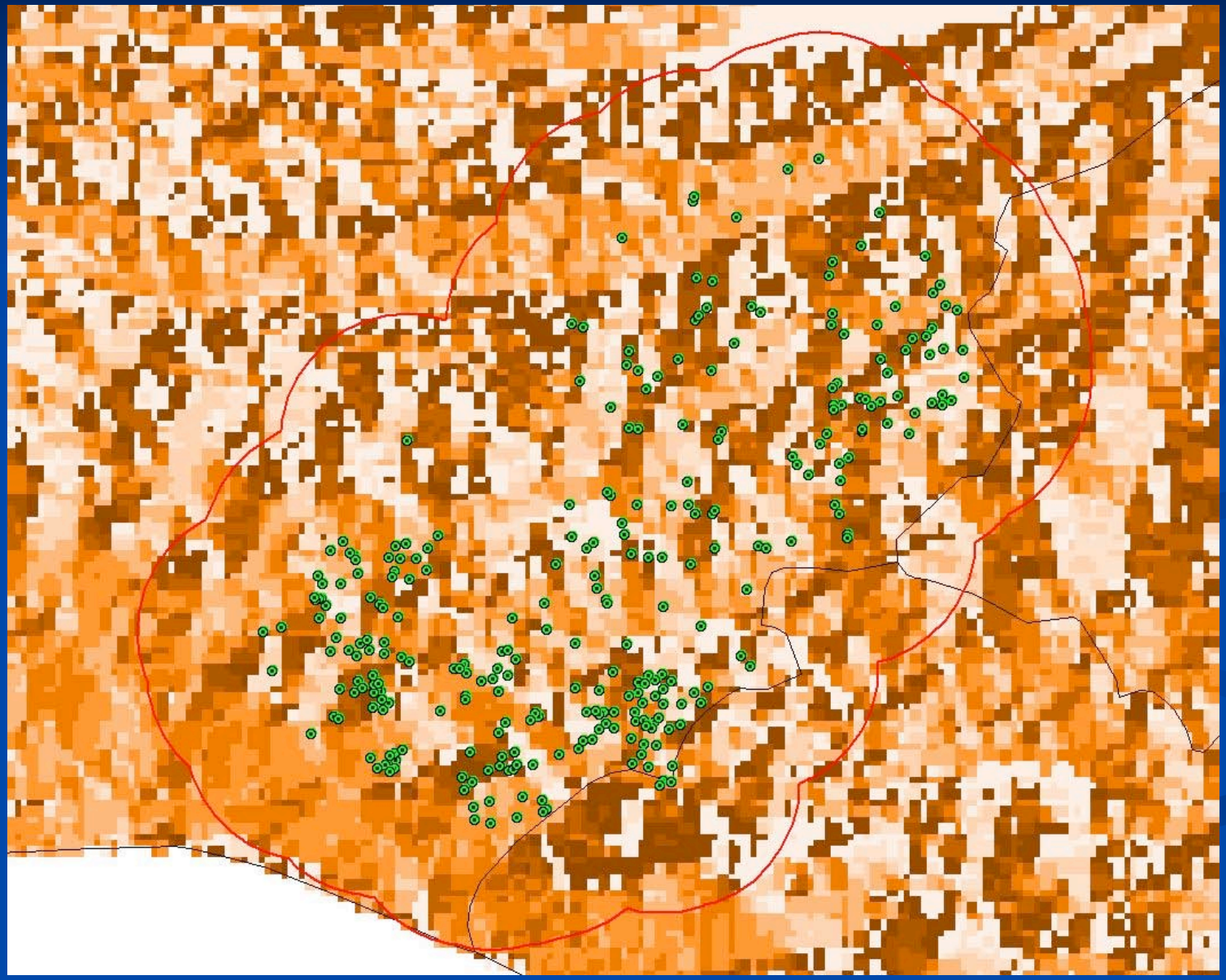
Environmental Data Layers – AVHRR NDVI

The Normalized Difference Vegetation Index (NDVI), which is related to the proportion of photosynthetically absorbed radiation, is calculated from atmospherically corrected reflectances from the visible and near infrared AVHRR

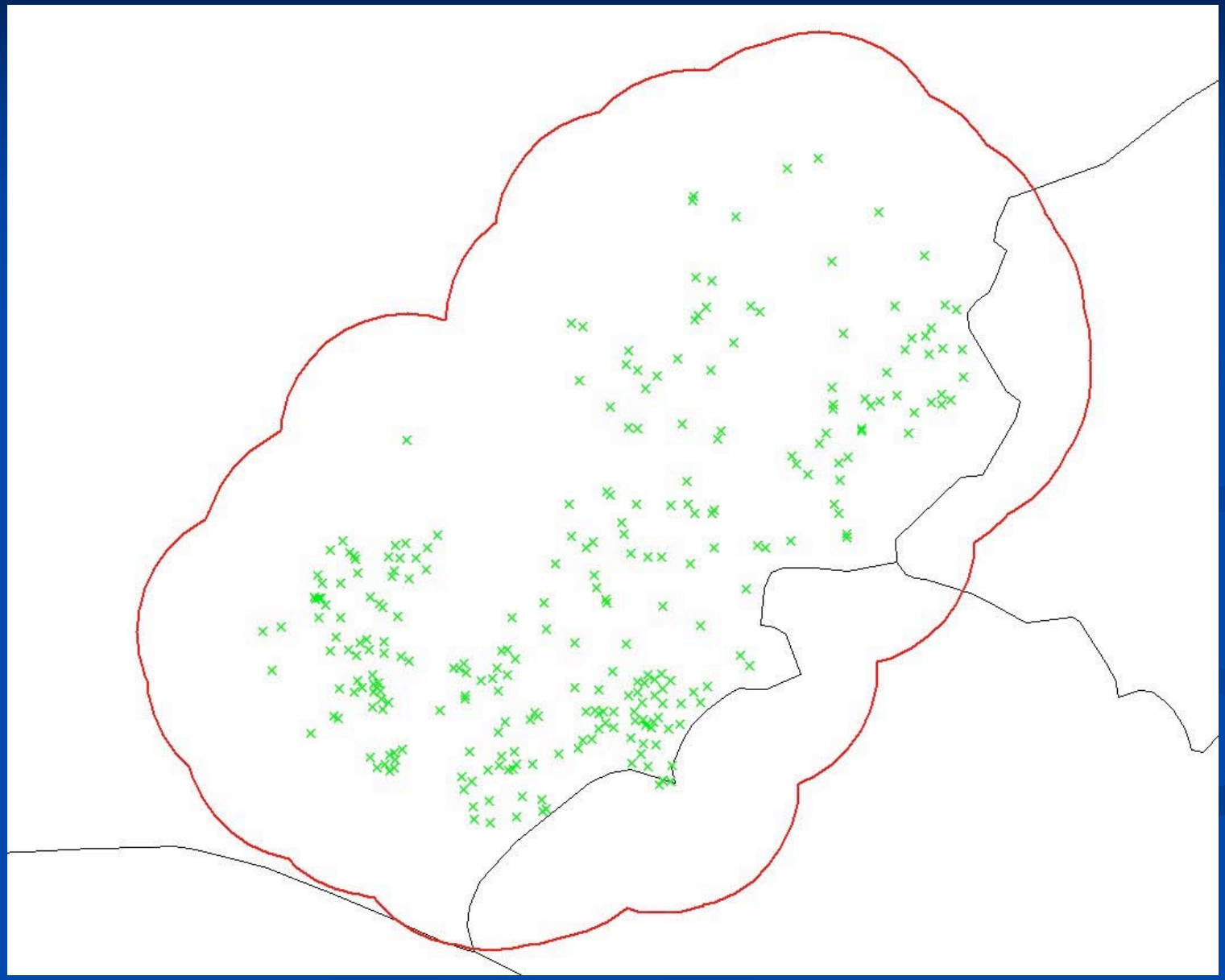


Advanced Very High Resolution Radiometer

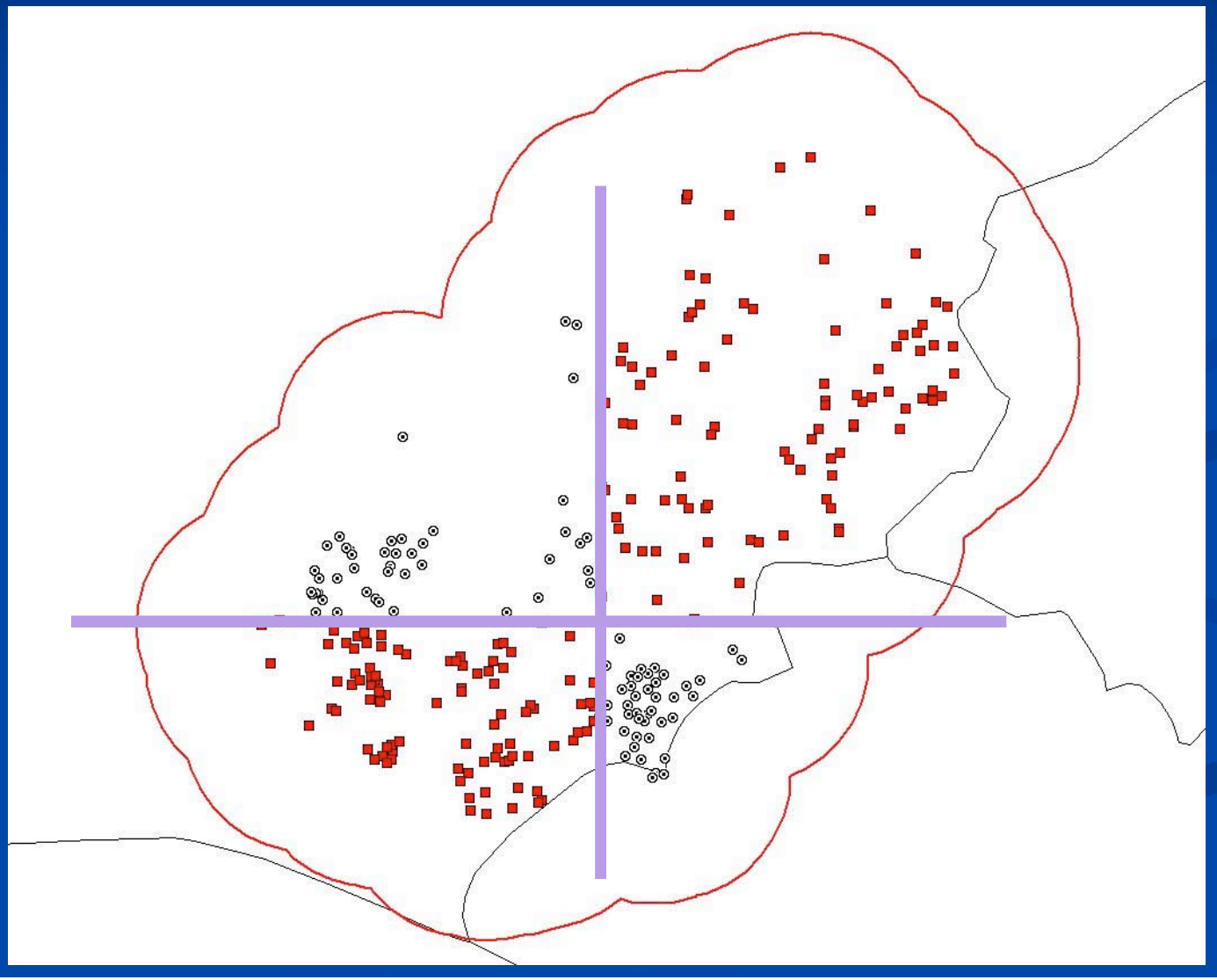
Environmental Data Layers – Aspect



Known Occurrences – *Triatoma dimidiata*

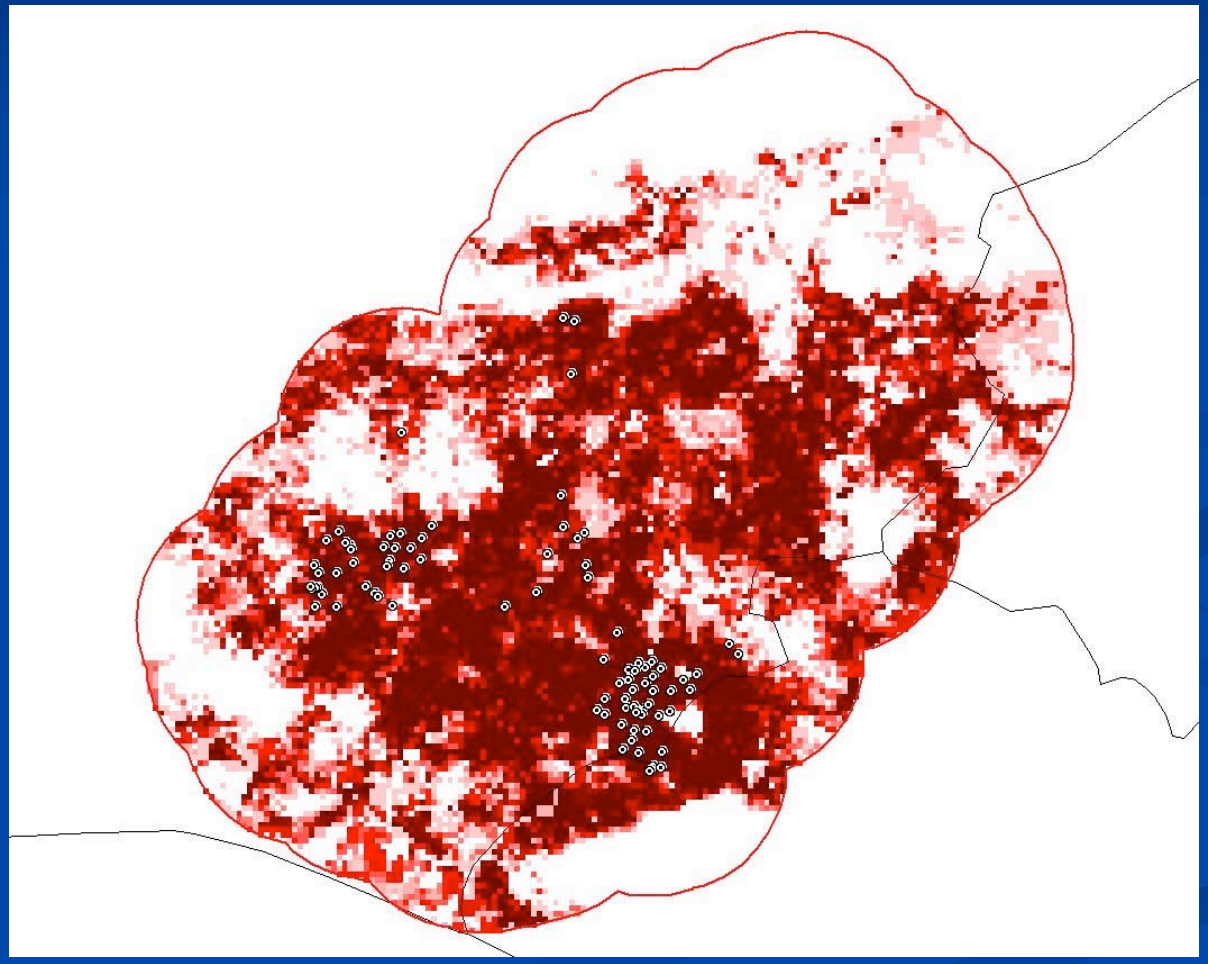


Divide Points into Quadrants (On and Off Diagonal)

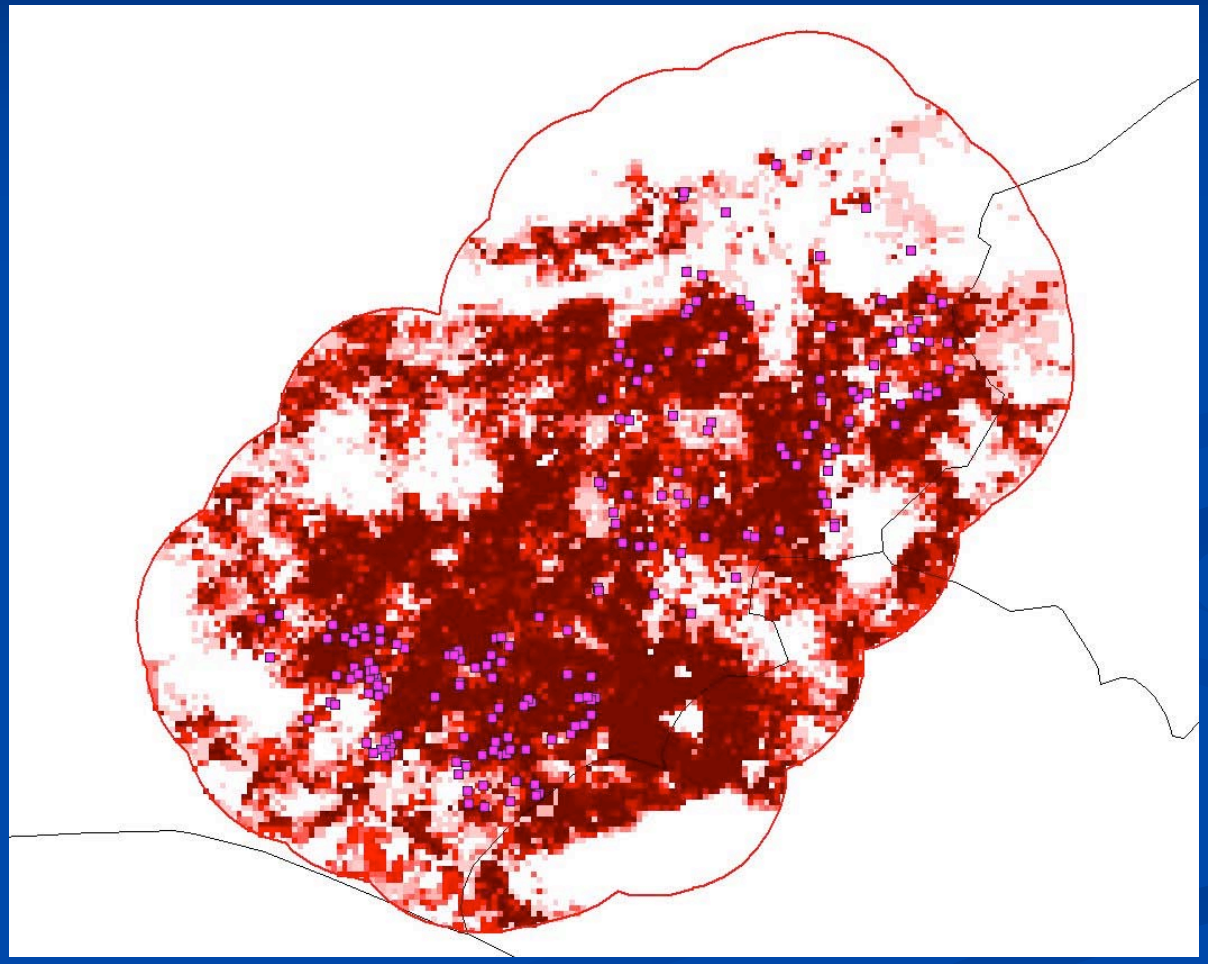


On-diagonal Points

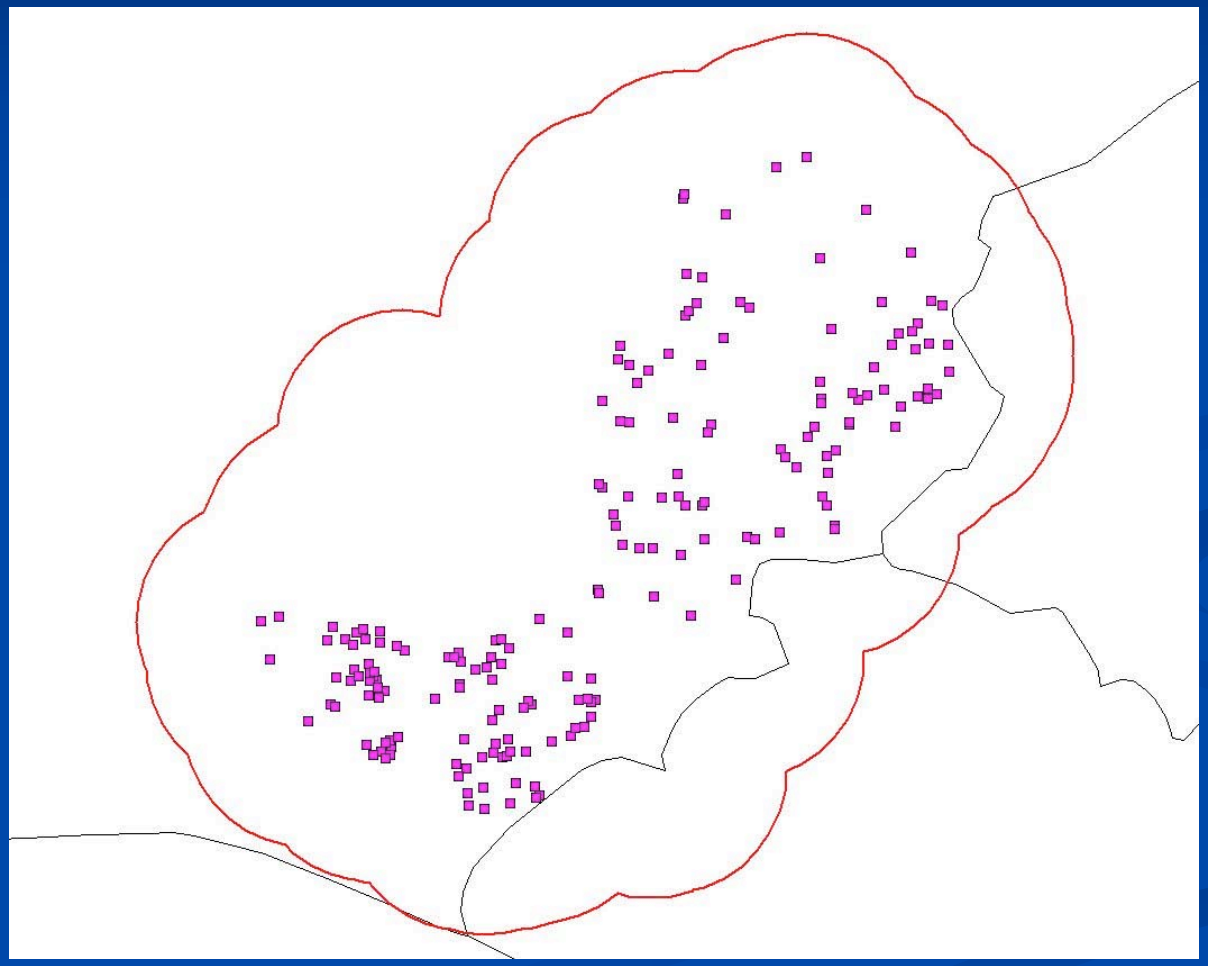
Model Based on On-diagonal Points



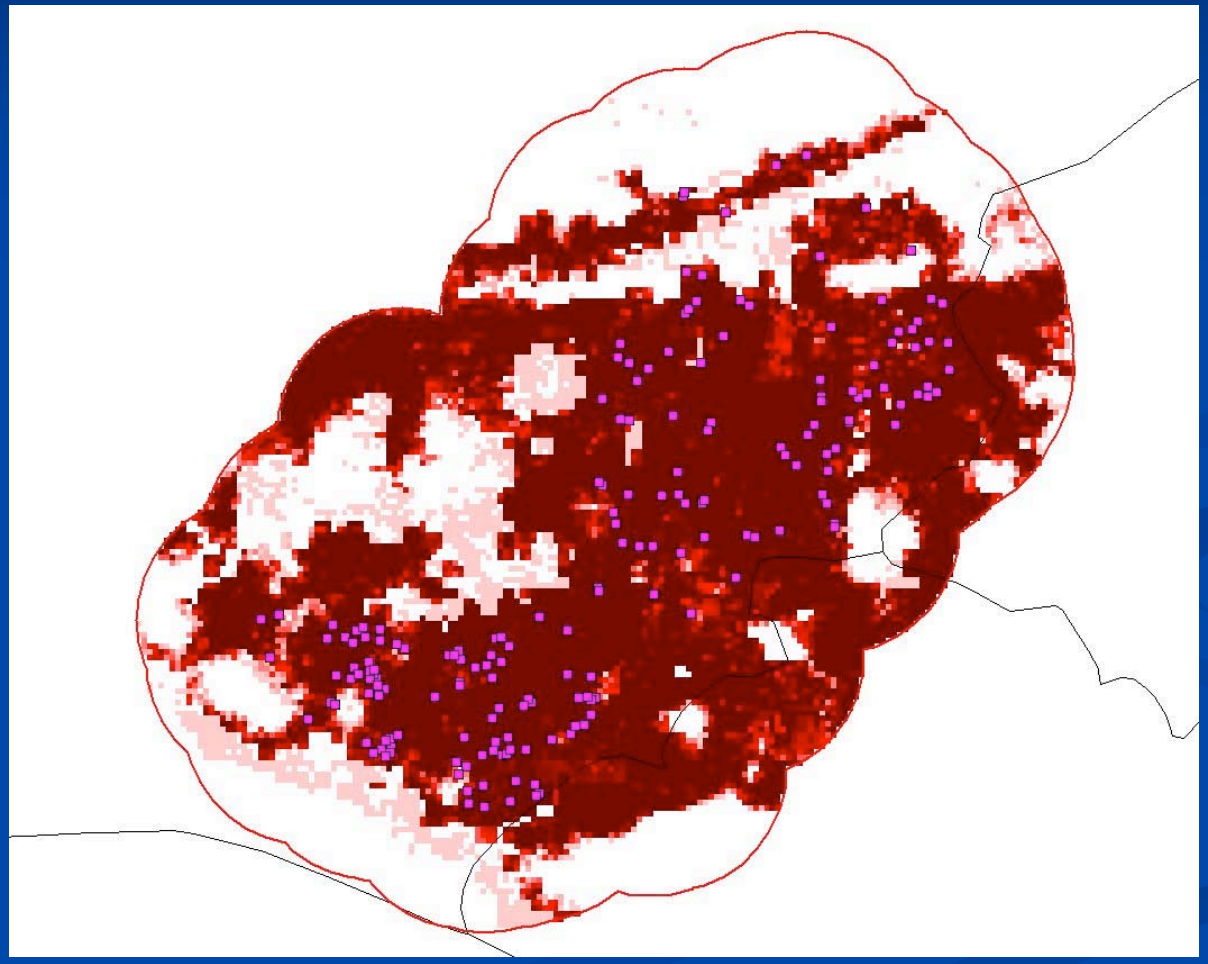
Overlay Independent Off-diagonal Points



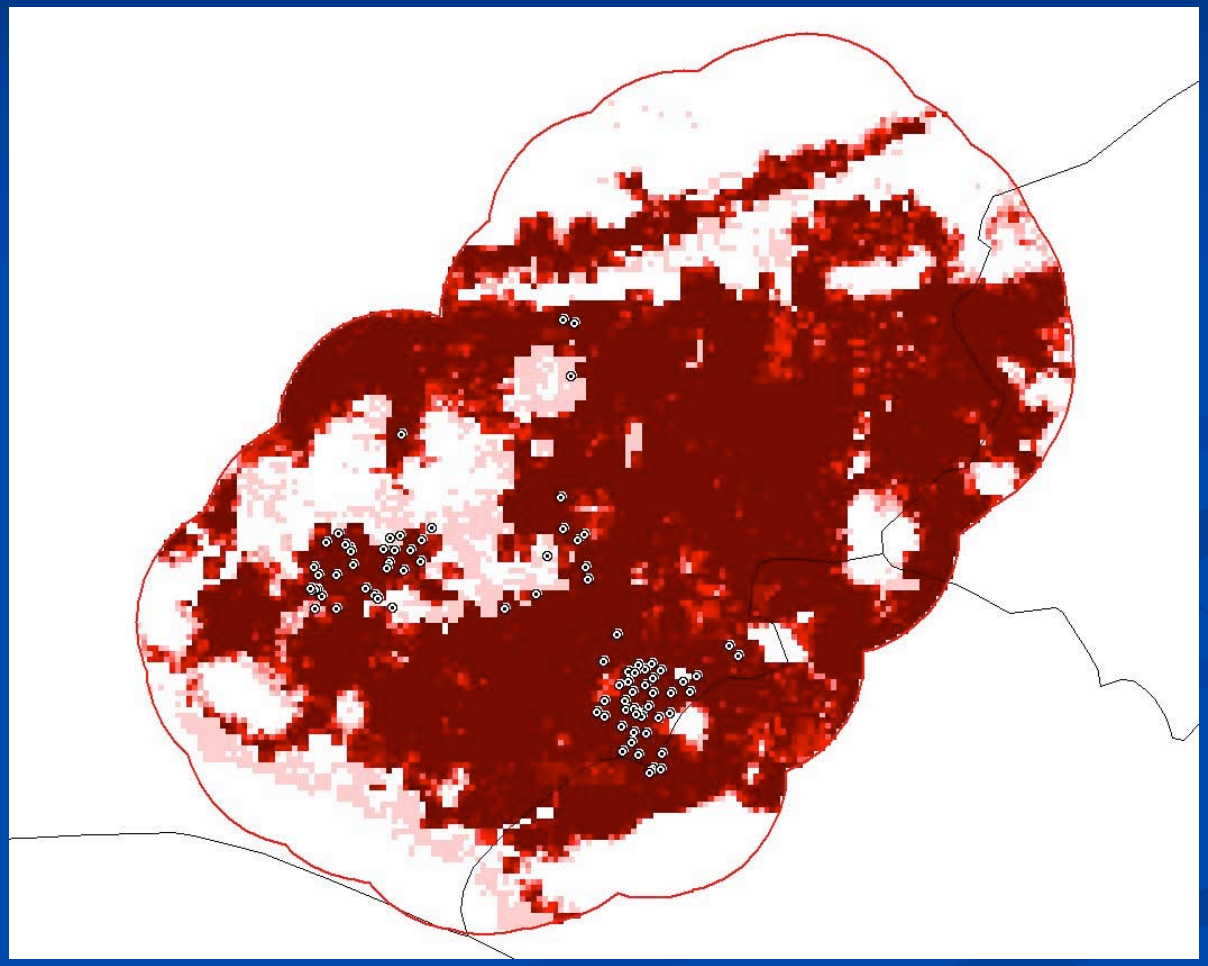
Off-diagonal Points



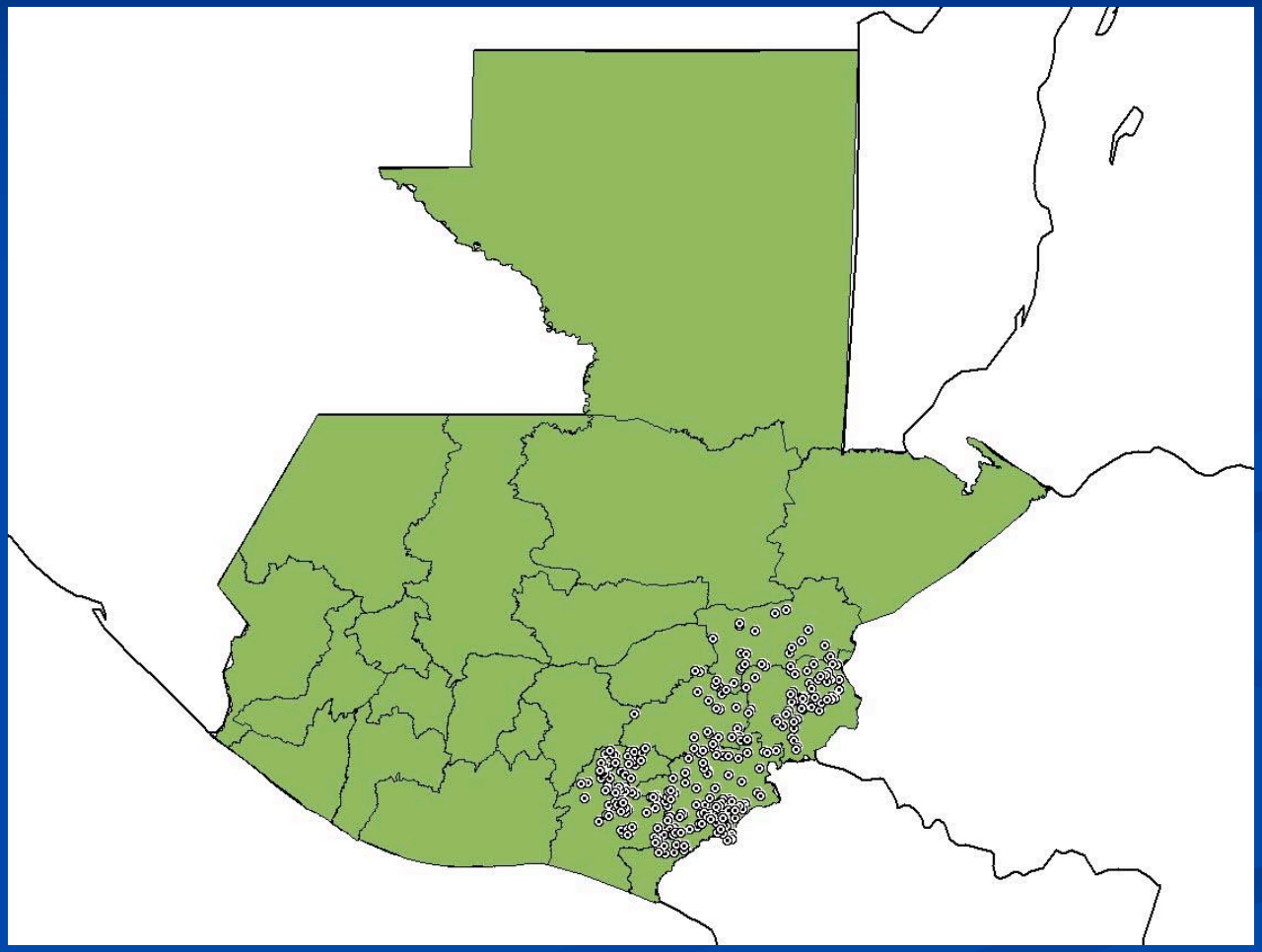
Model Based on Off-diagonal Points



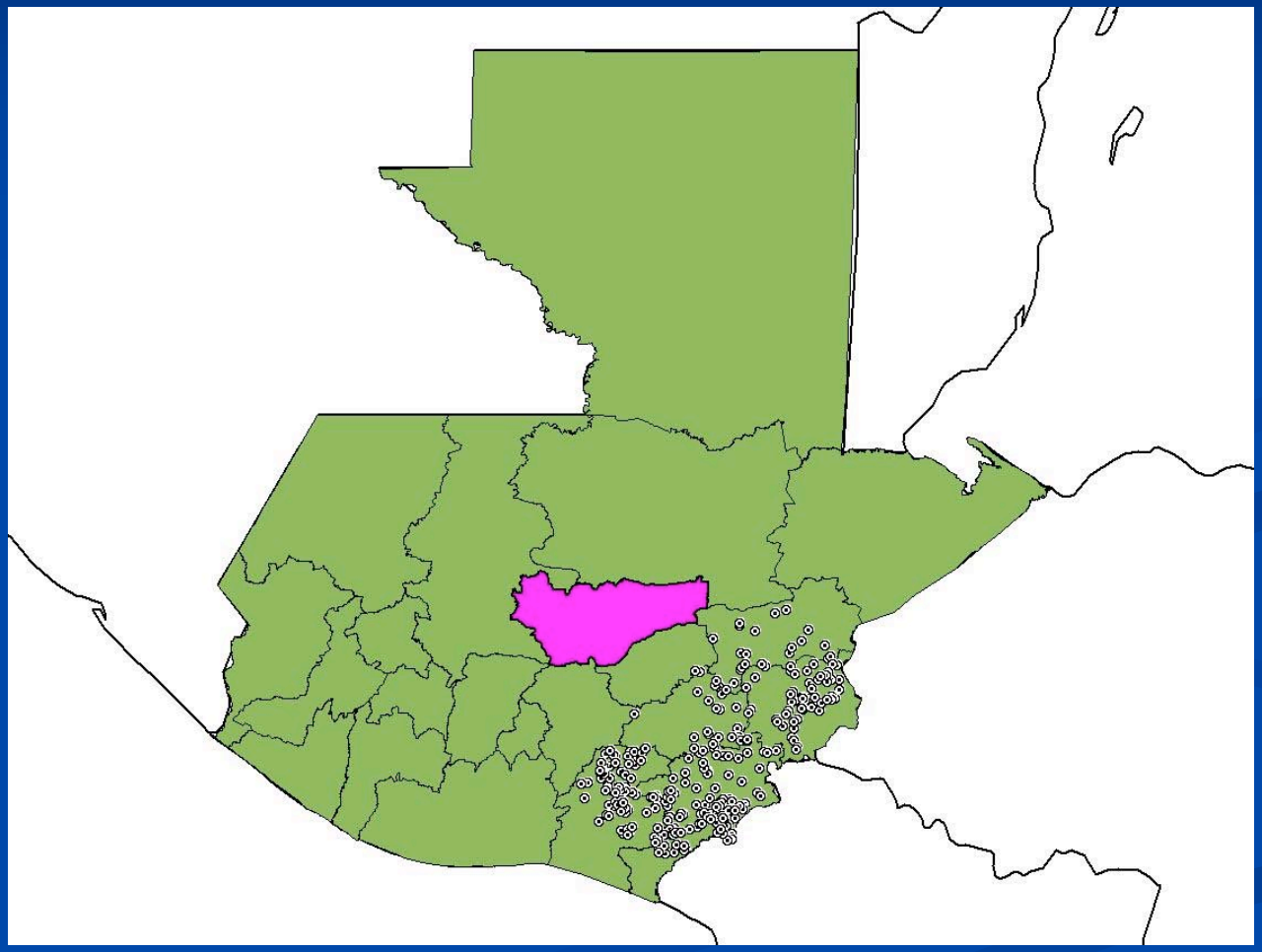
Overlay of Independent On-diagonal Points



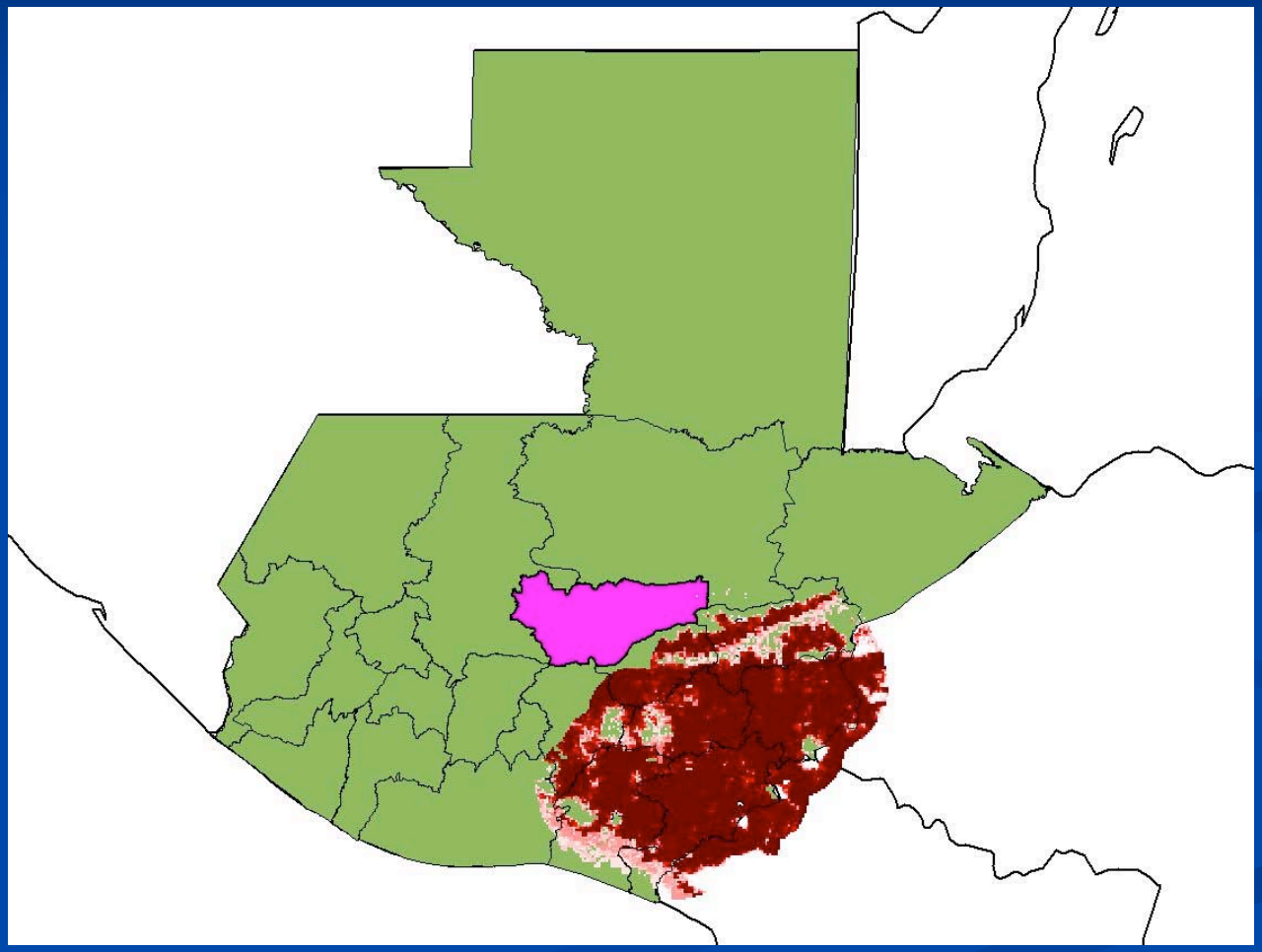
Projection to Other Region



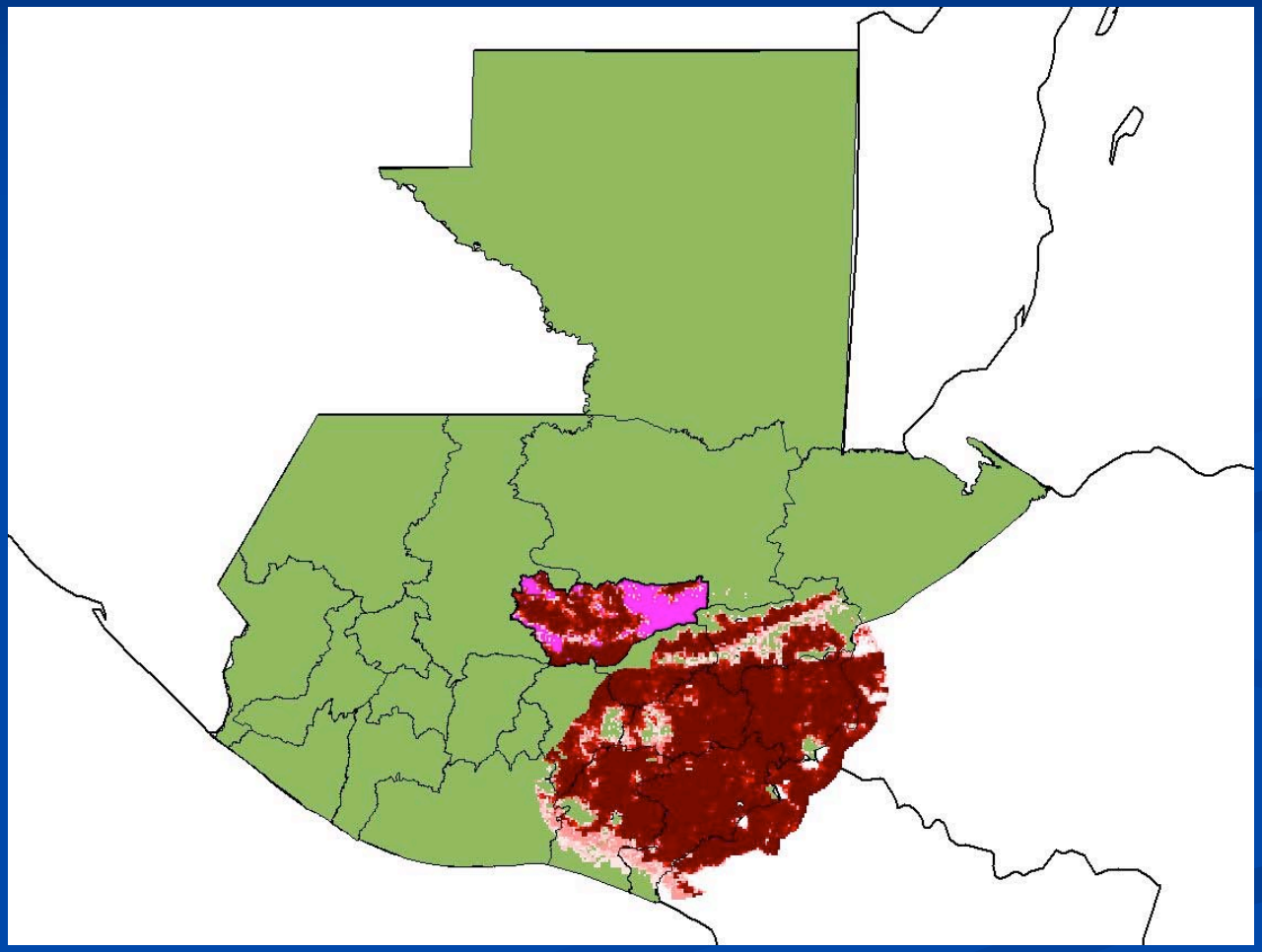
Baja Verapaz



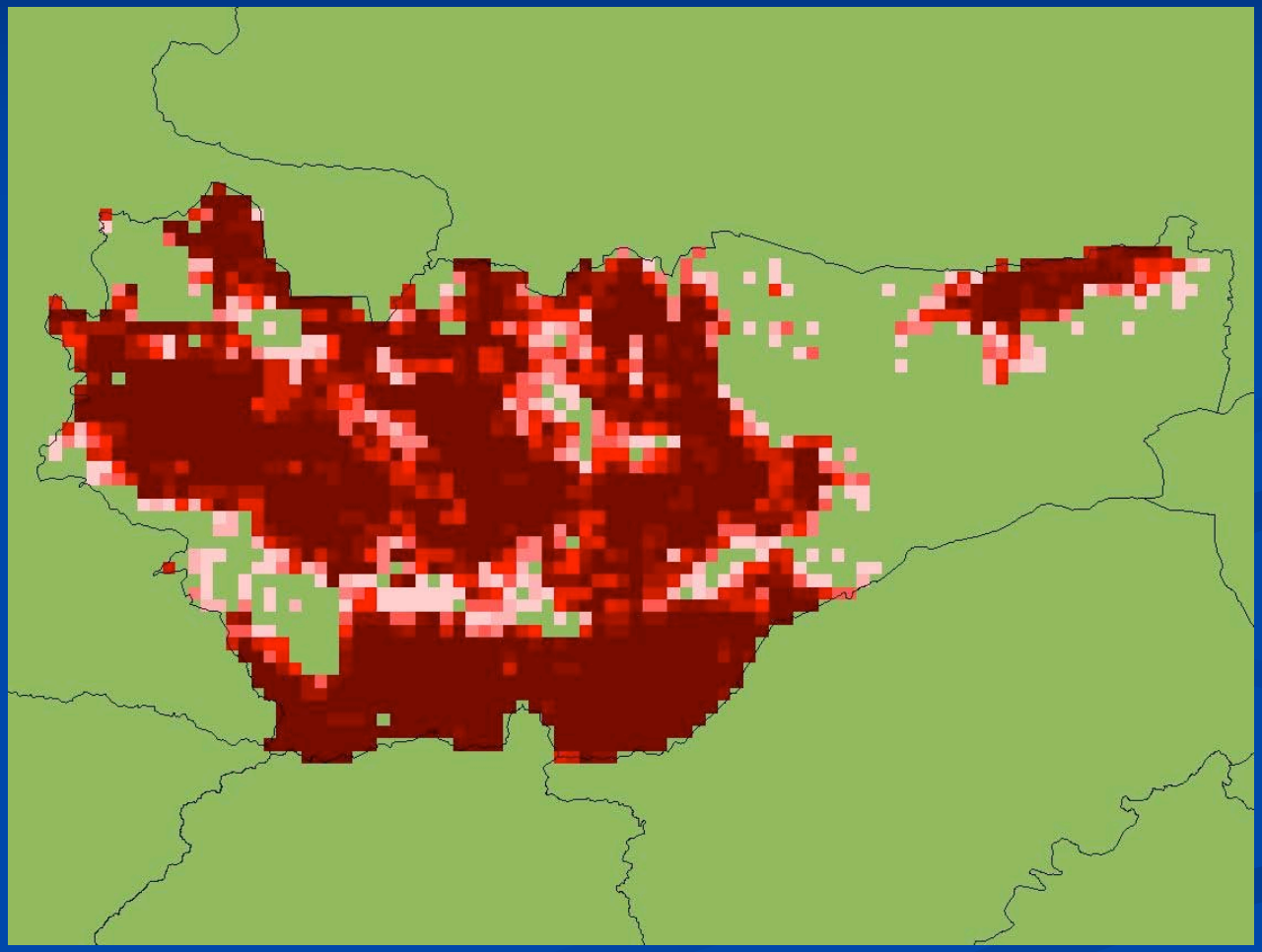
Model from Original Region



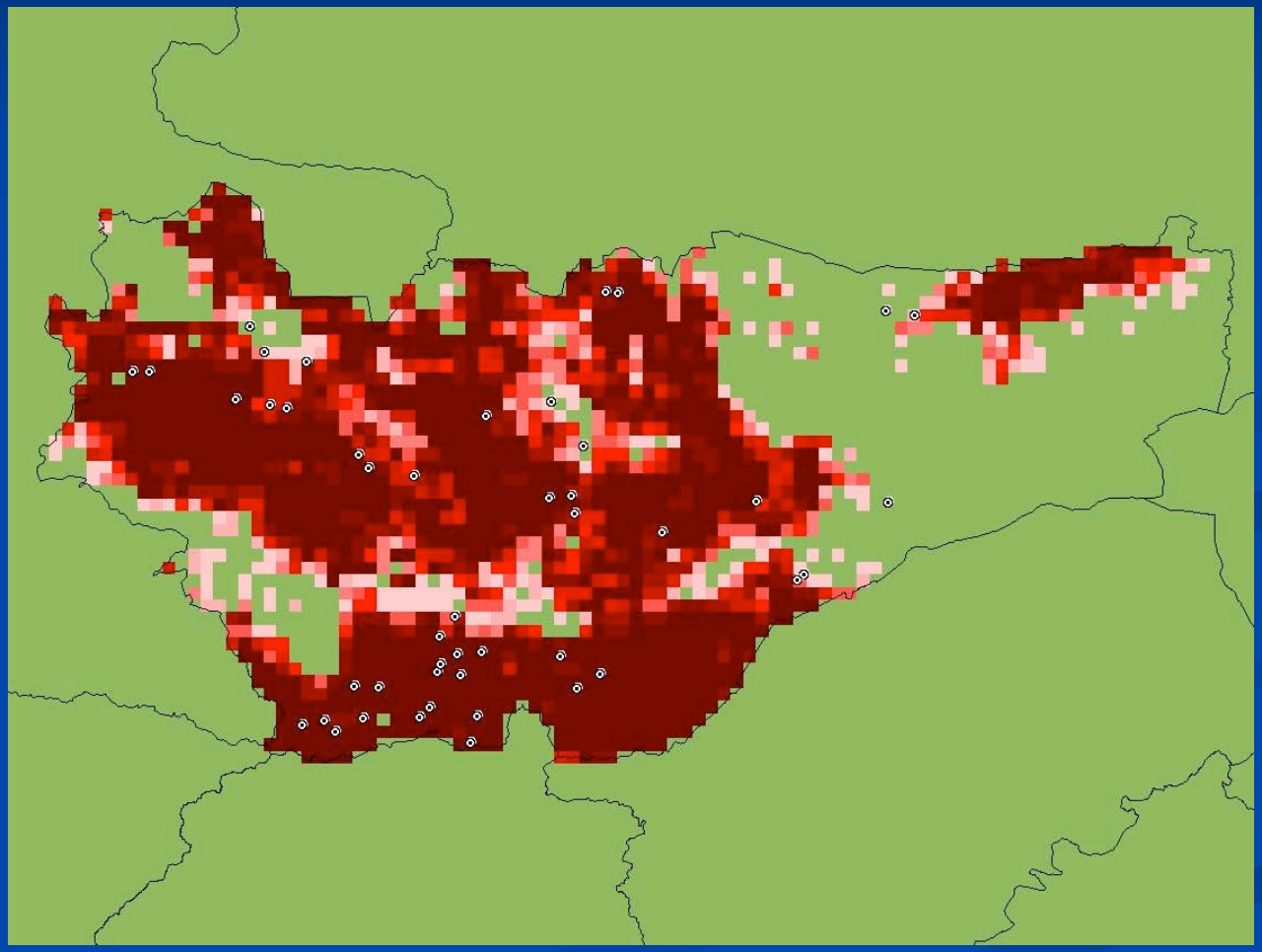
Project to Baja Verapaz



Baja Verapaz "Closeup"



Overlay of Baja Verapaz Occurrences




Aedes albopictus
invading worldwide
Image © 2005 MDA EarthSat
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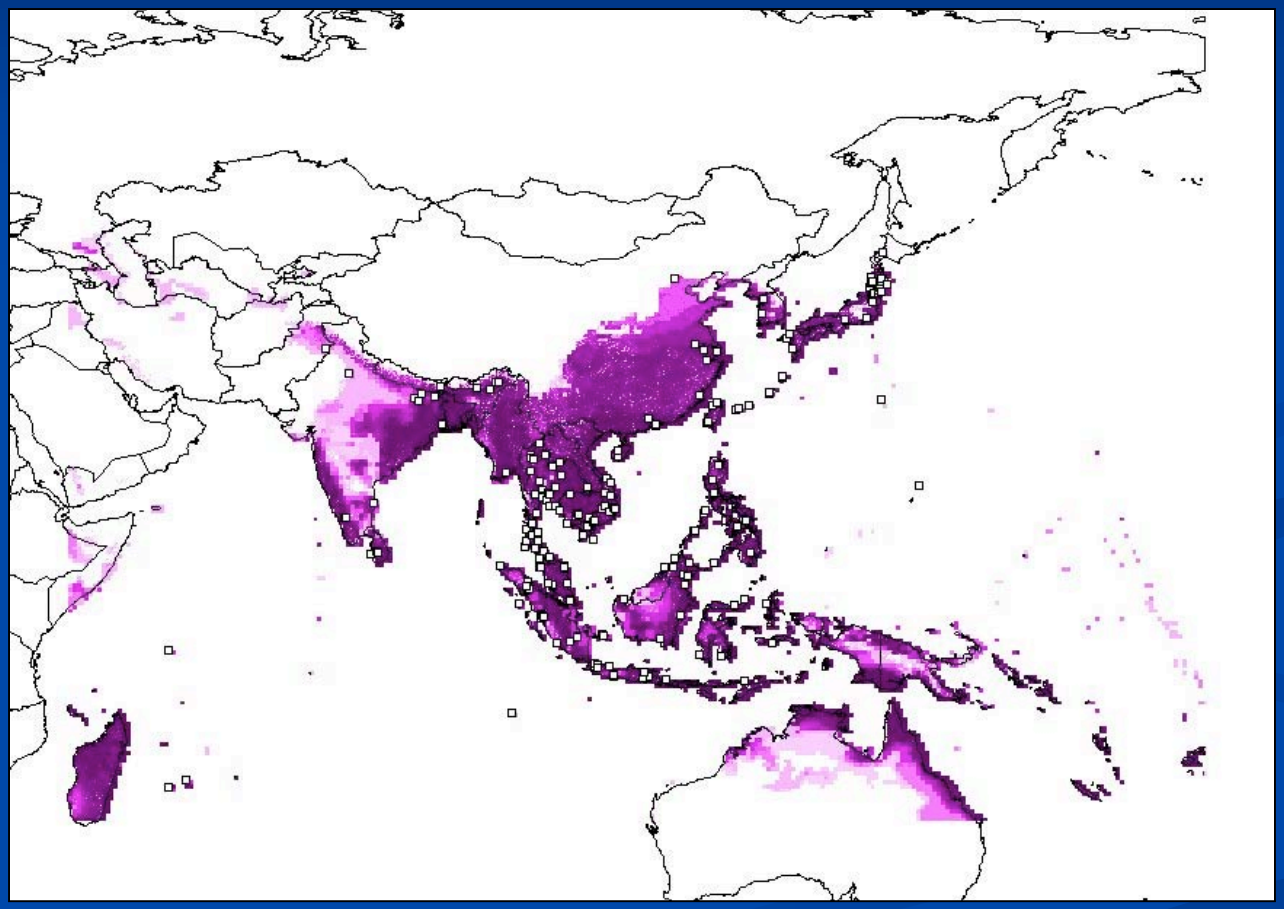
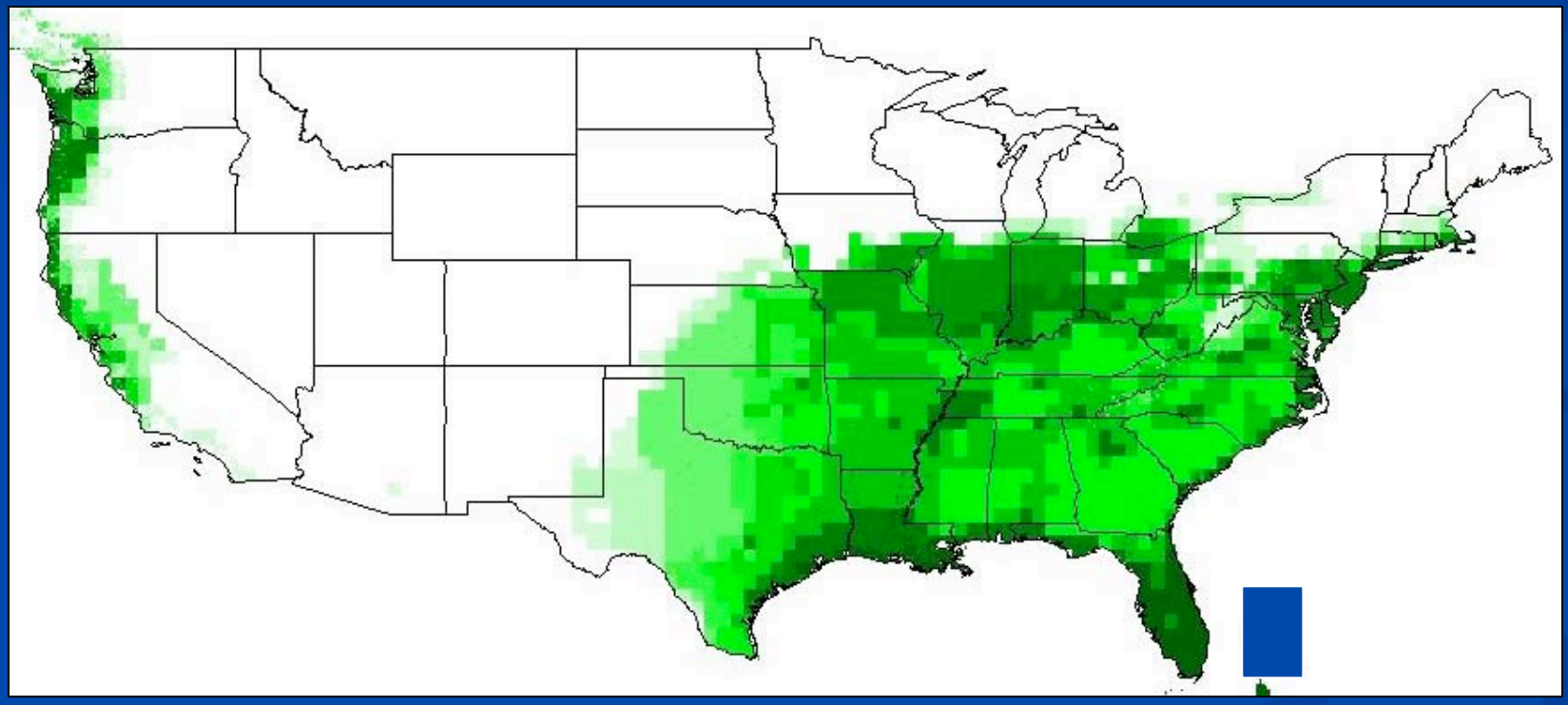
Aedes albopictus



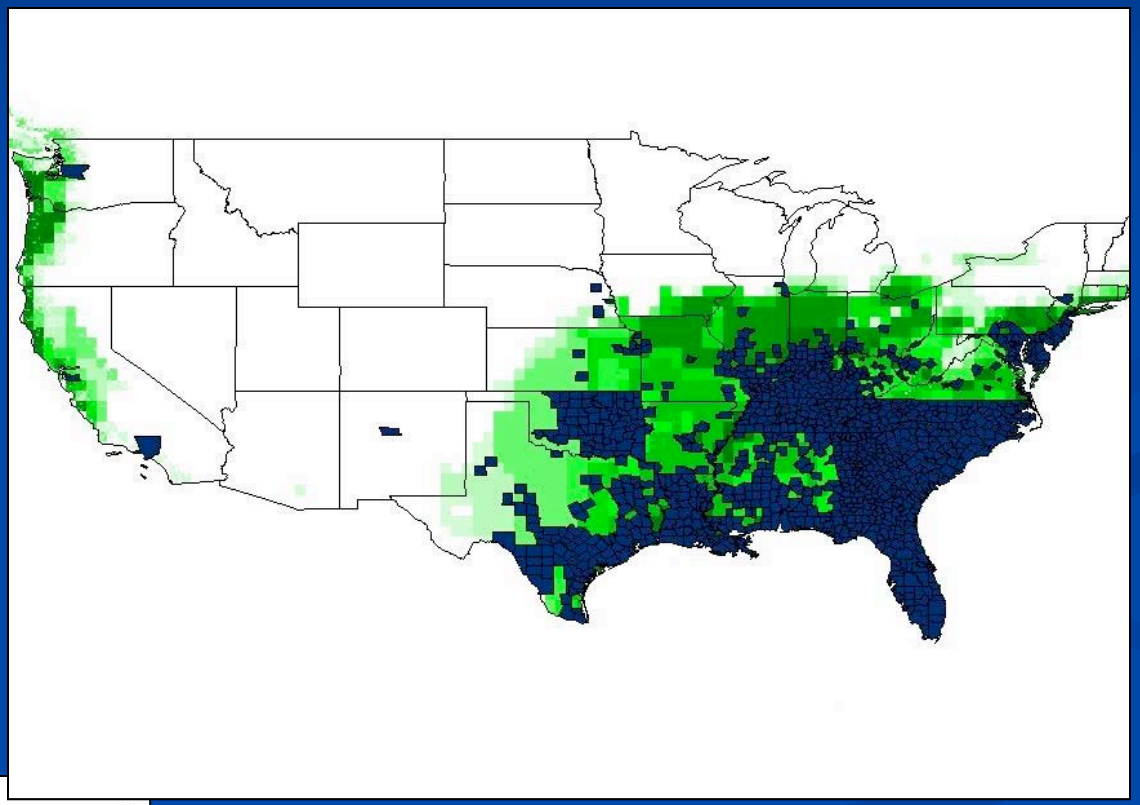
Present predicted distribution, native range in Asia

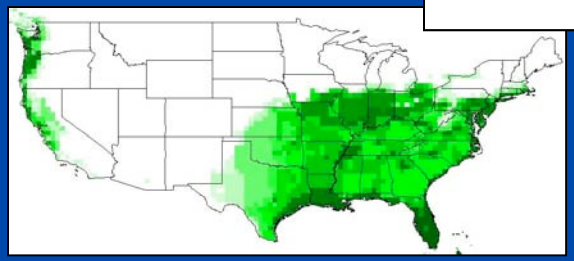
Aedes albopictus: USA invasion



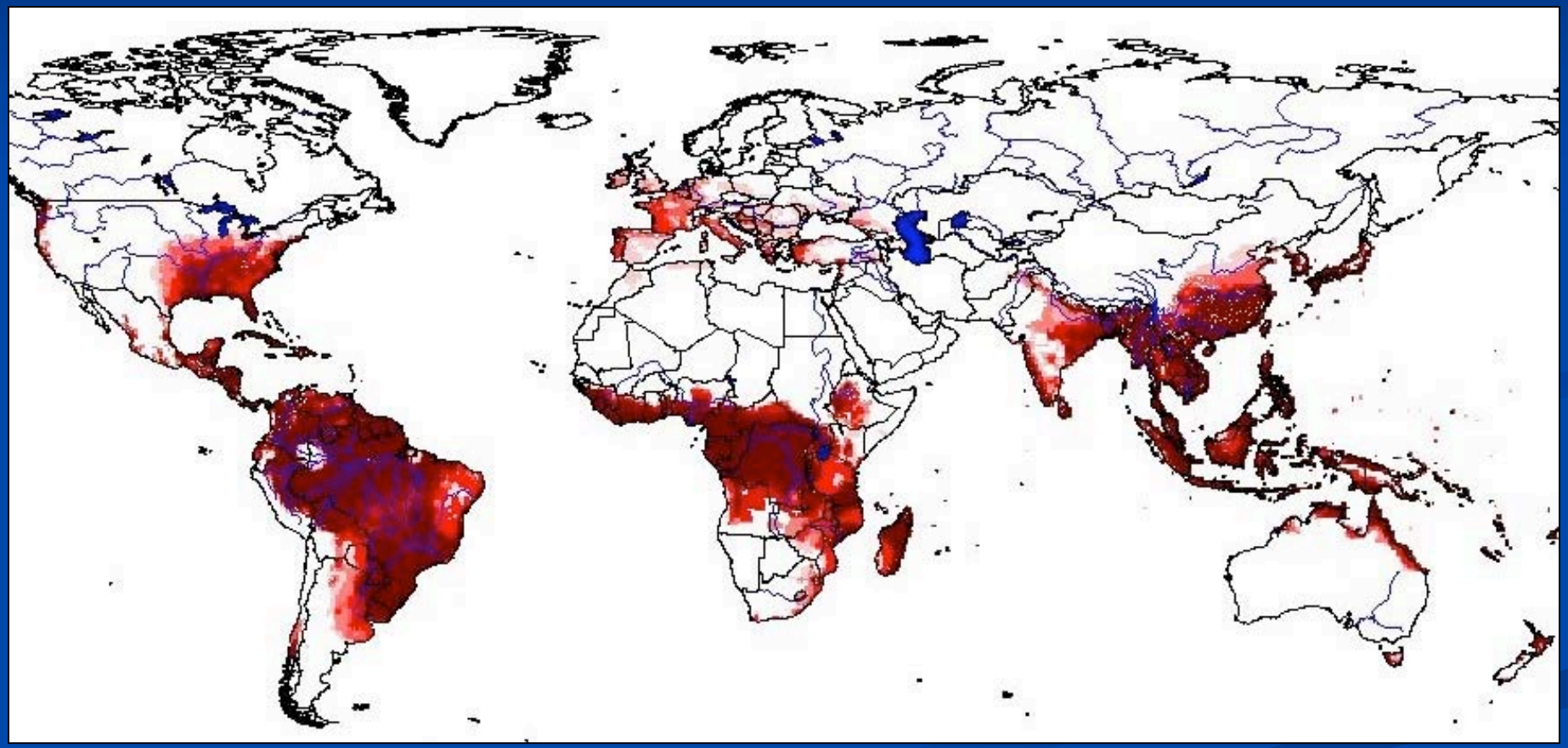
Projected Asian niche into USA present to create invasion risk-map. How well did GARP perform...

Aedes albopictus: USA invasion



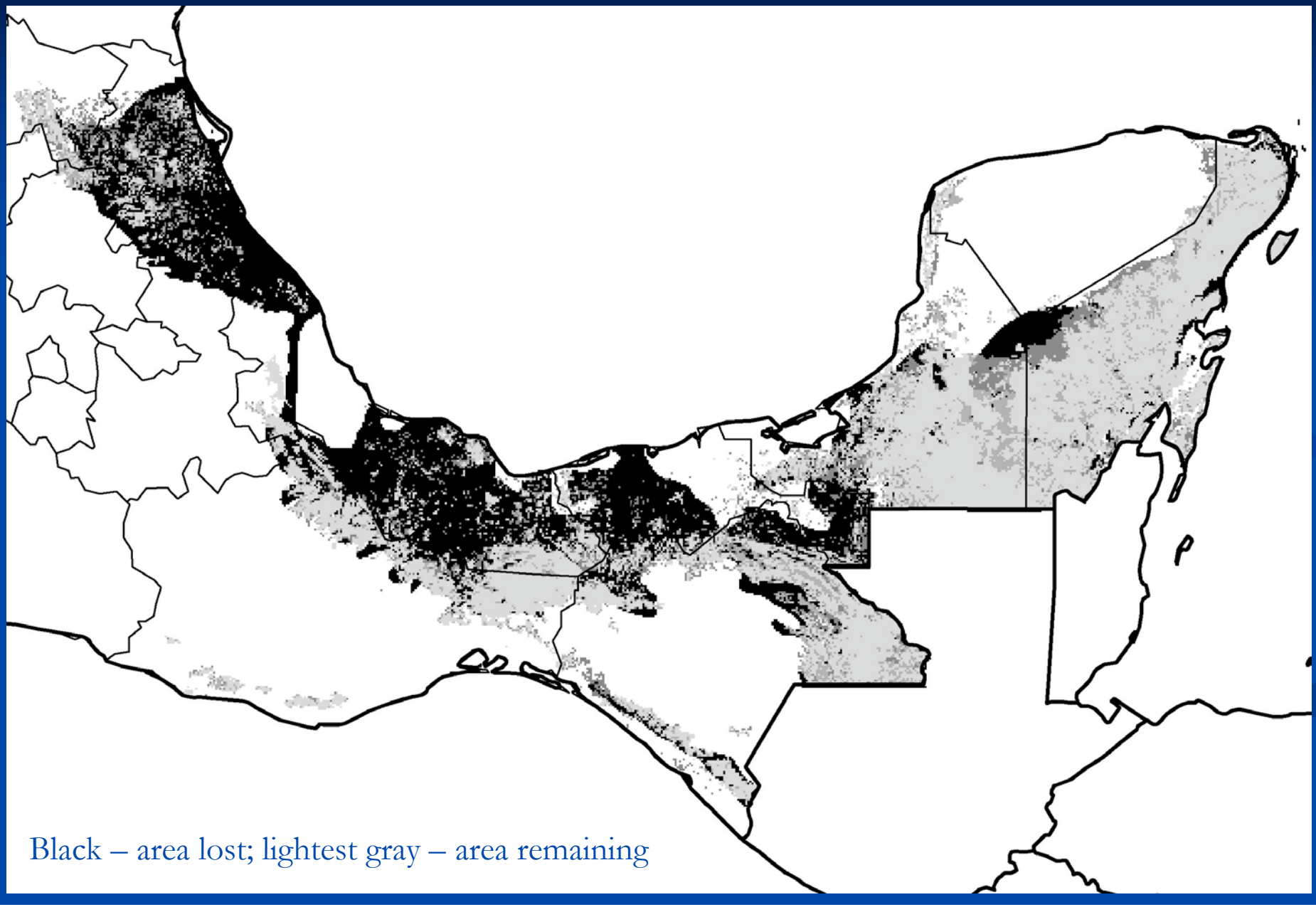


Aedes albopictus: world risk-map



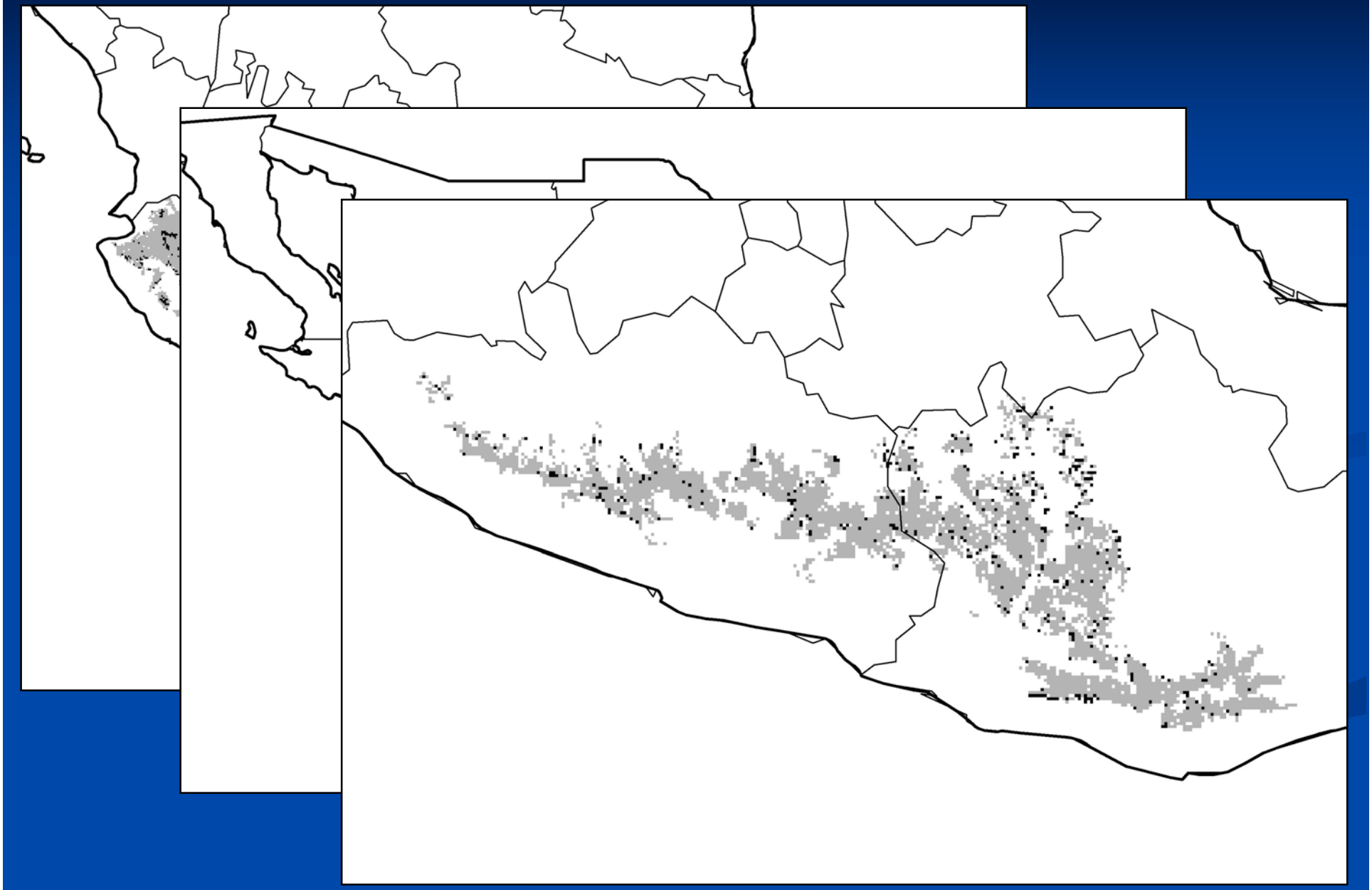
Biodiversity Loss in Mexico

Loss of Evergreen Tropical Forest

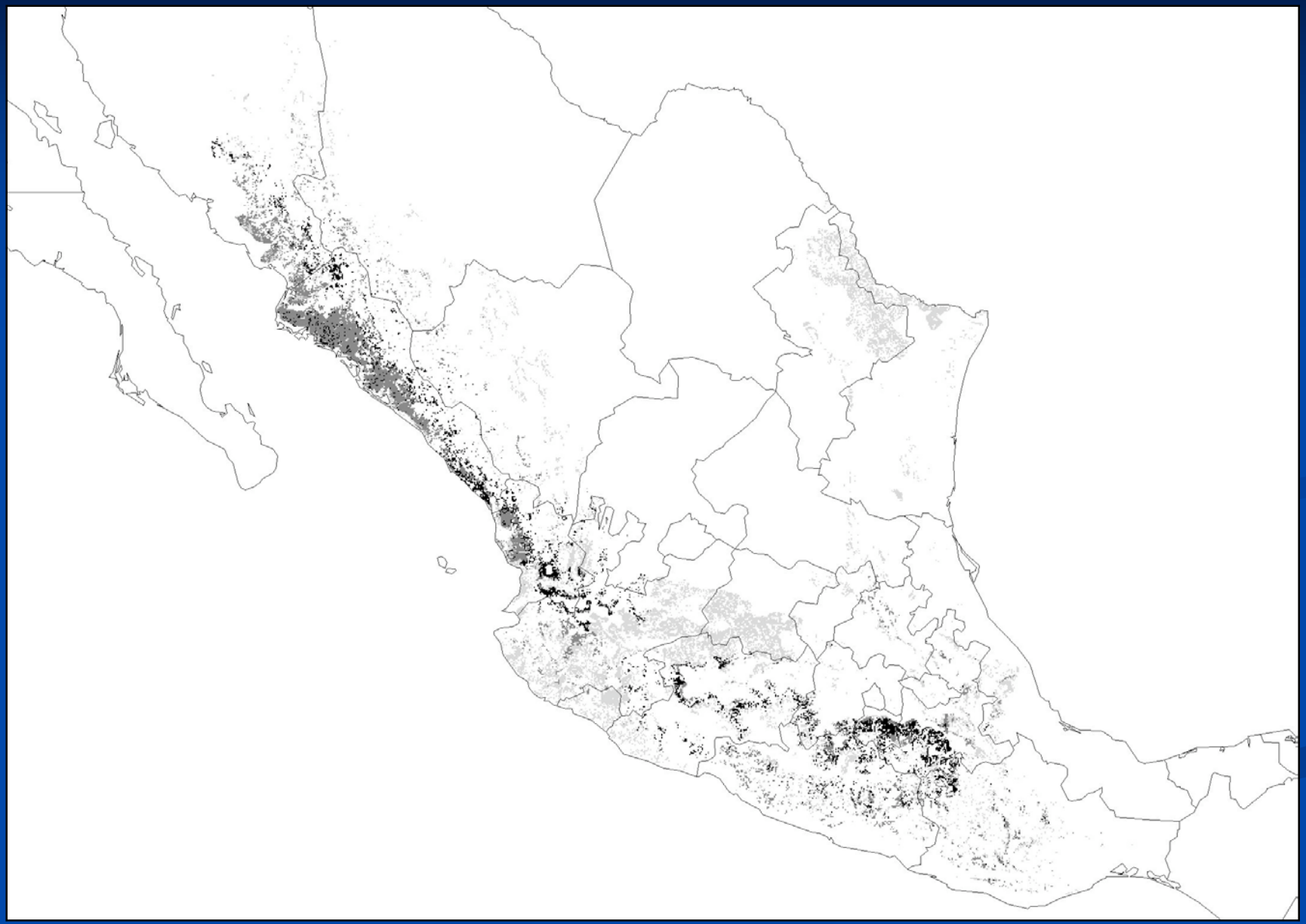


Black – area lost; lightest gray – area remaining

Jay Species – Distributional Loss



Map of Distributional Loss - Corvids



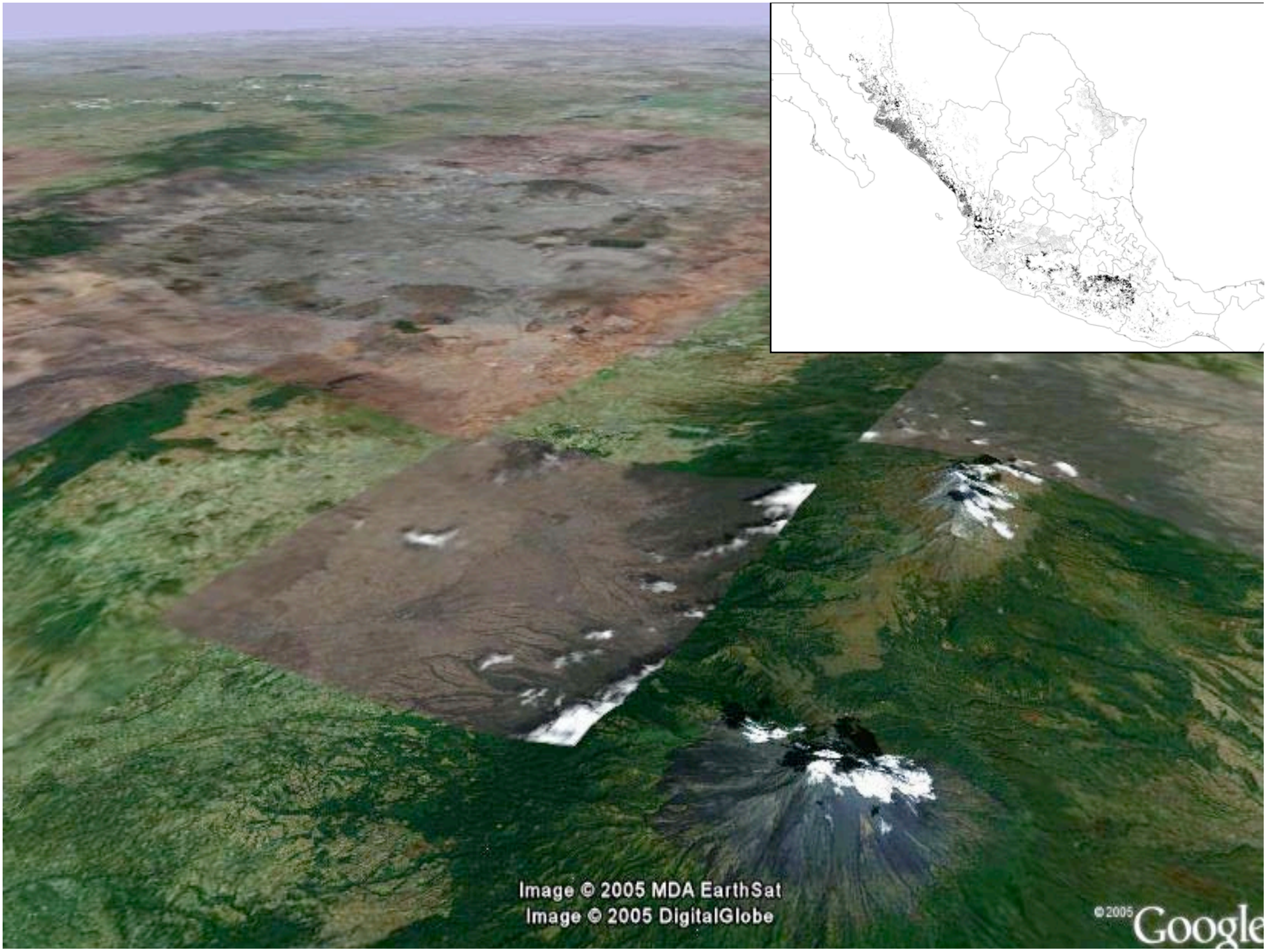


Image © 2005 MDA EarthSat
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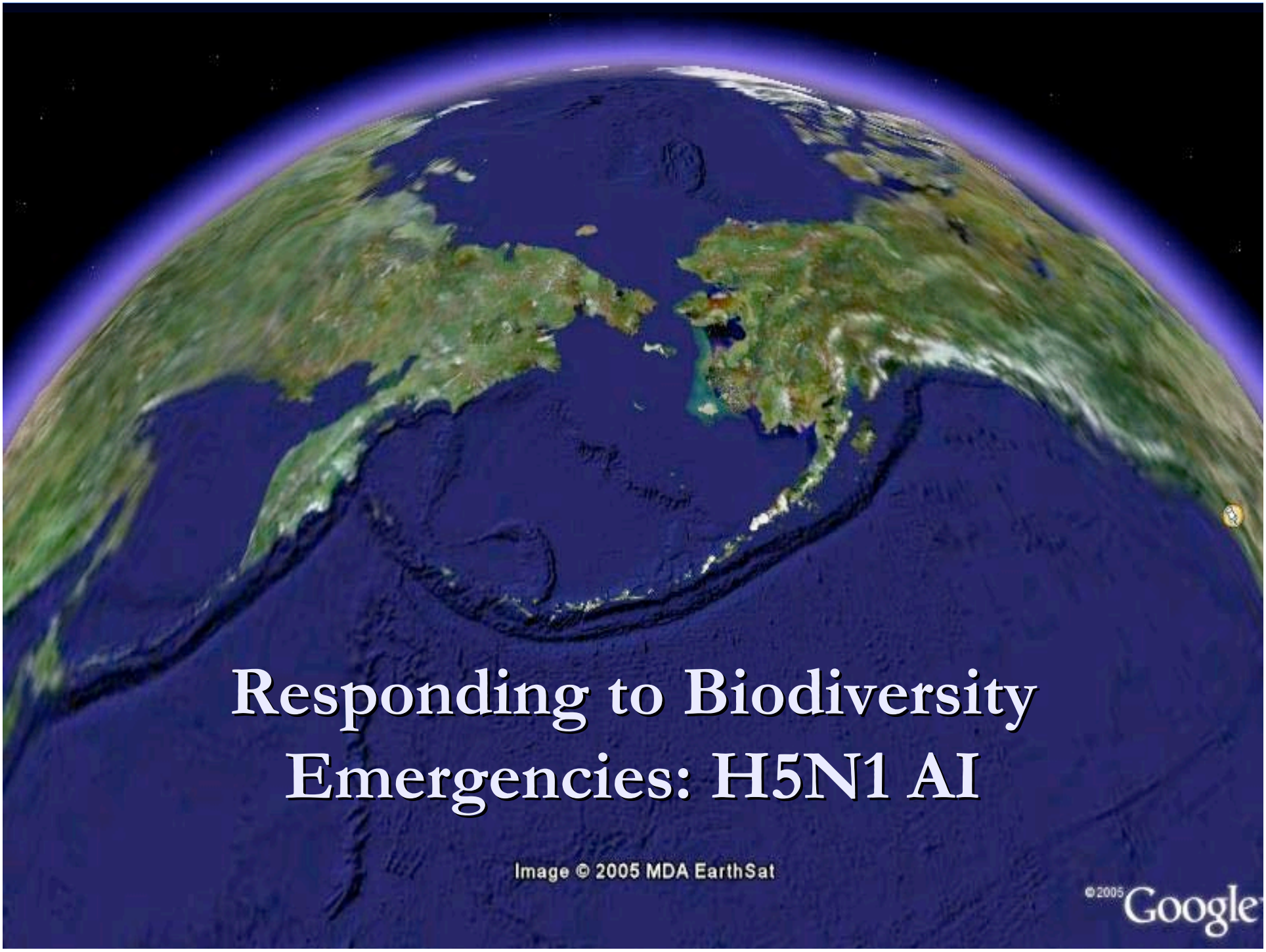
Responding to Biodiversity Emergencies: H5N1 AI
Image © 2005 MDA EarthSat
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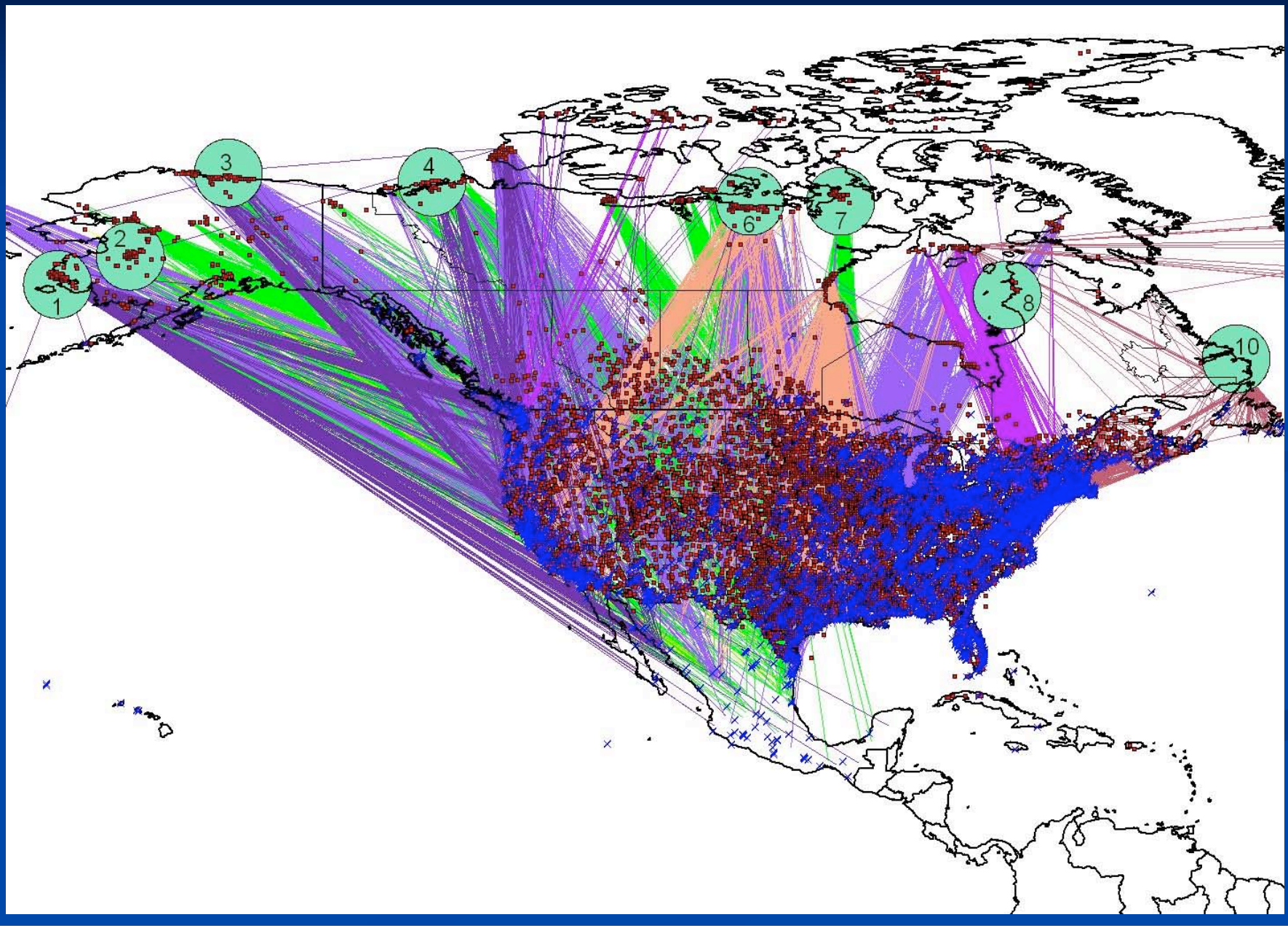
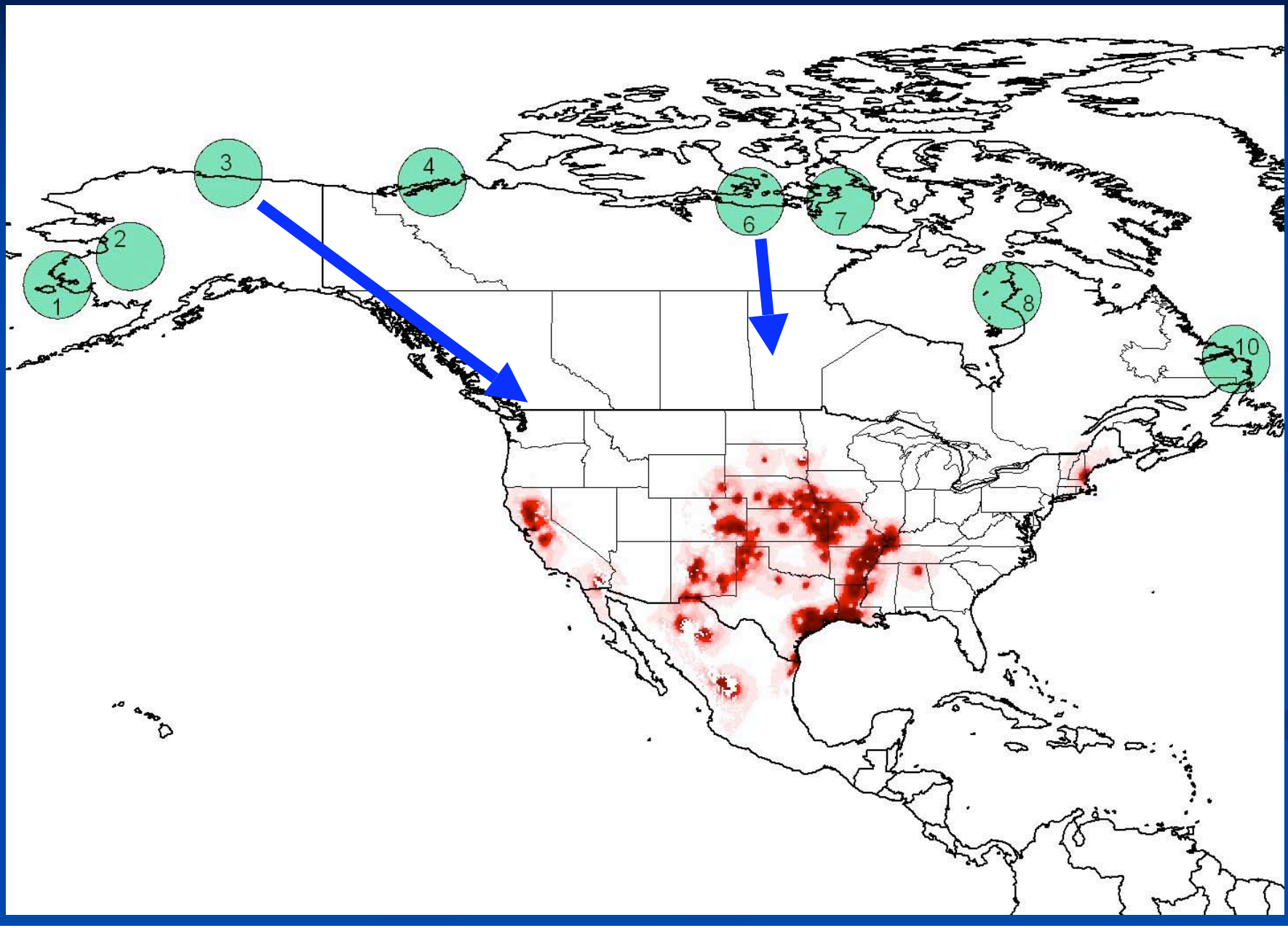
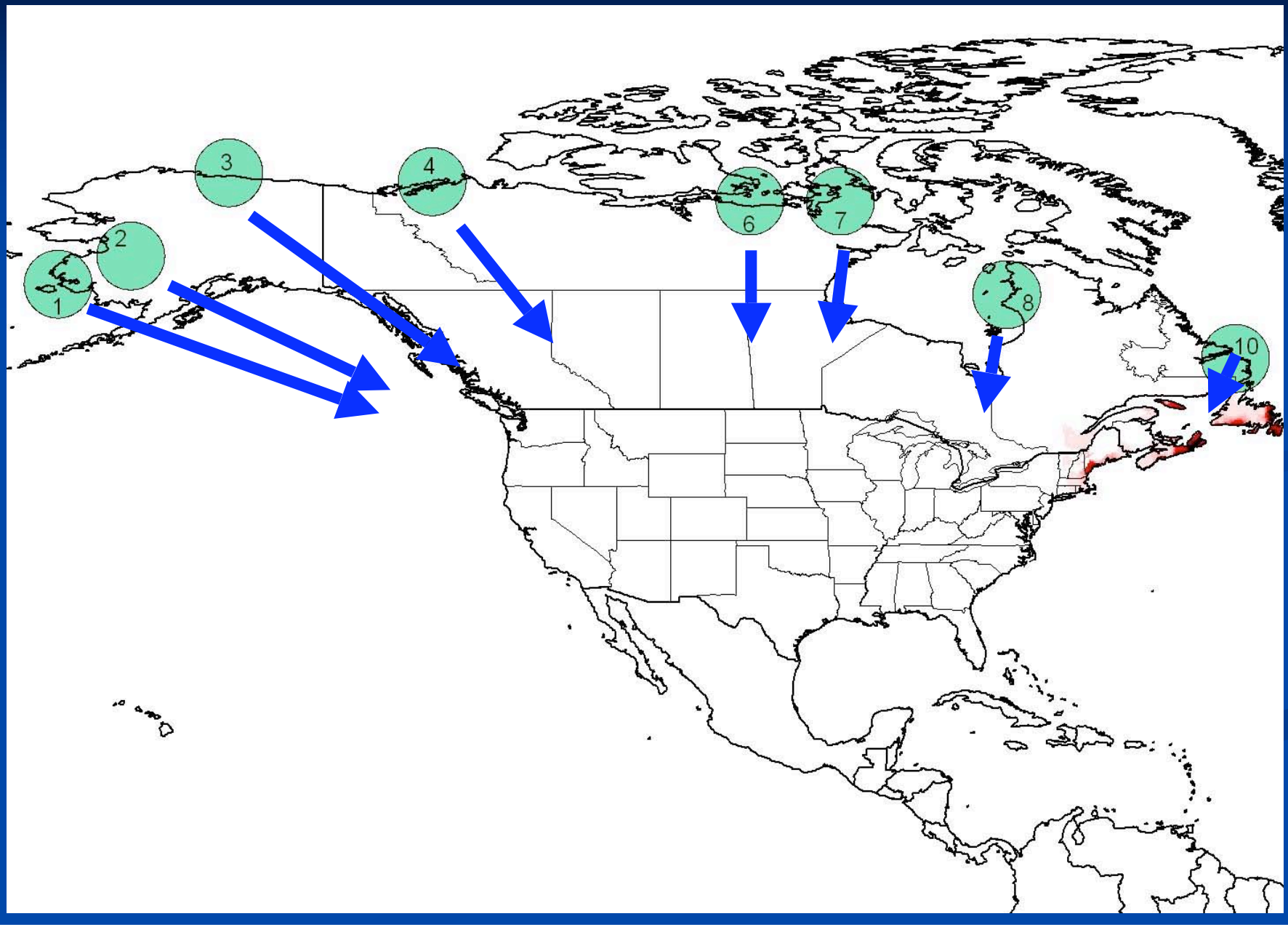
Paths and Windows



Snow Goose Example



Connectivity - 7 Arctic Waterfowl Species



Cyberinfrastructure for the Americas

- Information
  - Break down biodiversity information barriers and biases
  - DiGIR-enabled distributed biodiversity information networks are a first step
- Tools
  - Diverse tools – visualization, ecological niche modeling, statistical analysis, phylogenetic analysis, etc.
  - Open source should be the norm
- Communications media
  - Internet access, etc.
- Training
  - High-level training – doctoral level is key
  - South-south training as well as in North America and Europe


Muchas Gracias …
town@ku.edu