INTEGRATED MONITORING SYSTEMS FOR MANAGING AQUATIC INVASIVE SPECIES IN A CHANGING CLIMATE

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Overview

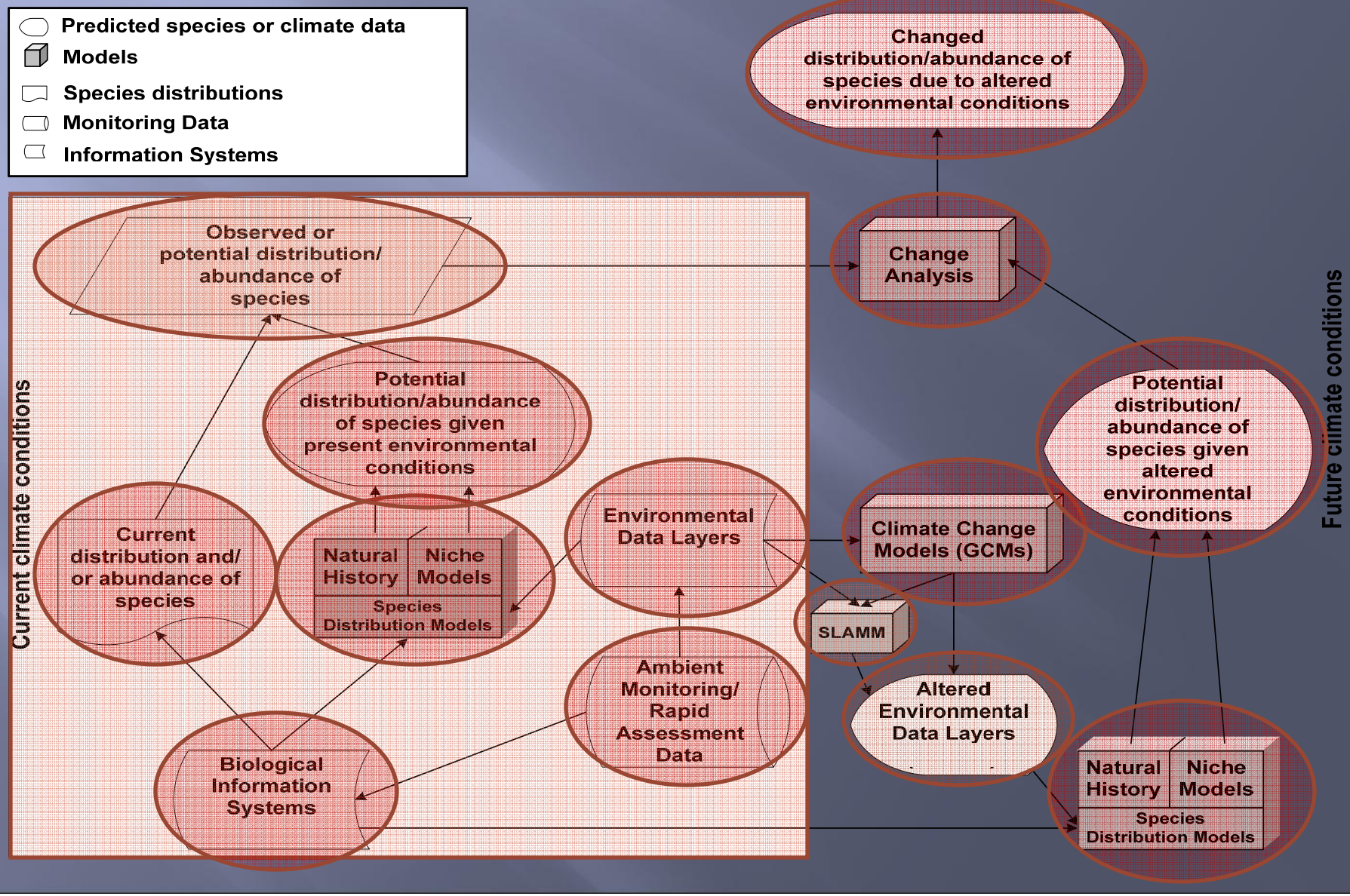
- Introduction
- Walk through a proposed framework for an integrated model prediction system for aquatic species
- Highlight key modules
- Present some known challenges
- Offer some conclusions
- Questions

Impacts of Climate Change on Native and Non-Native Aquatic Species

- Direct effects from environmental changes
  - temperature, salinity, sea level rise, acidification
- Indirect effects include
  - range expansions of existing invaders
  - new invaders

Predicting these combined effects requires the integration of biological and environmental data and models across individual systems at multiple scales

Framework for a Climate Induced Alternative Futures Species Distribution Prediction System



Monitoring Data

- Baseline biotic and habitat data
- Foundation for assessment
- Sampling design →→ Questions addressed
  - Geographic scope
  - Random versus fixed or nonrandom samples
  - Sample density / re-sampled over time
  - Target species and/or habitats

Regional and National monitoring data are sparse

Biological Information Systems

- Synthesizes biotic distributions at regional to international scales

- Extensive data exists for common species but in disparate sources that require time to gather for analysis

Automated integration of species' information across data sources is needed

Environmental Data Layers

- Oceanographic data (SST)
- Climatic data (PRISM)
- Habitat (National Wetlands Inventory)
- Current and historical hydrologic data
- Current and historical land use (NLCD)

Integration of these environmental data requires specialized expertise

Natural History Data

- Provides species tolerances to environmental condition and species interactions
- Provides data to identify a species potential distribution in areas no records exist
- Information is difficult to extract because most natural history data are text based and can not be queried for multiple species

A hierarchical data storage and retrieval system is needed for natural history data

Niche Models

- Presence only (e.g. museum records)
  - Genetic Algorithms for Ruleset Production (GARP)
- Abundance and Presence/Absence (e.g. NAWQA and EMAP)
  - Non-Parametric Multiplicative Regression (NPMR)

These modeling tools need more development and validation for aquatic systems

Climate Change Models

- Complex and rapidly evolving research area
- IPCC (2007) used more than 20 general circulation models
- Current models converge well reproducing temperature
- Not consistent for future precipitation or sea level rise

Down scaling from regional to an ecological scale appropriate for predicting biotic distributions is needed

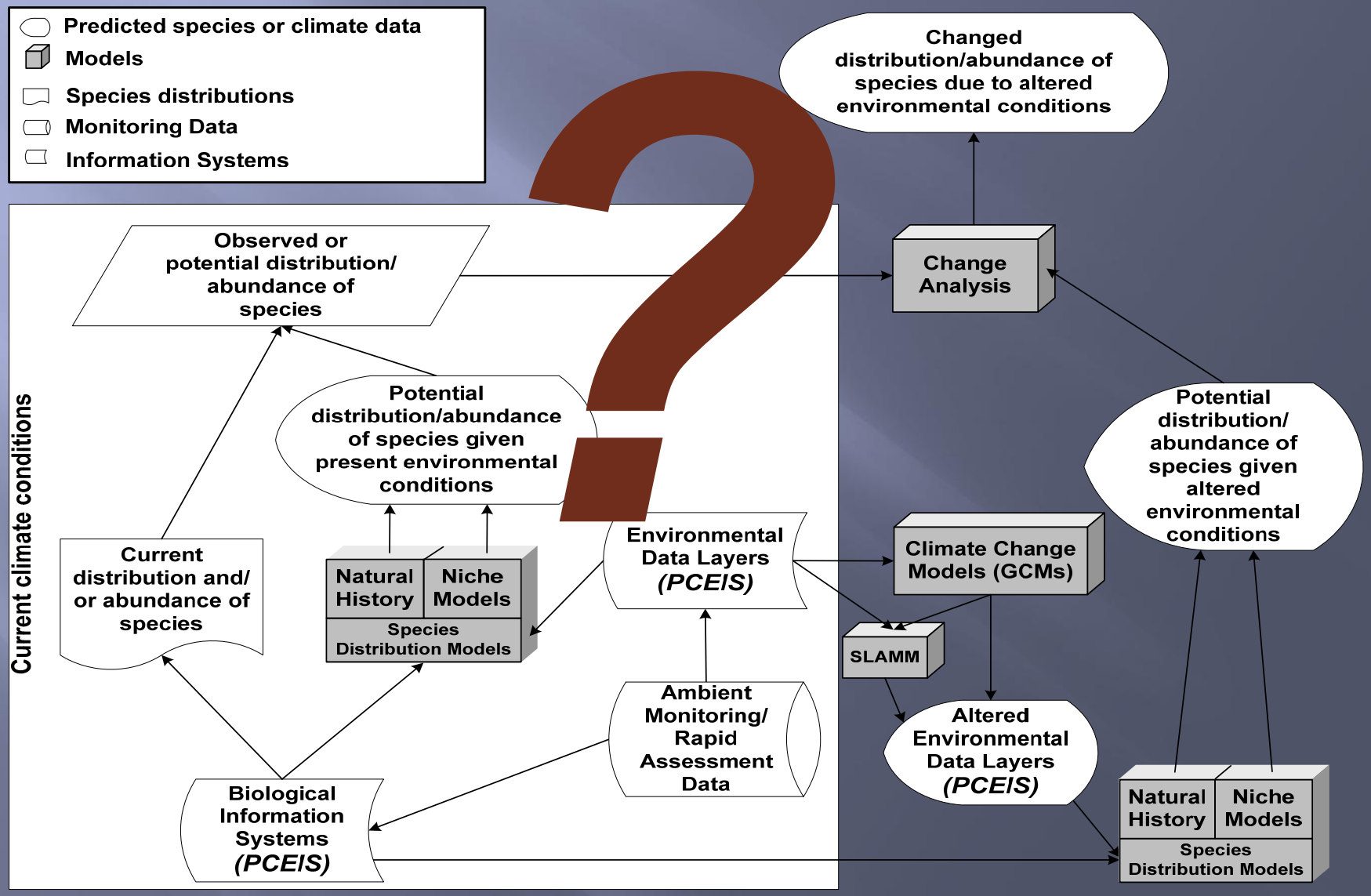
Challenges

- We need more consistent monitoring data at regional and national scales
- Spatial resolution between biotic data and climate model outputs is some times different by orders of magnitude
- Integration of the components is complex and costly

Connectivity between components requires a consortium of knowledge and skills across multiple agencies and institutions

Conclusions

- In an ideal world one system with all the components would exist
- Reality dictates the modules will be distributed across disciplines, programs, and agencies

Integrating modules may prove as challenging as building the modules themselves.

The Goal: Develop a Framework where Predictions Outweigh Uncertainties