Amphibian Research and Monitoring Initiative (ARMI)

http://armi.usgs.gov

OBJECTIVES

1. Estimate the status and distribution of amphibians on public lands across the country

2. Determine the causes of their decline and provide data to managers for their conservation

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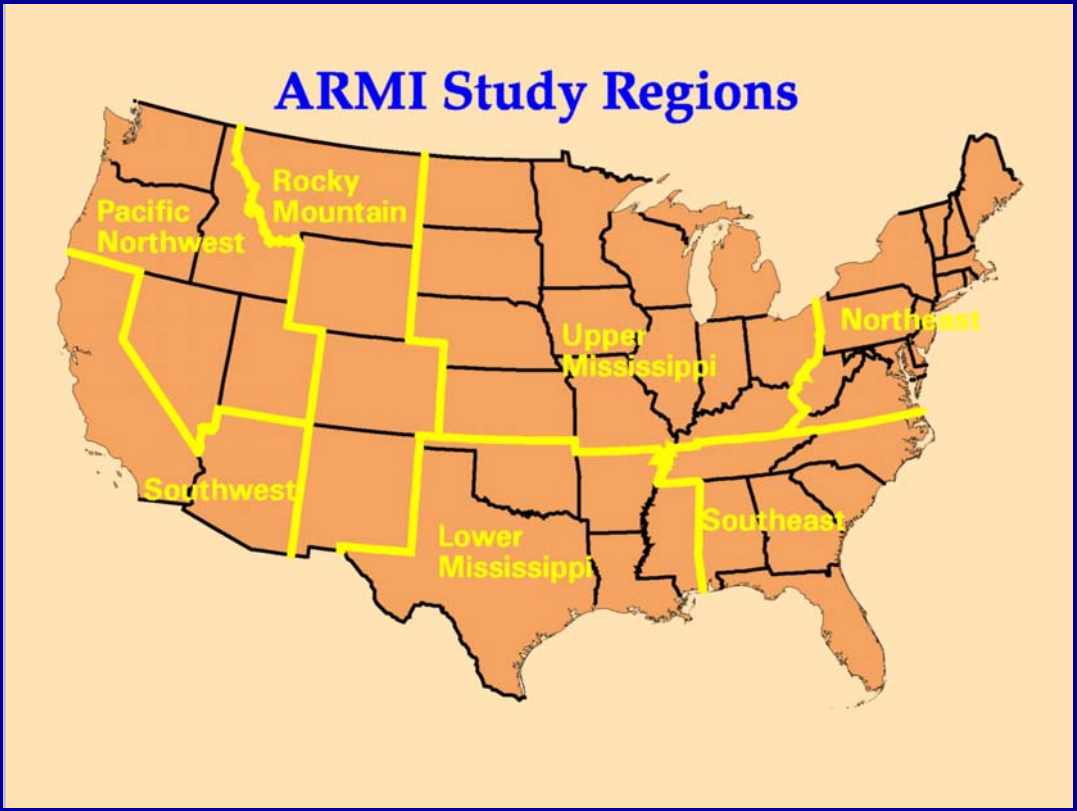
The structure of ARMI?

We have an ecologist and water scientist working together in every region



National Program
- 2 Objectives
- Priorities
- Standards for monitoring design

Regional Scientists
- Ask regional questions

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Reasons for Declines Poorly Understood

- Potential Factors:
  - Habitat Loss
  - Disease
  - Pesticides
  - Climate Change
  - Invasive Species
  - Domestic and International Trade

How can we speed up our learning?

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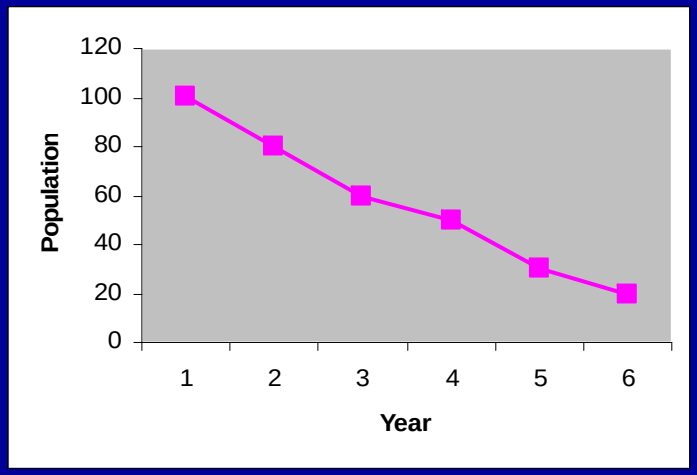
Traditional Monitoring Programs Track Trends in the Population

Data are collected on many variables
- rain
- vegetation
- distance to roads

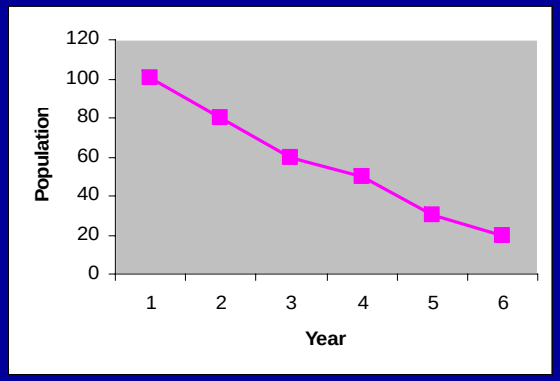
When the population reaches a level, managers respond with action

Trend Data



The population declined…… What do you do?

Trend Data



Conduct research to determine why a species is decreasing

Problems

You have to spend time learning as the species keeps decreasing
Conservation usually become more expensive with time

Could you have collected data on status and learned about the species at the same time?

Model-based monitoring

How does it work?

Ask *a priori* questions or make predictions about the species' response to the environment or a management action

Potential Factors for loss:

- Habitat Loss
- Disease
- Pesticides
- Climate Change
- Invasive Species

Put factors into *a priori* models

(Nichols and Williams. 2006. Monitoring for conservation. TREE 21:668-673)

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Model-Based Monitoring: integrated into conservation practice. Design and implementation based on *a priori* models

Metric used in each ARMI Region to describe status: Occupancy

MacKenzie et al. 2002. Ecology 83:2248-2255
Schmidt and Pellet. 2005. Journal of Wildlife Management 69:884-893

Extension of presence/absence (+/0), but with estimates of detection probability

Akaike's Information Criterion (AIC) for model comparison

Burnham and Anderson. 2002. Model selection and multimodel inference: a practical information-theoretic approach. Springer

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Strength of Inference

Retrospective Analysis of Trend Data

(Spurious correlations possible)

Observational Study (Model-based monitoring)

(Mechanisms uncertain)

Experiment

Uses for Model-based Monitoring (e.g. Occupancy)

1. Learn about or predict species occurrence (e.g. habitat variables)
2. Learn about factors affecting species co-occurrence
3. Learn about factors influencing population trends (estimated as colonization and local extinction)
4. Ask questions about disease spread and influential covariates
5. Inform management decisions

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How do you change from trend monitoring to model-based monitoring?

Trend monitoring: estimate density over time
Model-based monitoring: Asking questions before you monitor

Ask questions before you survey: turn these questions into models

Example: You want to understand the distribution of a frog

Predict: frog is more often in large ponds than small ponds

Predict: frog does not occur when species B is also in pond (multiple species)

Predict: frog more likely to occur as distance to roads increases (continuous variable)

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How do you change from trend monitoring to model-based monitoring?

Adjust where you sample

Example: What lands do you conserve?

Predict: frog is more often in habitat A than habitat B
Predict: frog occurs at low elevation more often than high elevation

Survey (e.g., stratify) in the land types that contain variables in those models and compare occupancy rates

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Long-term monitoring by ARMI

- When we monitor, we develop *a priori* models, but we do not use the same set of models everywhere because the same models are not important everywhere. We can change the models.
- We can not survey every species, so decisions about which species to survey are made regionally.
- The species surveyed are not chosen because they are indicators of other species. However other species may be influenced by similar factors and this is useful for managers.
- We use robust estimators (estimate detection) and are confident in our inference (probability-based sampling).

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