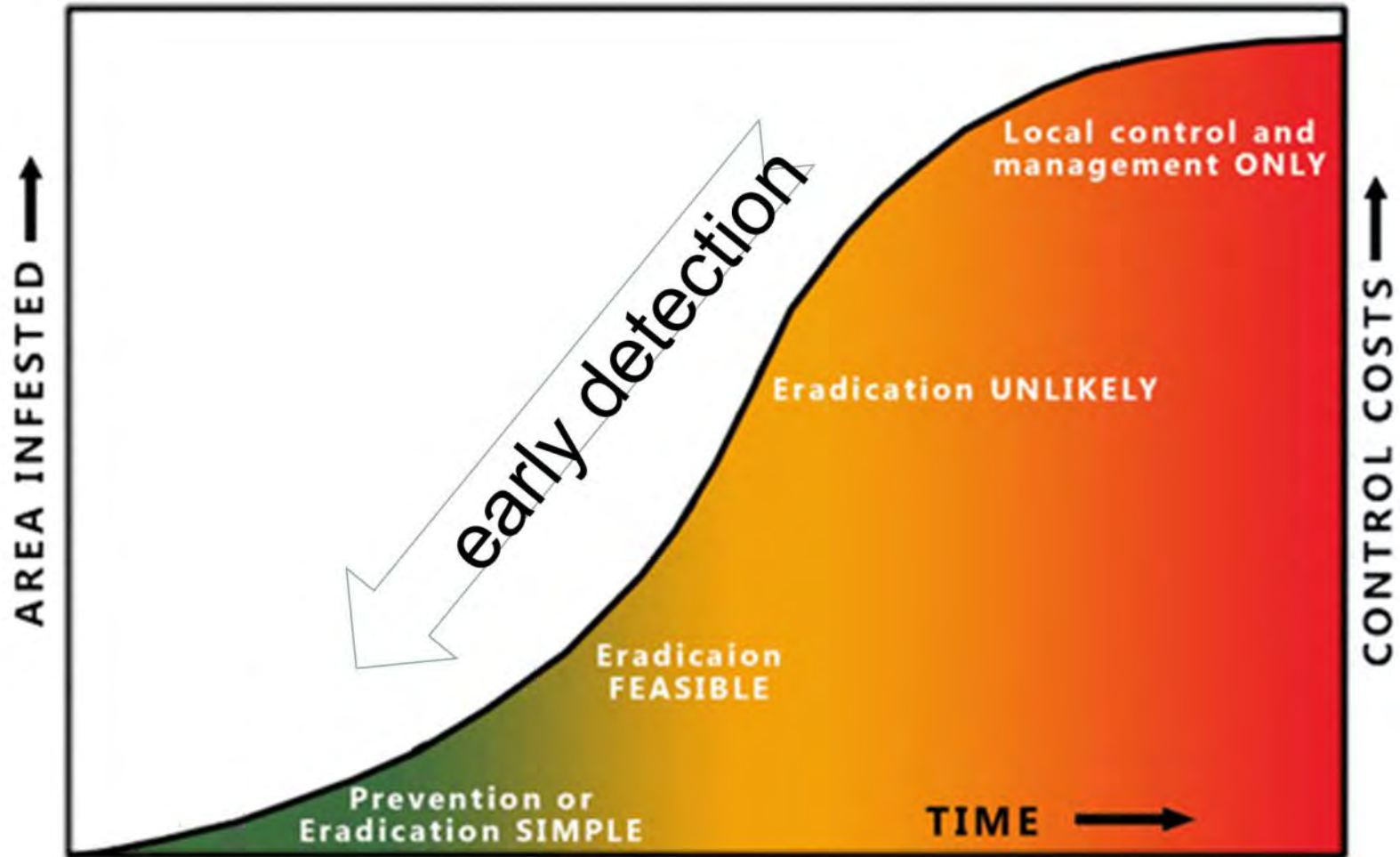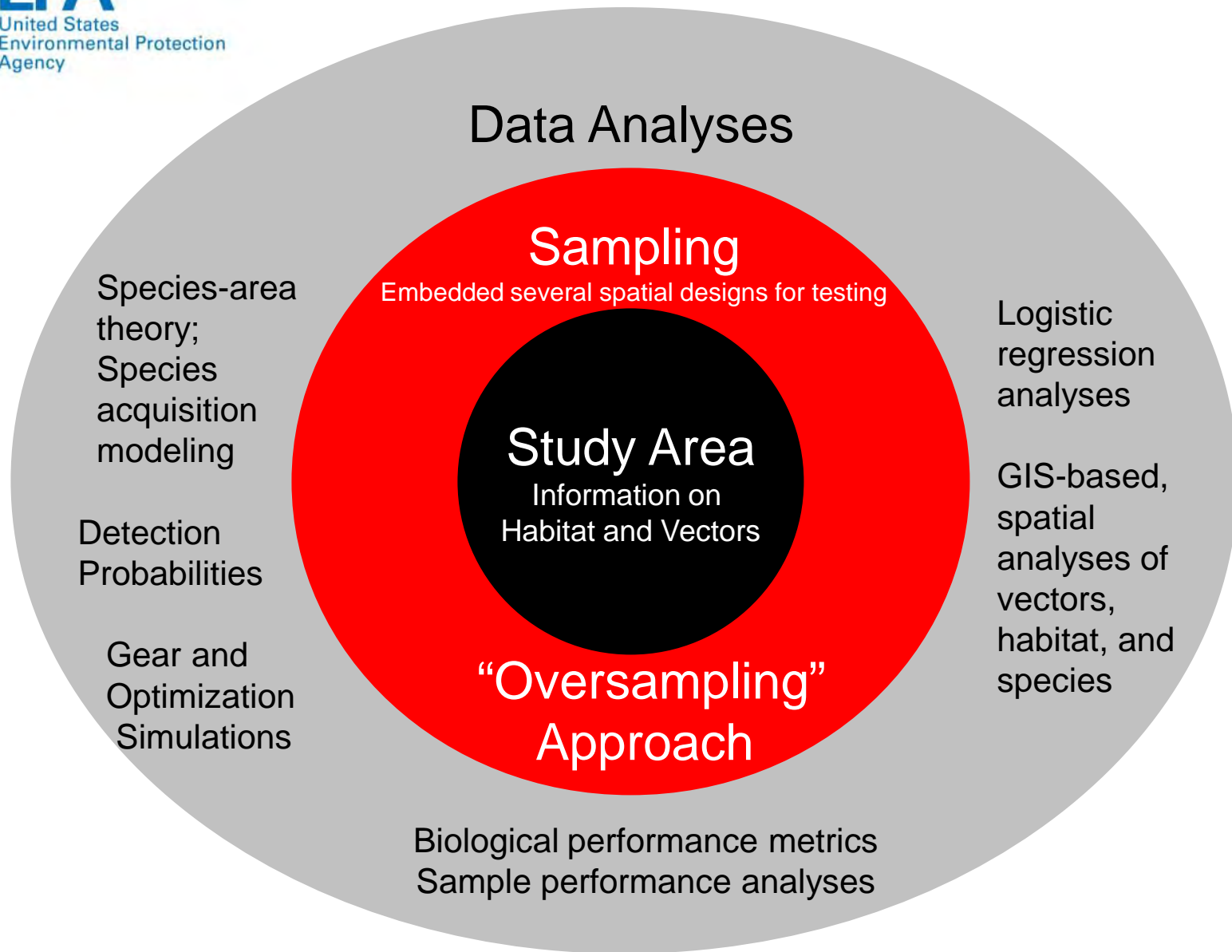# 'Team Effort'

- **Mid-Continent Ecology Division (Duluth)**
  - Jack Kelly
  - Joel Hoffman
  - Anett Trebitz
  - Greg Peterson
  - Julie Barker
  - Chelsea Hatzenbuhler

- **Ecological Exposure Research Division (Cincinnati)**
  - Erik Pilgrim
  - John Darling (RTP)
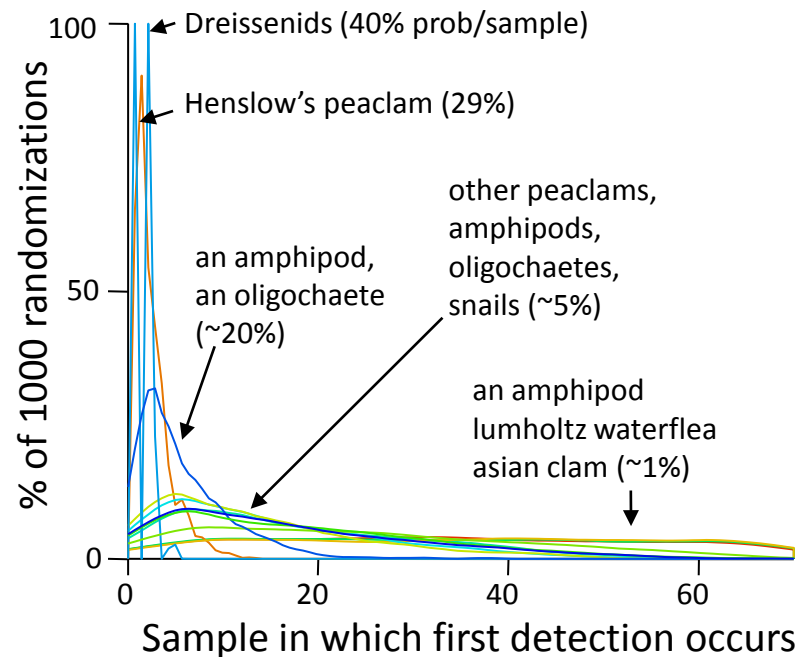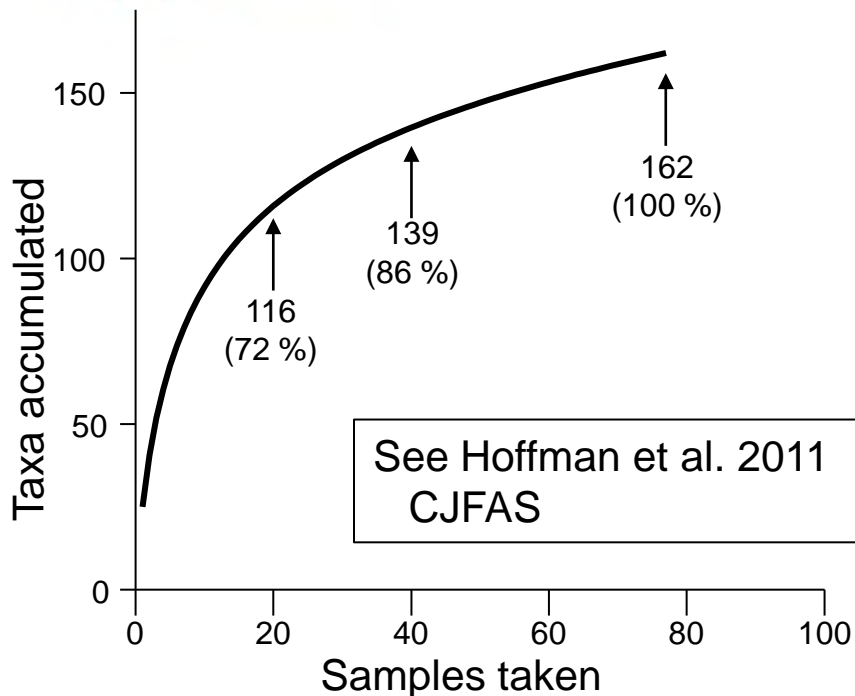 - John Martinson
  - Sara Matthews

Why early detection?

Case Study Approach

Look hard. It takes increasing effort to find the next species.

Taxa accumulated vs. Samples taken:
- 116 (72 %)
- 139 (86 %)
- 162 (100 %)

See Hoffman et al. 2011 CJFAS

% of 1000 randomizations vs. Sample in which first detection occurs:
- Dreissenids (40% prob/sample)
- Henslow's peaclam (29%)
- an amphipod, an oligochaete (~20%)
- other peaclams, amphipods, oligochaetes, snails (~5%)
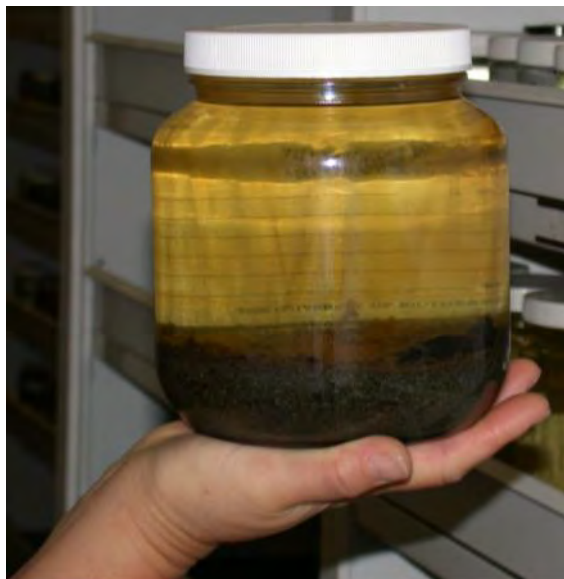- an amphipod lumholtz waterflea asian clam (~1%)

Taxa curve still rising, probably have not approached asymptote, where rare species will be.

You get lucky sometimes, but effort helps ensure higher probability of detection.

Detection probability should be an required design element.

Can DNA methods detect rare species?

Genetic Monitoring for Invasives

- Two main investigative pathways:
  - 1) Targeting particular invaders with developed biomarkers (eDNA)
    - Advantage: sensitivity
    - Disadvantage: works only for targeted species
  - 2) Community profiles based on genetic data
    - Advantage: ability to detect 'foreign' DNA
    - Disadvantage: not as sensitive as targeted

Next-Generation Sequencing

- **Ability to handle bulk/batch samples**
  - **Bulk extraction (water, sediment, benthos)**
  - **Bulk PCR**
  - **Bulk sequencing**
- **Ability to run multiple samples in a single sequencing run (multiplexing)**
 - **Molecular ID tags—flagging different samples**

Work in Support of GLNPO/GLRI

- **Benthos sampling for detecting and monitoring invasives**
  - **Lake Superior (Isle Royale)**
  - **Lake Huron (National Coastal Condition Assessment)**
    - **Sampled subset of NCCA sites**
      - **Paired ponar grabs**
    - **Compare genetic results to standard NCCA data analysis**

Work in Support of GLNPO/GLRI

- **Sensitivity Testing: Constructed Samples**
  - **Samples prepared to test sensitivity of target detection**
    - **Samples contain target and non-target fish tissue**
    - **Created with adult fillets to mimic biomass conditions**
    - **Testing ability to find one target in a mass of non-target**
      - **At what point to we lose the ability to detect target species? 1 in 100? 1 in 1000? 1 in 10,000?**

Rainbow Smelt- *Osmerus mordax* averages 7-8 inches

Work in Support of GLNPO/GLRI
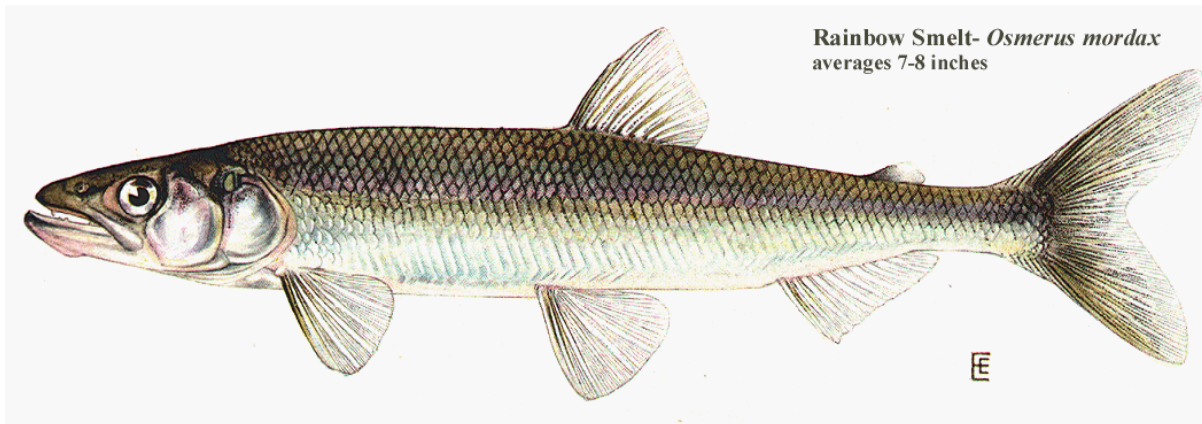
- **Larval Fish Sampling**
  - **Rationale**
    - **Fish eggs, larvae can serve as propagules**
    - **Generally, more abundant than adults**
  - **Goals (Pilot)**
    - **Estimate detection probabilities**
    - **Determine efficiency of sampling**
    - **Compare efficiency of sampling compared to juvenile and adult fishes**
    - **Compare morphological, molecular taxonomy**

Work in Support of GLNPO/GLRI

- **Larval Fish Sampling**
  - **Genetic results—strong signals for:**
    - **Eurasian Ruffe**
    - **Tubenose Goby**
    - **Round Goby**

What's next?

- **Go through lots of data (millions of DNA sequences)**
- **Compare genetic and traditional results**
- **Continue to ground-truth various aspects of genetic work**
  - *This is a young science, and as such requires rigorous testing.*
- **Plan for the next sets of samples**
- *Goal: Provide methods and guidance for genetics in monitoring and detecting invasive species in the Great Lakes.*