Evaluating assessment programs for humpback chub in the Grand Canyon

**Background**
- Glenn Canyon dam completed in 1964.
- Humpback chub were listed on the federal list of endangered species in 1967.
- Monitoring program based on mark-recapture methods.
- Complicated life-history ontogeny & movement between CR and LCR.
Method used to assess chub abundance

**Age-Structured Mark-Recapture analysis** (ASMR, Coggins et al. 2006)

• A combination of VPA and SCA methods to jointly estimate abundance and age-specific capture probabilities.
  
  • VPA to reconstruct untagged population
  
  • SCA to predicted fate of tagged individuals

• Assumptions include:
  - M is known
  - no aging error

• **Historical estimates of abundance are extremely precise; so what is the problem?**
Expensive monitoring programs for HBC, or glorified rafting trips for biologists?
Overarching project objective

- Examine how estimates of uncertainty in HBC abundance would change if monitoring efforts were reduced such that capture probabilities were reduced by as much as 50% over the current levels.

- Two steps to achieve this objective:

  1. Use historical sampling data to establish appropriate spatial and temporal sampling coverage that is consistent with the current program.

  2. Develop an IBM model to simulate mark-recapture data from reduced sampling efforts to quantify changes in estimates of uncertainty.
Scenarios

- **Scenario 1** represents the base line scenario where all available records between 1989 and 2009 are used to construct the ASMR input file.

- **Scenario 2** all September and October USFWS records have been removed (i.e., no fall sampling).

- **Scenario 3** all September USFWS records have been removed.

- **Scenario 4** all October USFWS records have been removed.

- **Scenario 5** all lower 1200 records have been removed.

- **Scenario 6** all April or first sampling trips of the spring have been removed, second trip or May trips have not been excluded.

- **Scenario 7** all USFWS lower 5 km samples have been removed from the spring sampling periods (lower 1200 spring trips have not been excluded).
Estimates of adult abundance

![Graph showing adult abundance over years](image-url)
Estimates of age-2 recruits

![Chart showing estimates of age-2 recruits over years from 1990 to 2005. The y-axis represents Age-2 recruits in thousands, ranging from 0 to 4. The x-axis represents Years, with intervals from 1990 to 2005. There are multiple lines indicating different estimates, each labeled with a number from 1 to 7.](image-url)
Summary

- Historical data suggests non-random sampling is occurring:

  - Status quo: current population is at 78% of its 1989 abundance.

  - Temporal patterns: omit fall sampling, 57% depletion level.

  - Spatial patterns: omit lower 5km, 32% depletion level.

- Future changes (spatial or temporal) in sampling effort are likely to result in biased estimates of abundance.

- Reduced sampling frequency (e.g., every other year) may provide unbiased but less precise estimates of abundance.