

Five charges from AMWG...

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2. *Are Upper Basin methods appropriate for use in GC?*
3. *Are there ways to improve methods [ASMR] used in GC?*
4. *Do GC methods provide rigorous data pertinent to HBC recovery goals?*
5. *Are current methods providing scientifically rigorous data to inform decisions?*

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 - **Provide update on HBC status and trends**
 - *Updated since SCORE report*

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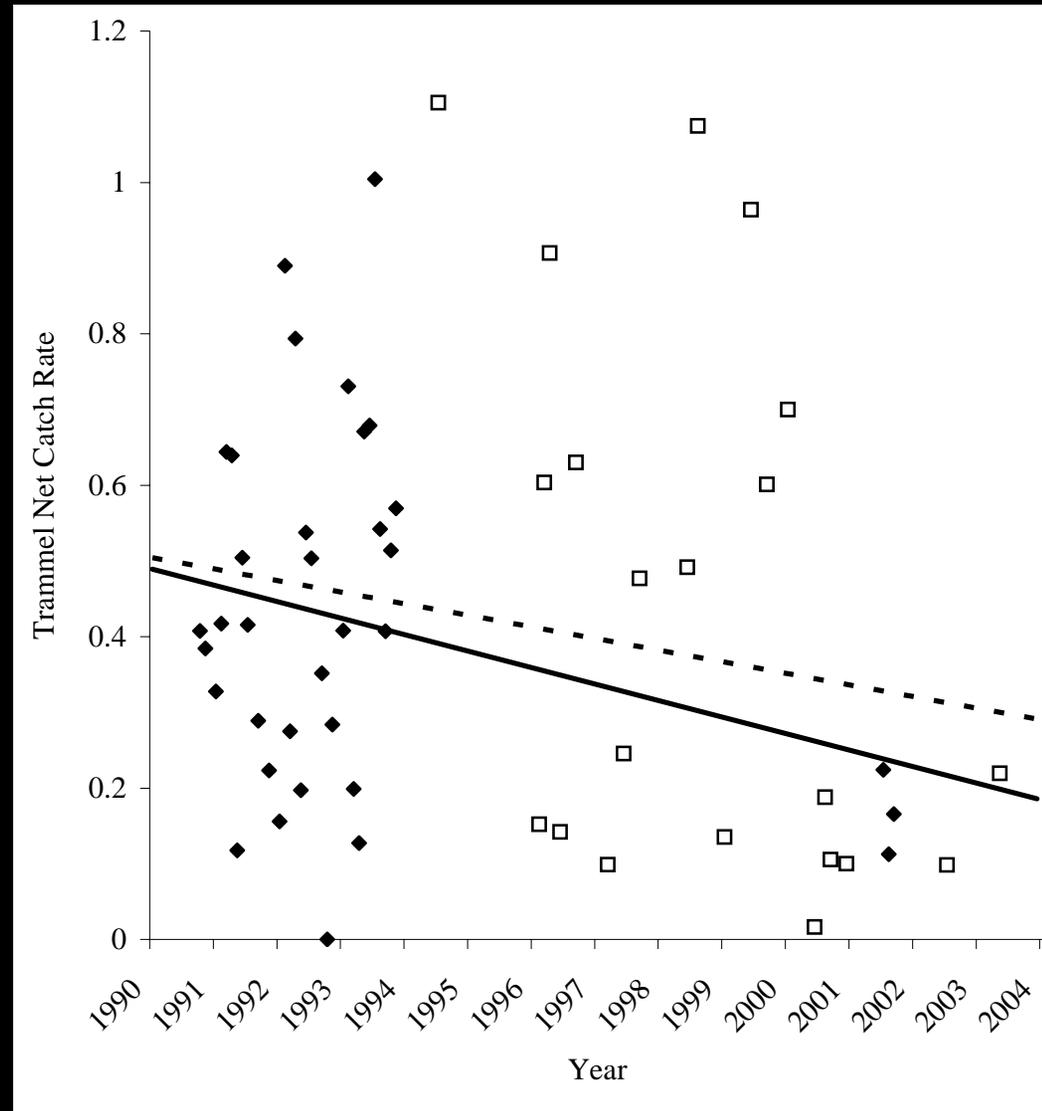


Lew Coggins – USGS GCMRC

Carl Walters – Univ. British Columbia

Mainstem Colorado River Trammel Net Relative Abundance Index (>200 mm TL)

- Long-term declines in standardized CPUE
- Black Diamonds
 - large samples, robust geographic coverage
- White Squares
 - smaller samples, focused near the confluence.



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 - *Comparison to Jolly-Seber analysis (MARK)*
 - *Focus on trend estimation*
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Methods

- Intensive tagging program since 1989
 - >14,000 capture events
 - Use capture-recapture methods to assess population
- Age Structured Mark Recapture Model (ASMR)
 - Combines Jolly-Seber model within a standard fisheries virtual population framework.
 - Provides age specific estimates N , survival, and recruitment

Methods

- Age Structured Mark Recapture Model (ASMR)
 - Combines Jolly-Seber model within a standard fisheries virtual population framework.
 - Provides age specific estimates N , survival, and recruitment
 - ASMR comprised of two sub-models:
 1. **State Dynamics Model : based on age-structure**
 - Estimate Unmarked fish by cohort each year
 - » Backward Virtual Population Analysis (VPA) type calculation
 - Estimate Marked fish by cohort each year
 - » Forward mortality type calculation
 2. **Observation Model : Predicts number of marked and unmarked fish captured by age and year**
 - Observations (or data) consist of numbers of unmarked and marked fish sampled over ages and years.

Methods

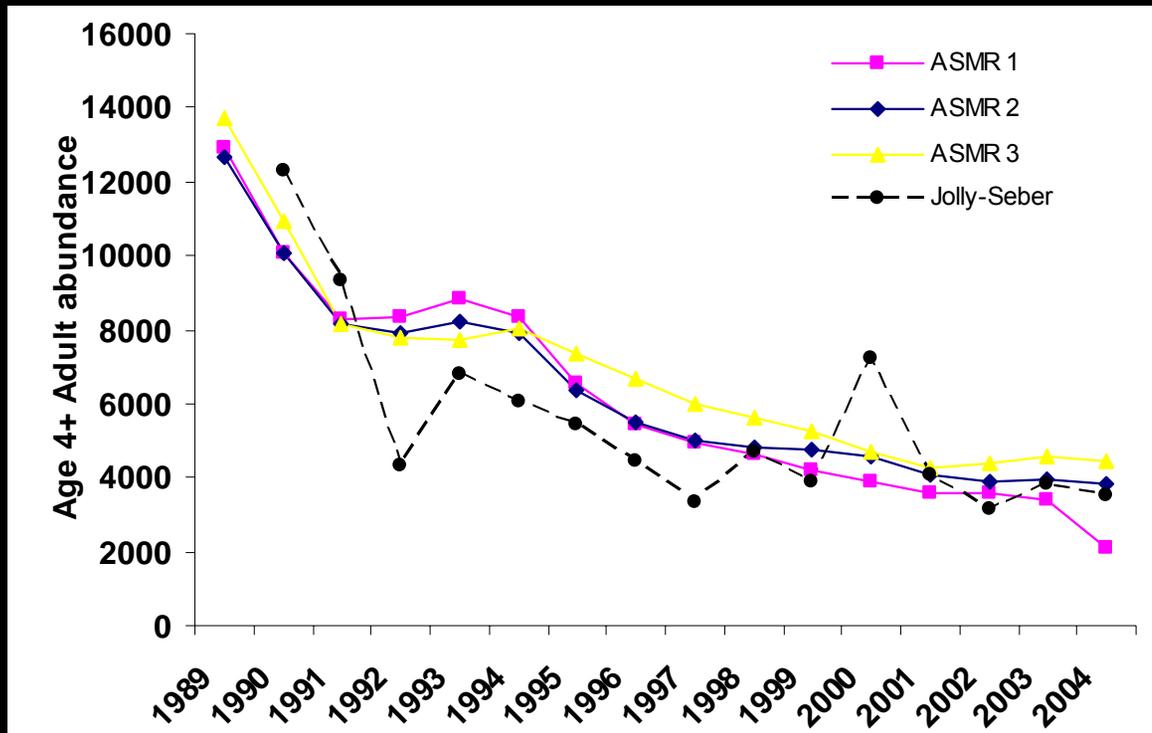
- Key Features of ASMR
 - Provides estimates of adult (age 4+) abundance, recruitment, adult survival
 - Three basic formulations of ASMR (1,2,3)
 - Differences related to initialization of terminal abundance for VPA back calculations
 - Estimation of time and age specific capture probabilities
 - MCMC based uncertainty estimates
- Similar to age-structured Jolly-Seber
 - ++ VPA framework and age information adds lots of additional structure
 - Recruitment at birth year
- Coggins, L.G. Jr., W.E. Pine III, C.J. Walters, and S.J.D. Martell. *In Press*. Age Structured Mark Recapture Analysis (ASMR): A VPA Based Model for Analyzing Age Structured Capture-Recapture Data. *North American Journal of Fisheries Management*.

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Open Population Abundance Estimates for the Little Colorado River Population of Humpback Chub (age 4+, >200 mm TL)

- ASMR and Jolly-Seber similar
- Focus on trend: λ Pradel model $\sim 12\%$ decline
- ASMR, Jolly-Seber, and λ agree \rightarrow downward trend



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4. *Do GC methods provide rigorous data pertinent to HBC recovery goals? **YES***
 - *Adult population trends show large declines*
5. *Are current methods providing scientifically rigorous data to inform decisions?*

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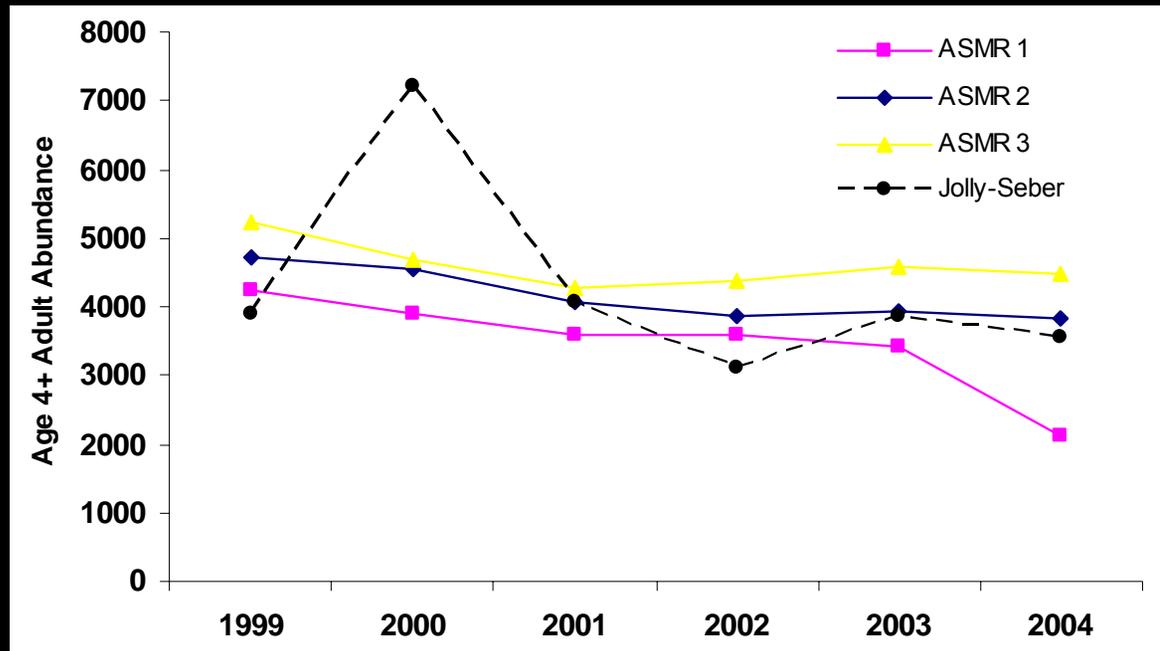
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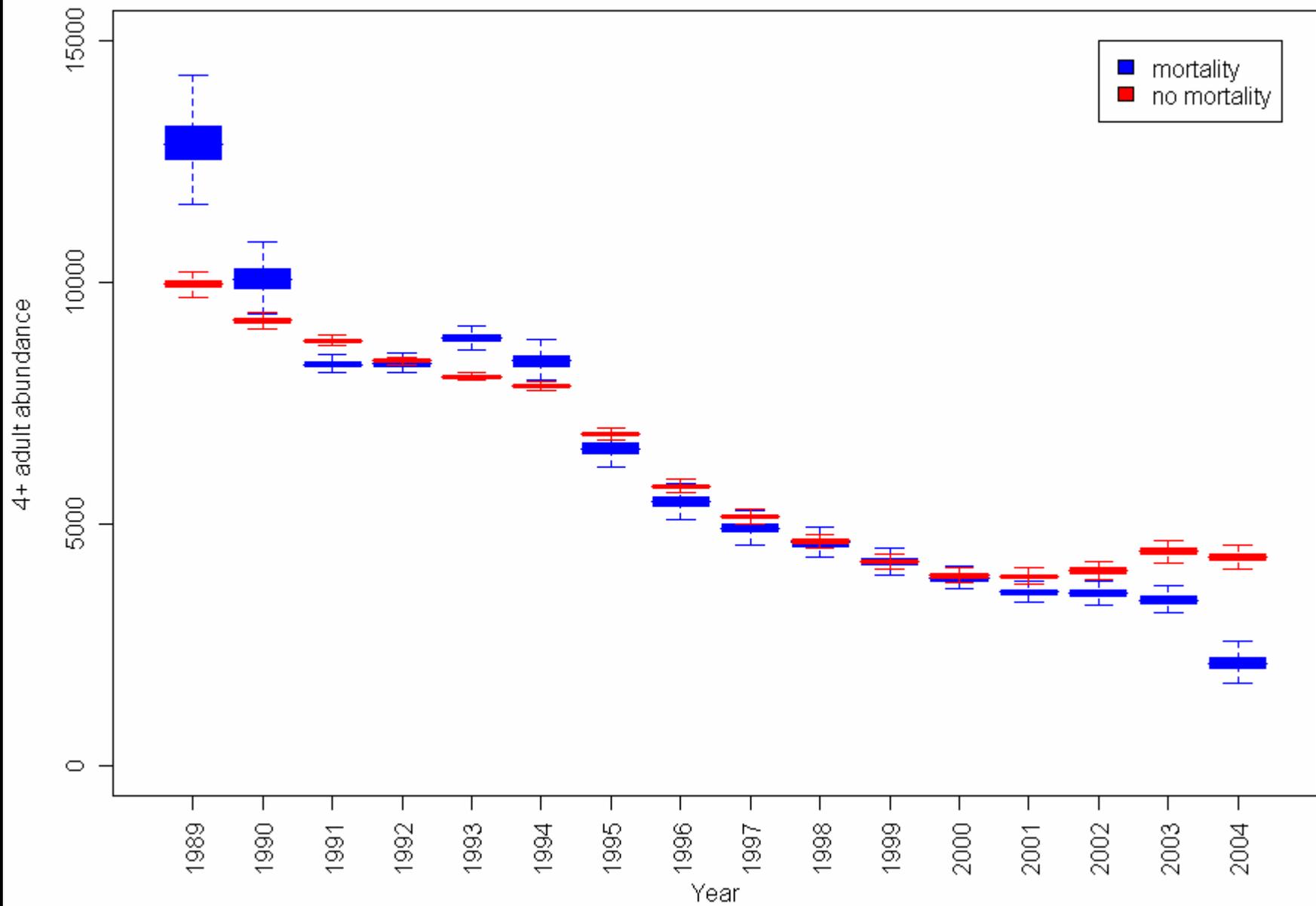
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5. *Are current methods providing scientifically rigorous data to inform decisions? **Yes** we hope so*
 - *We will focus on 2000-2004*

Recent findings very interesting...

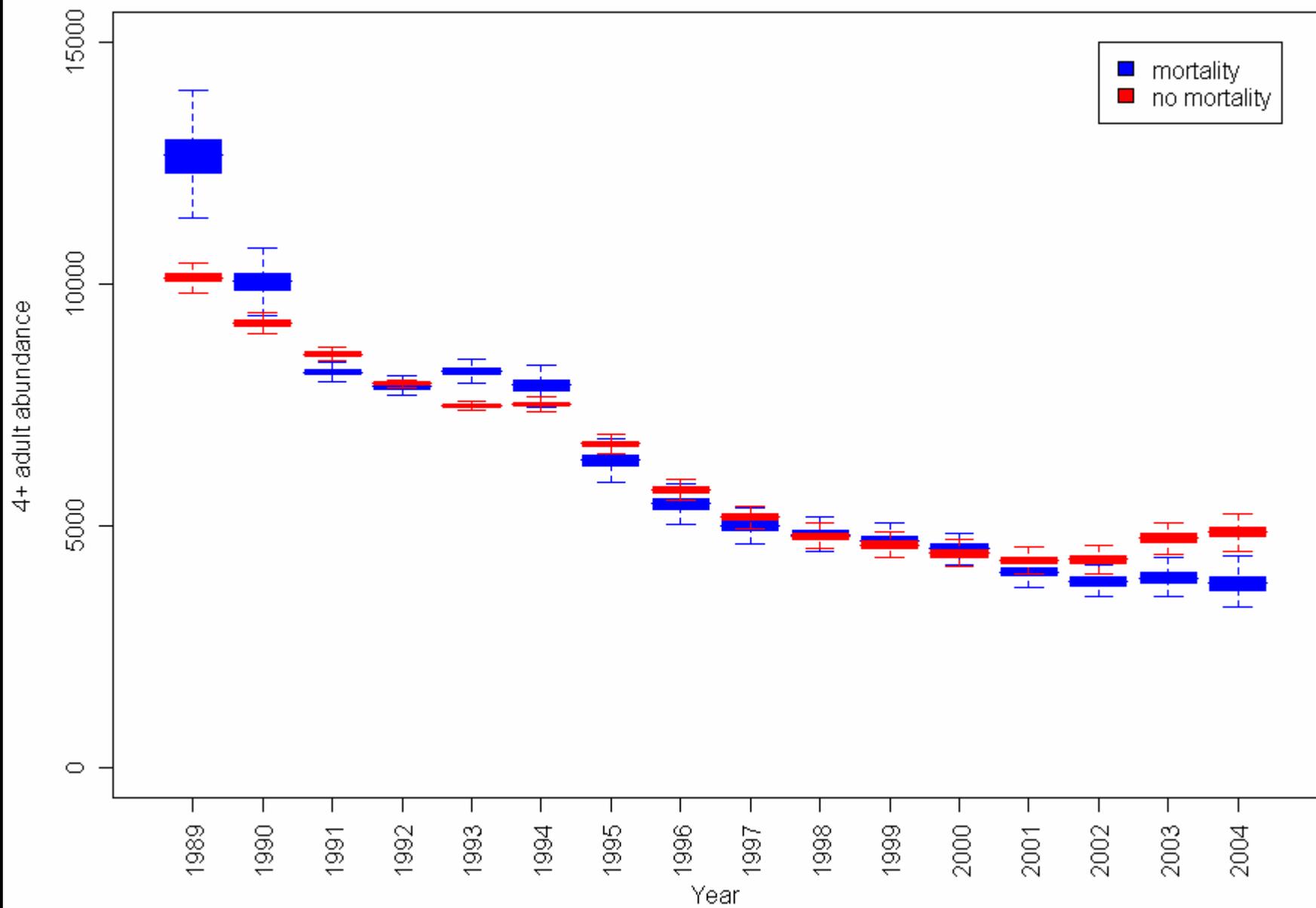
- Last 5-years
- Populations appear to be stabilizing?
- ASMR Jolly-Seber good agreement



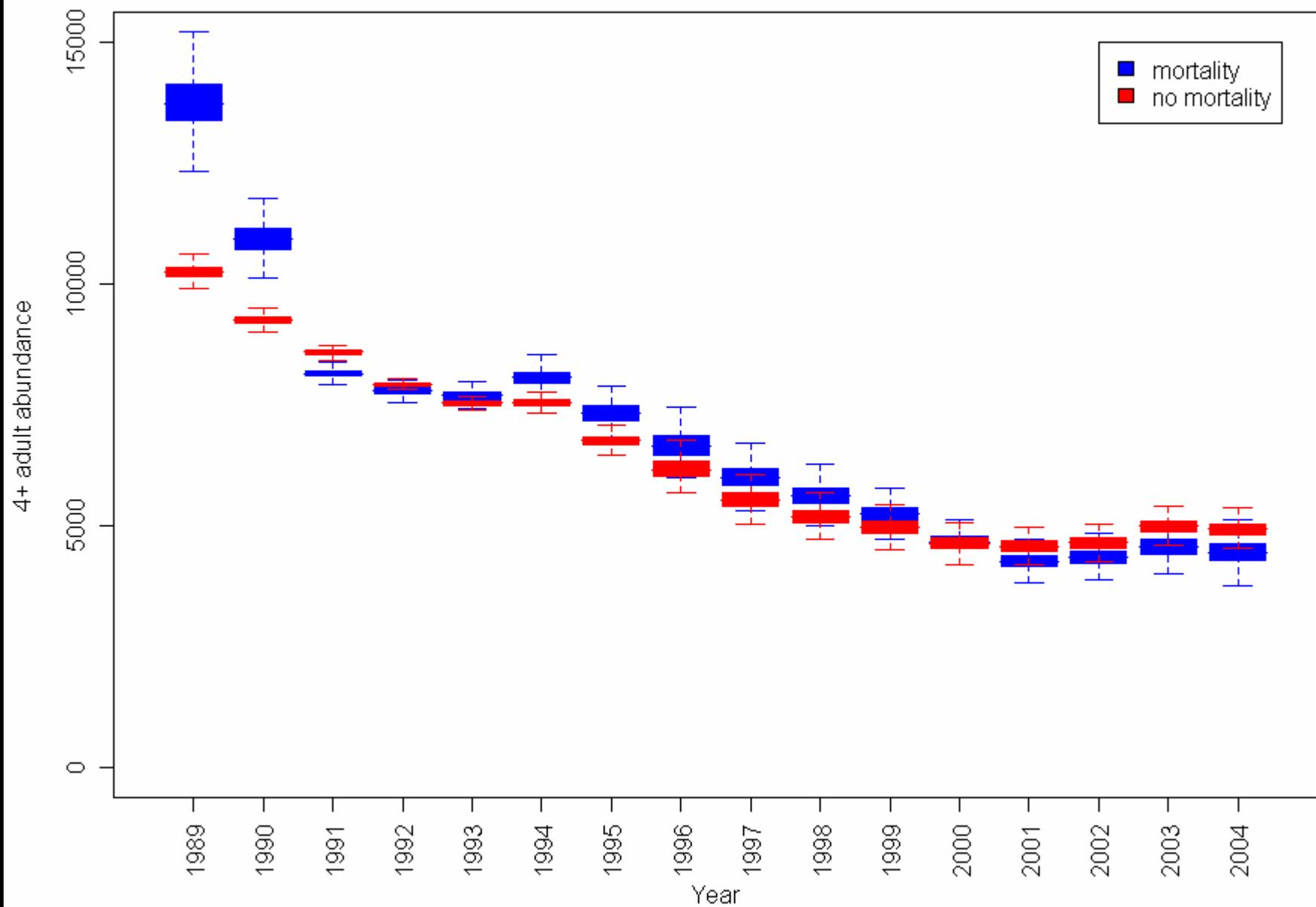
ASMR 1

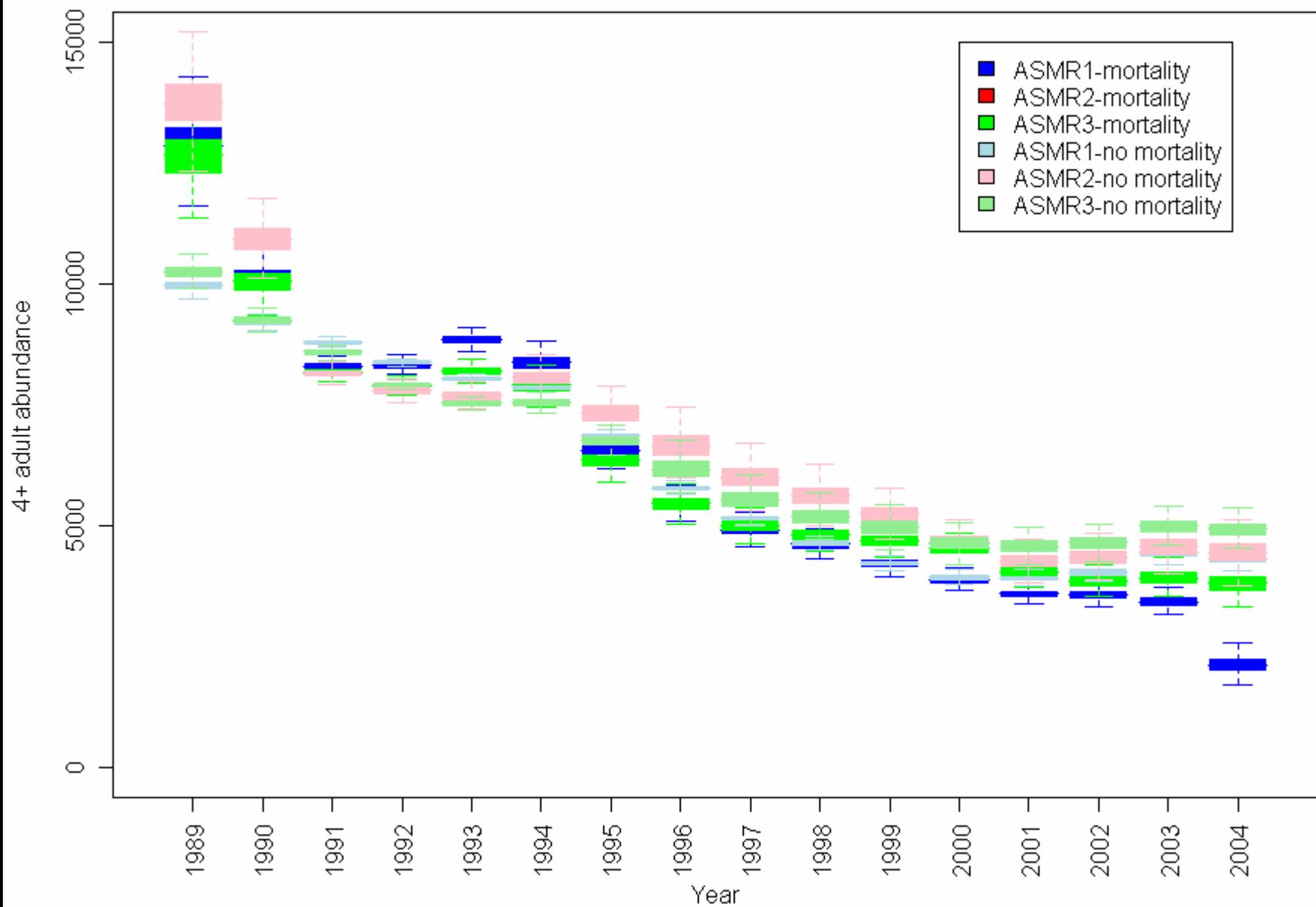


ASMR 2



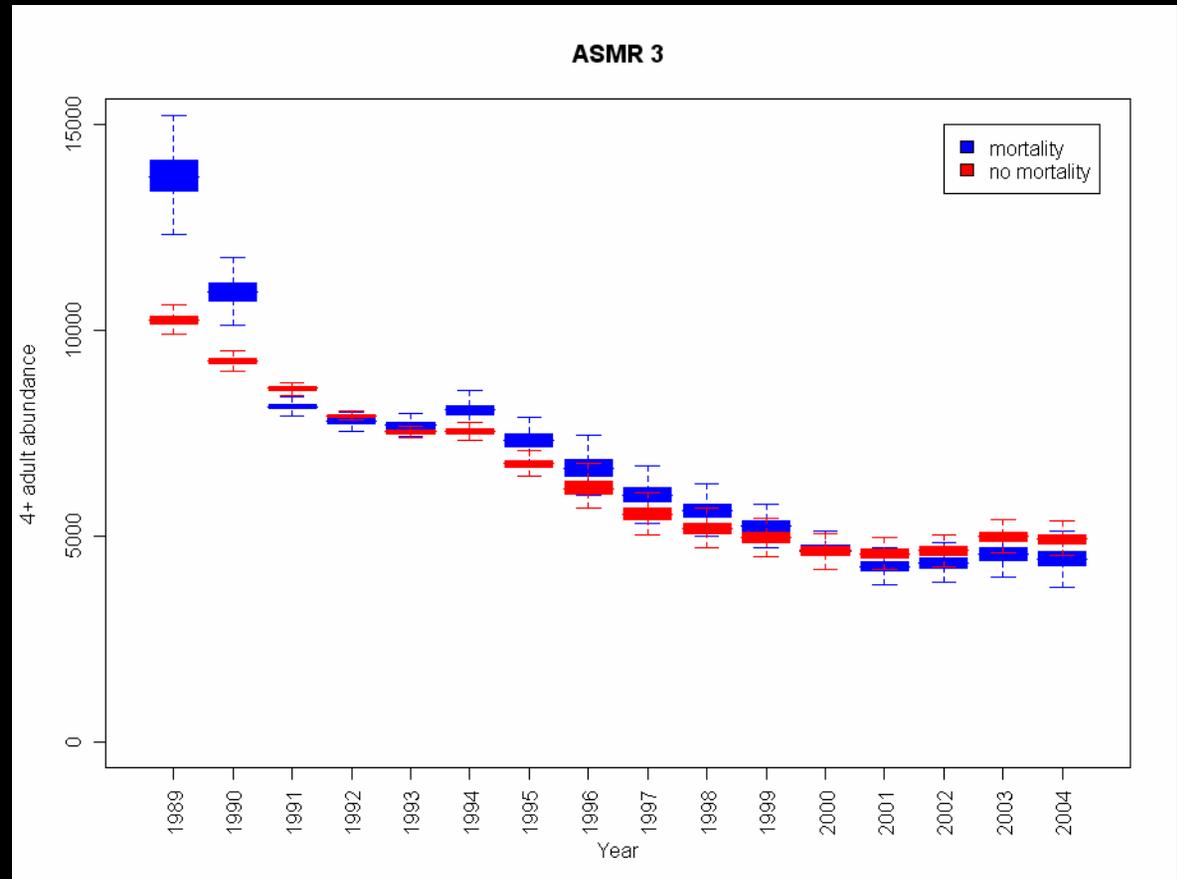
ASMR 3



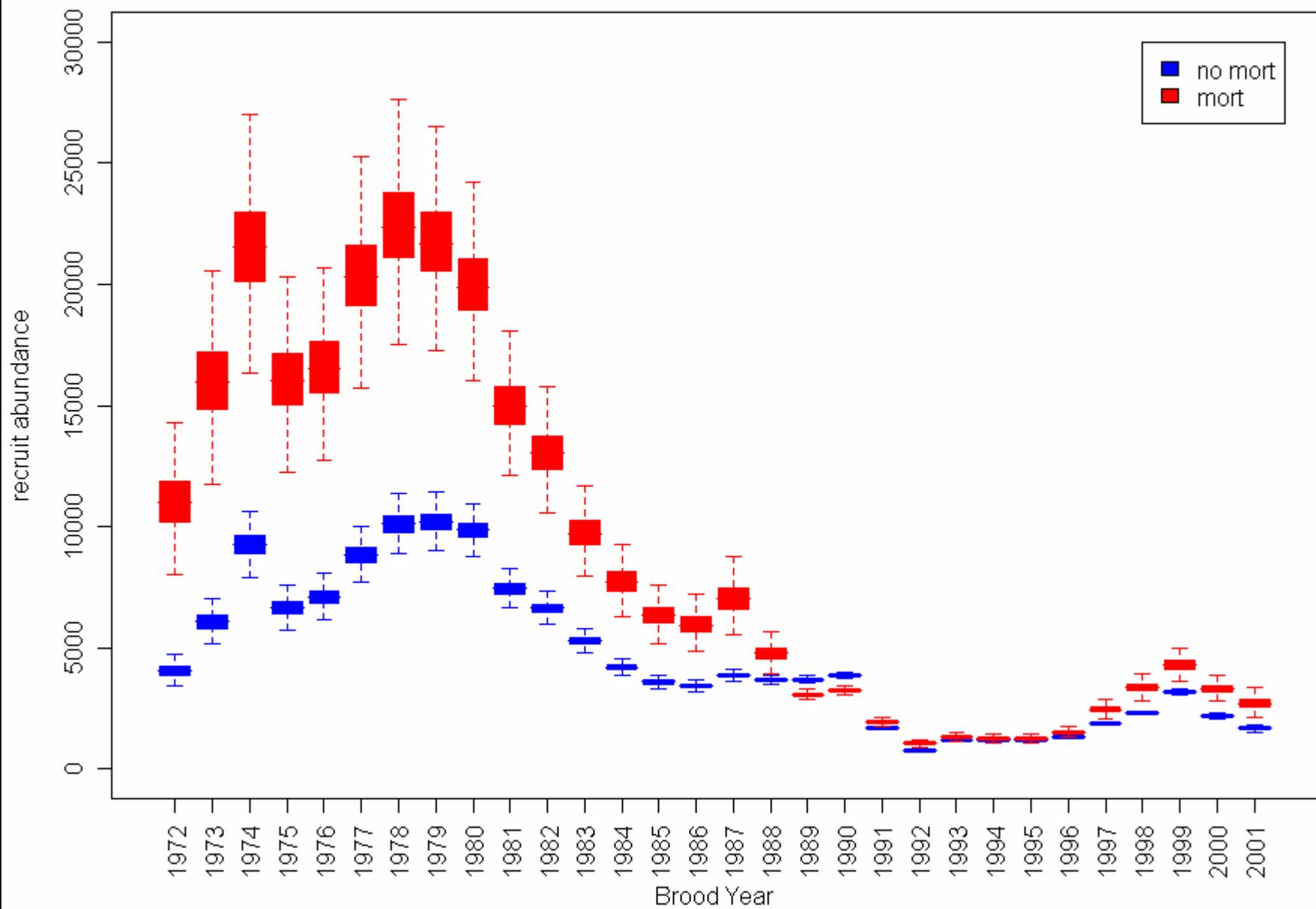


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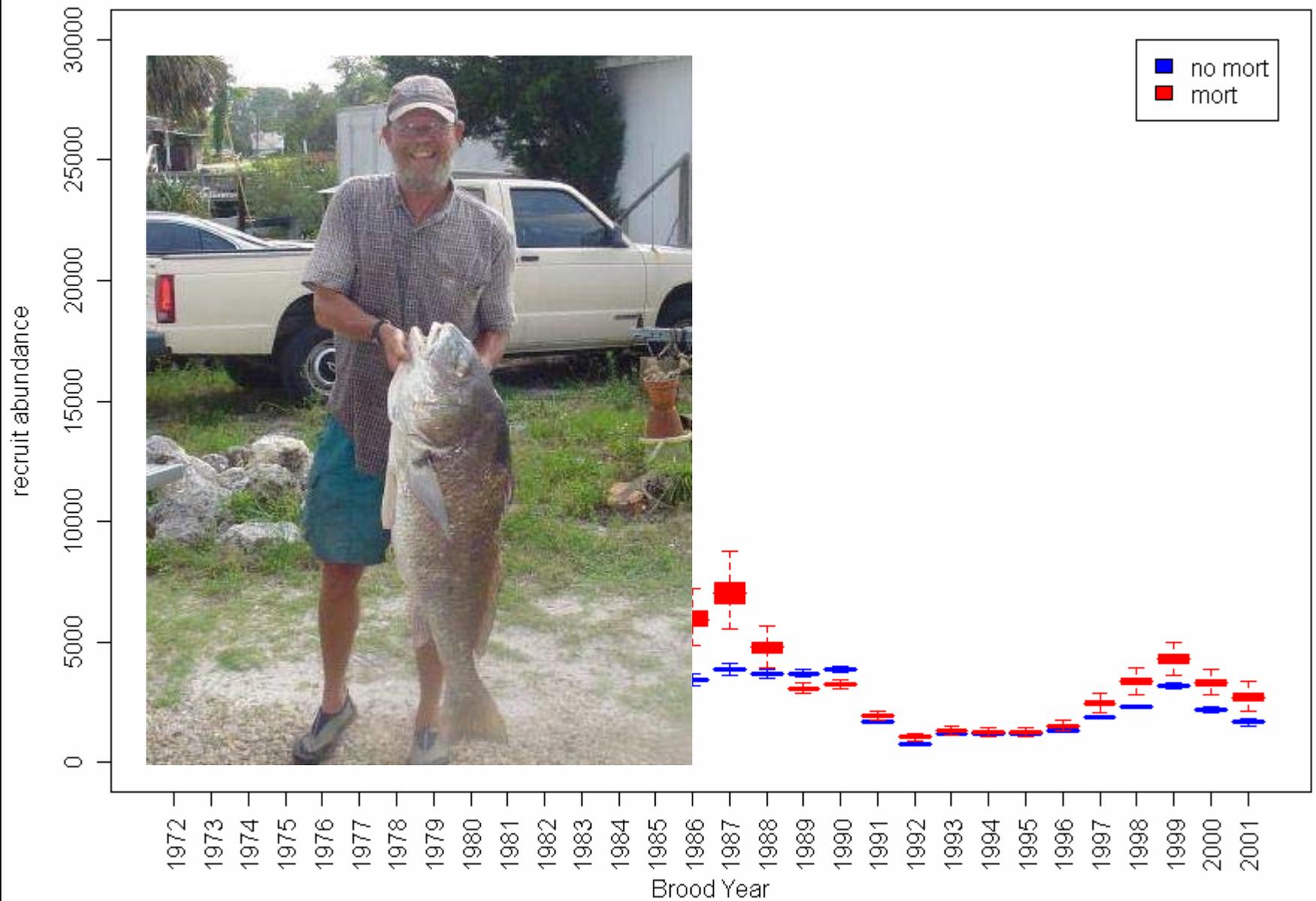
- What led to population declines?
- Why does it appear population stabilizing?
- Trends in births and deaths??
- Use ASMR to examine trends in
 - Recruitment
 - Adult mortality



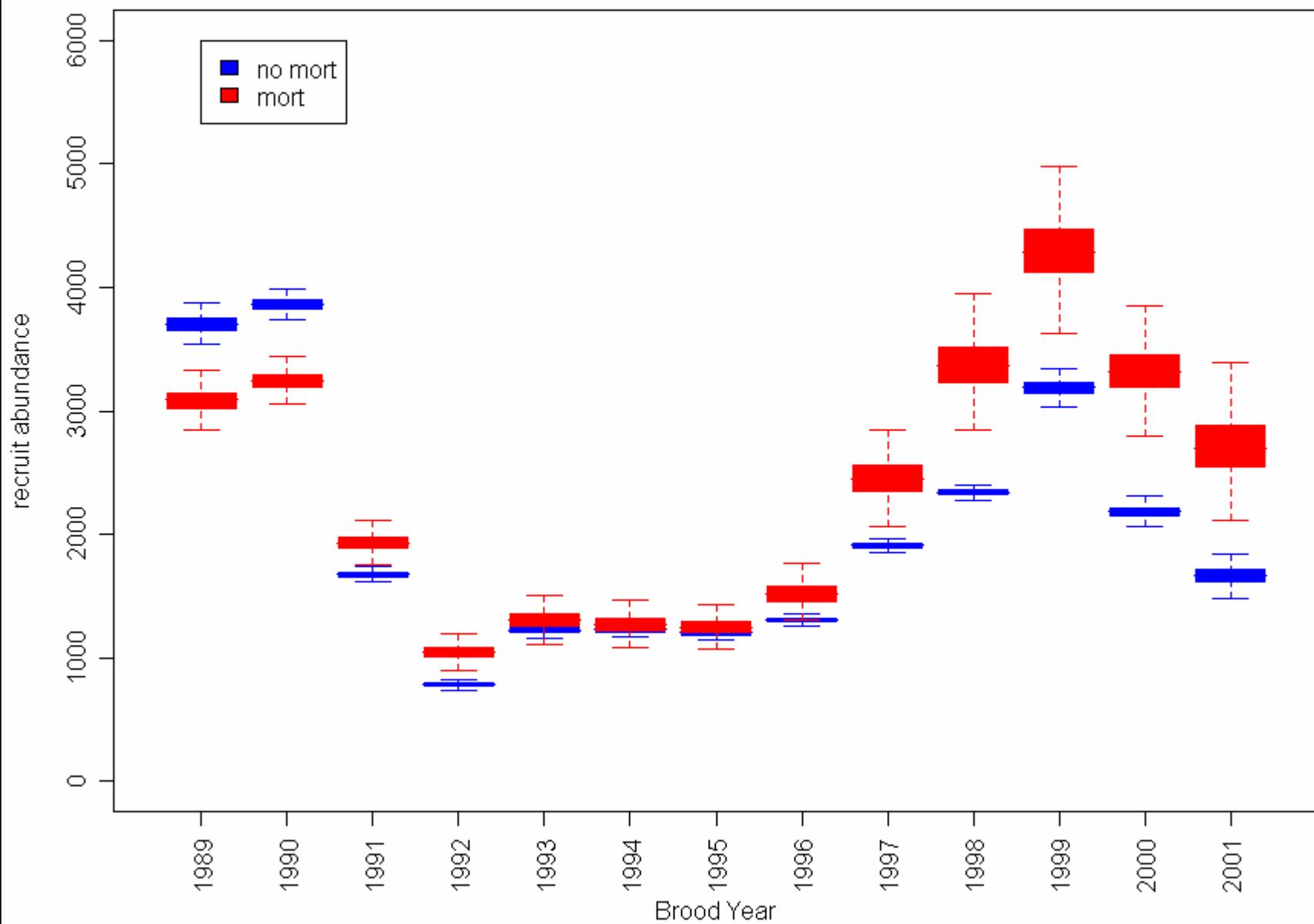
ASMR 1



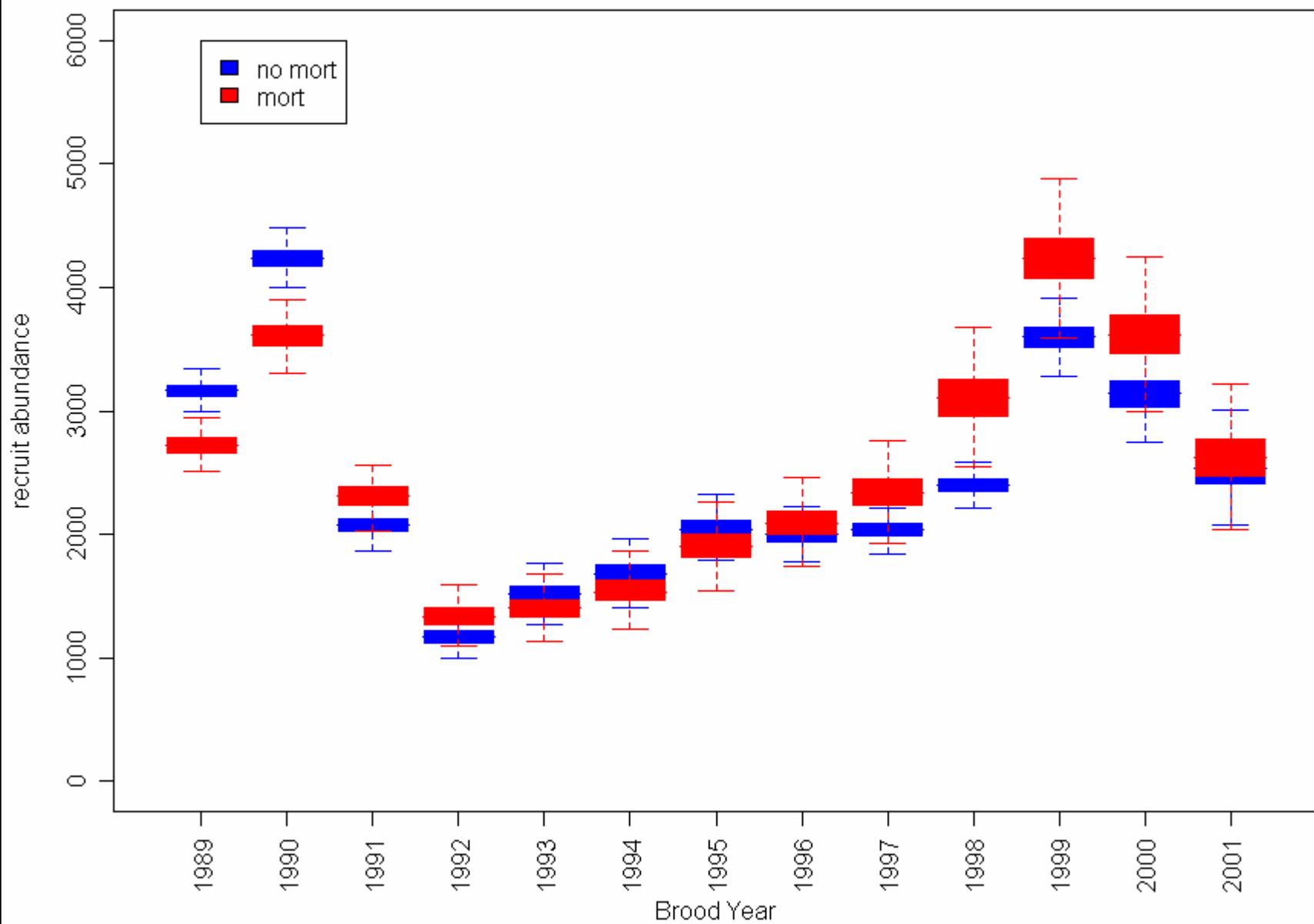
ASMR 1



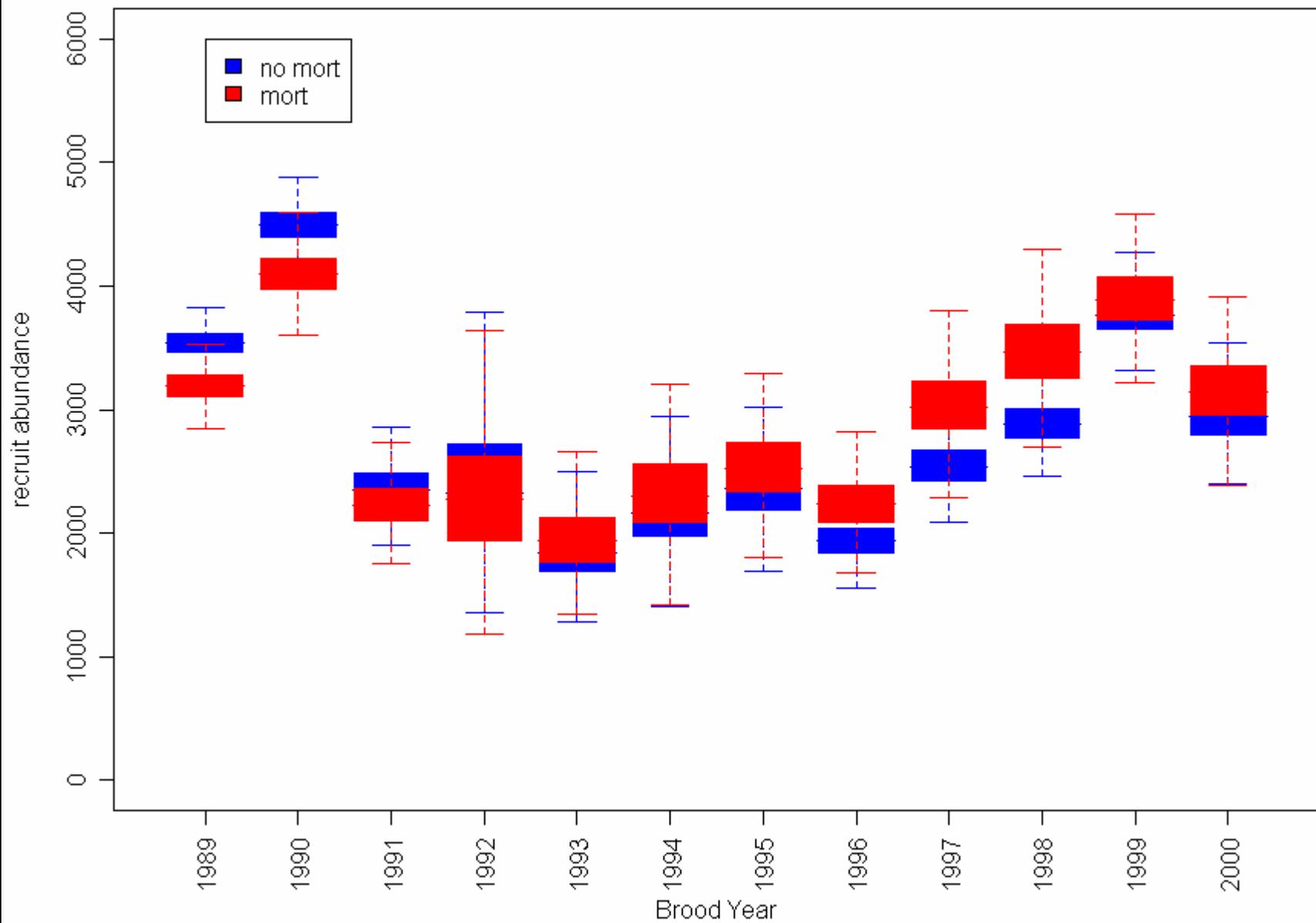
ASMR 1



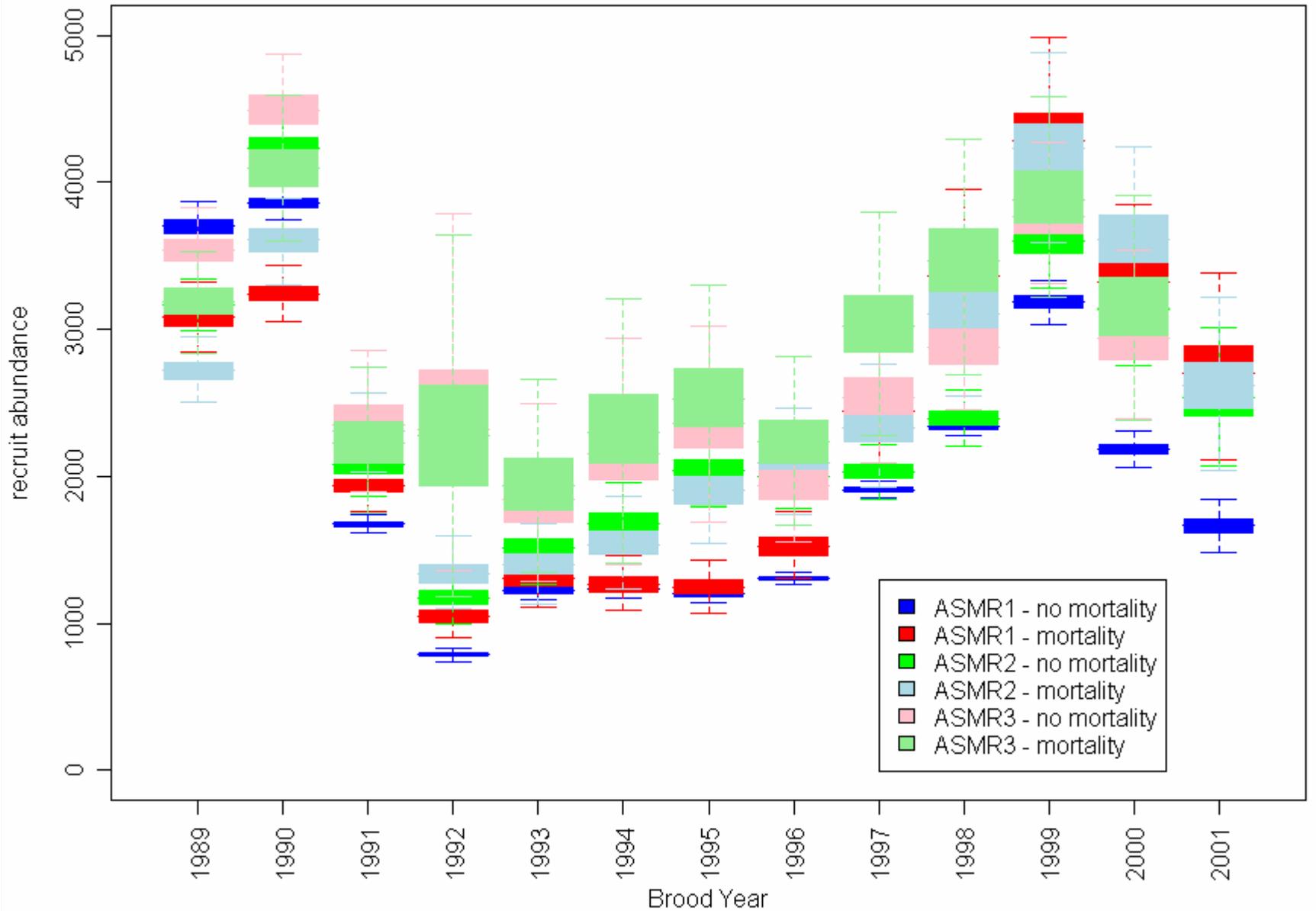
ASMR 2



ASMR 3



Recruit Abundance



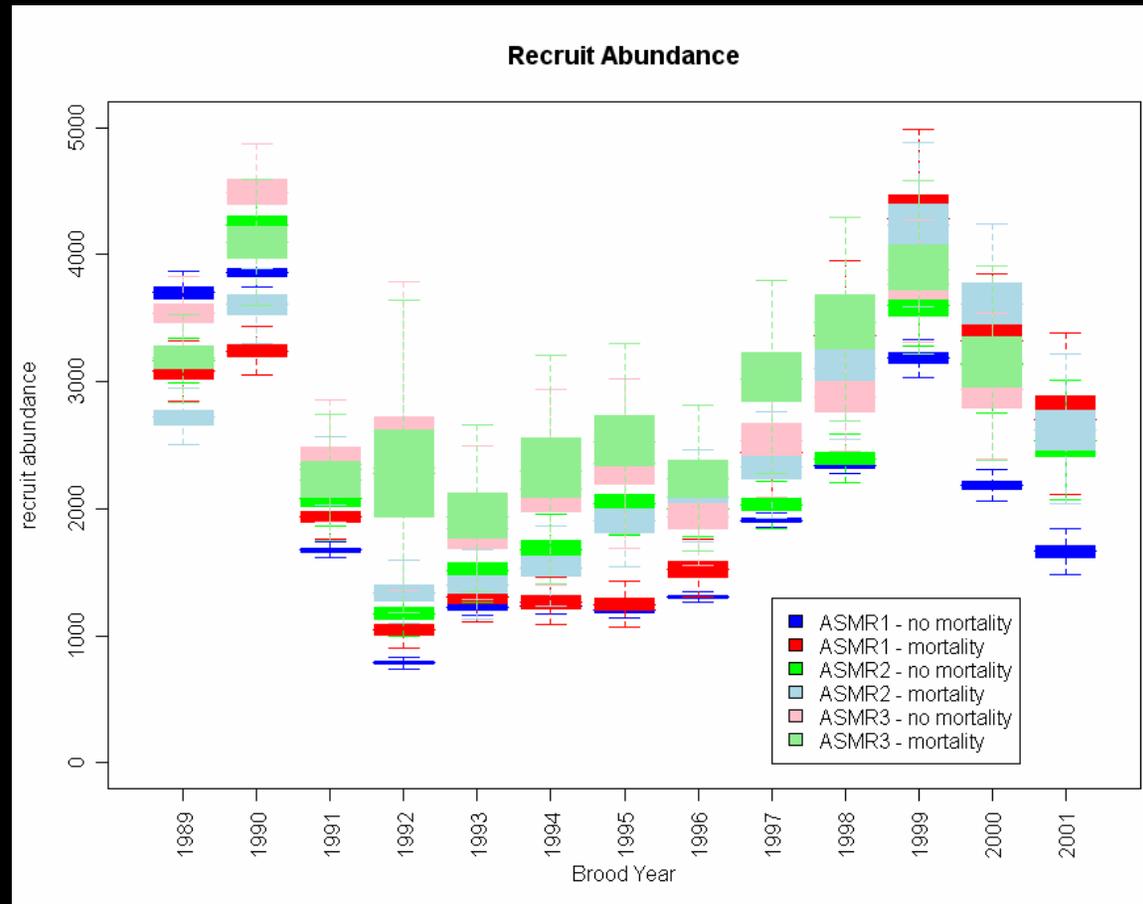
Recent findings very interesting...

- **GOOD**

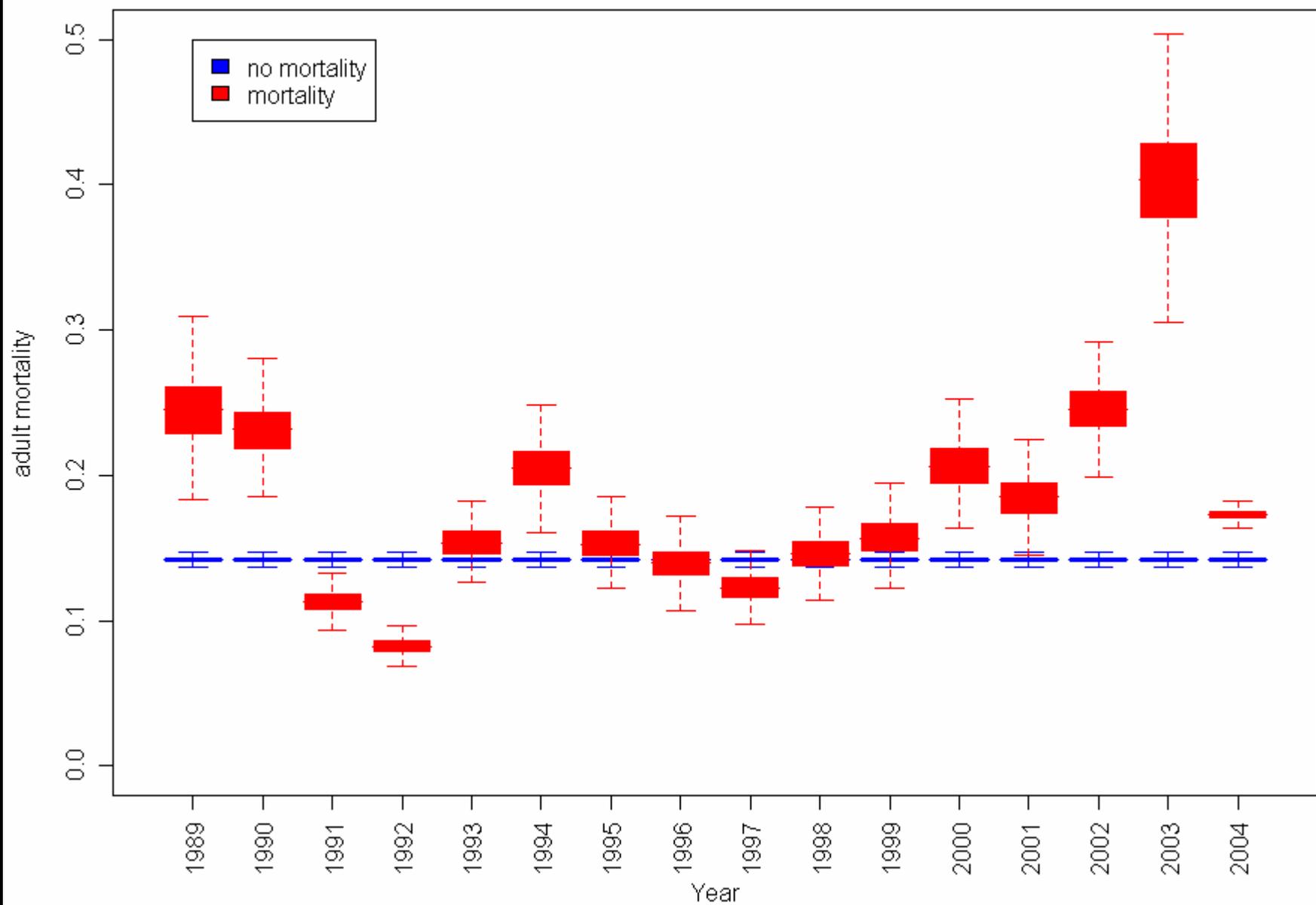
- + trend in recruitment
- Good YC(s) in last 5-6 years?

- **BAD**

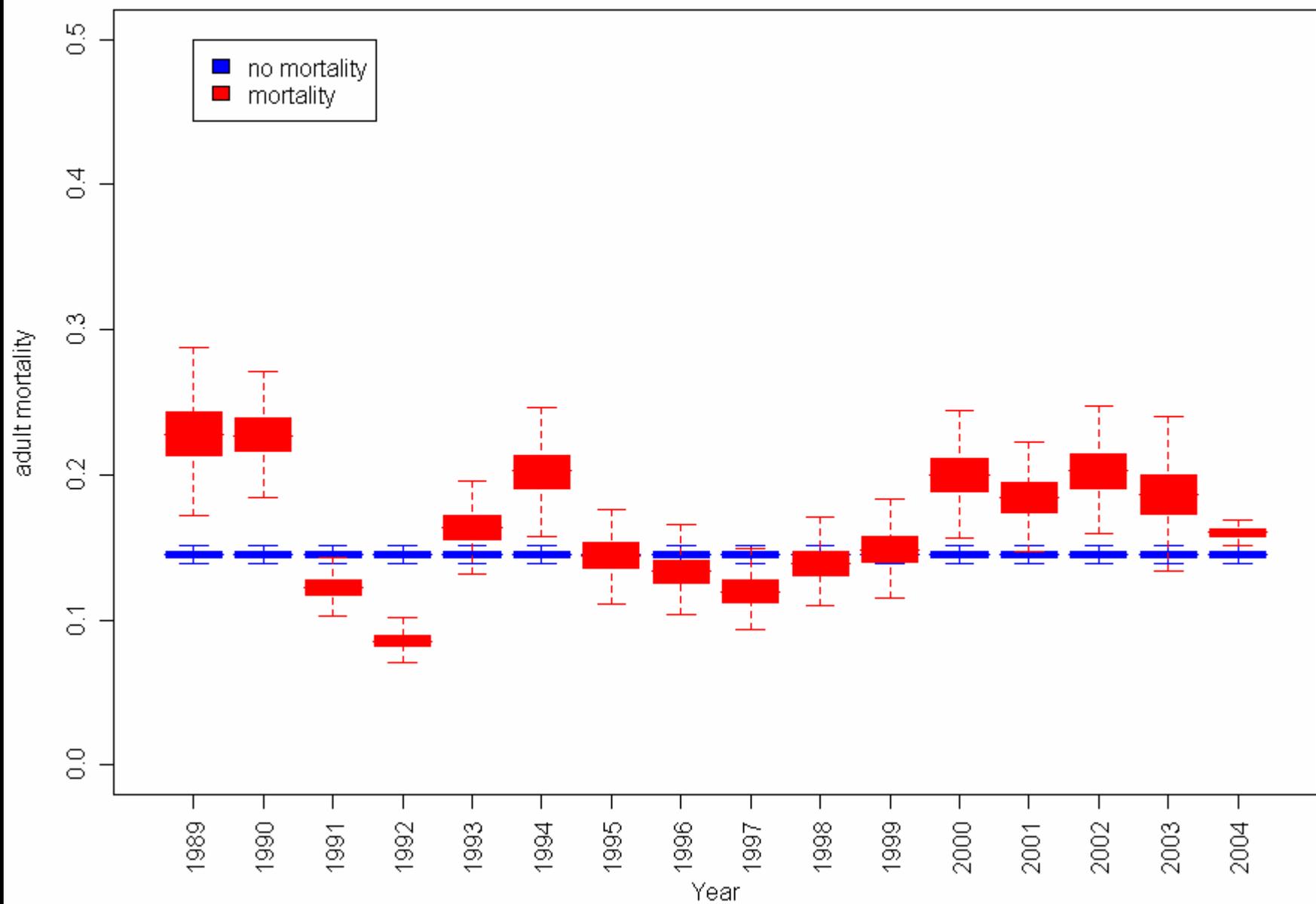
- Still takes ≥ 4 -years to detect
- Does that YC persist?
- Are age-0's the key?
- Don't hang your hat on one year...



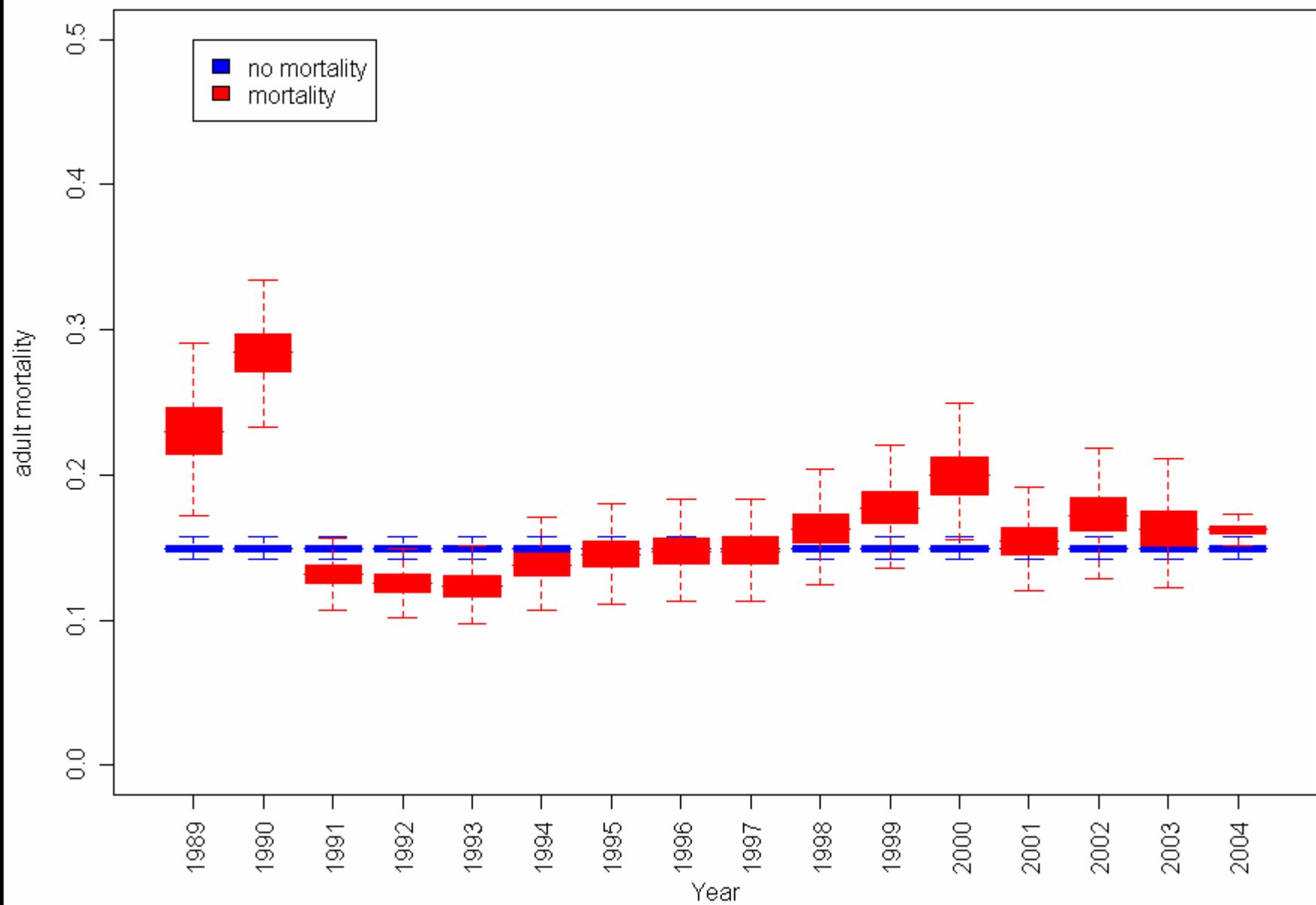
ASMR 1



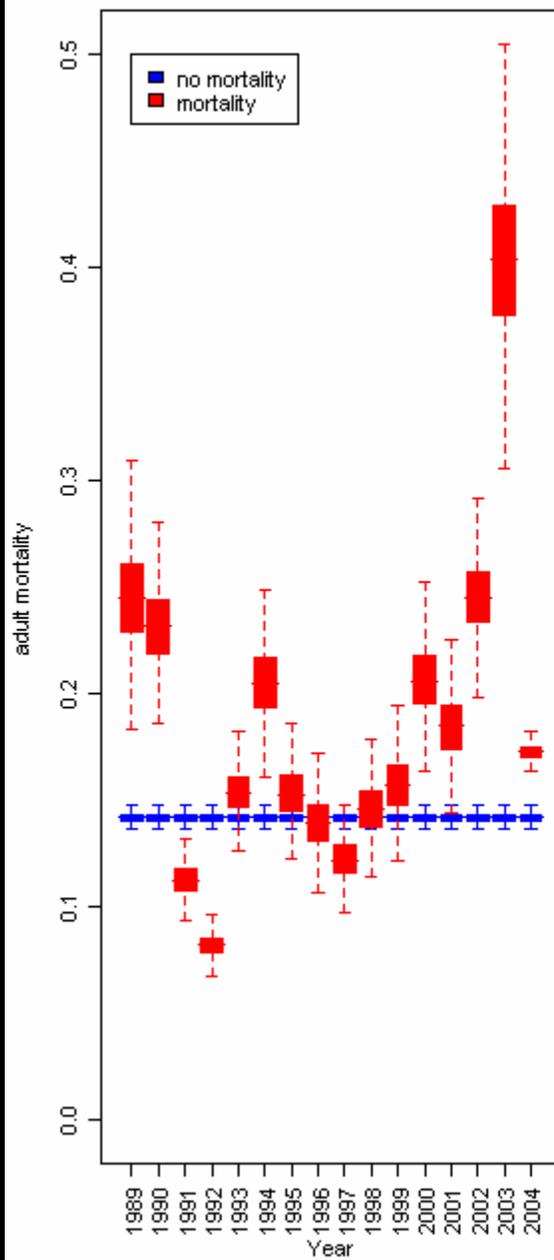
ASMR 2



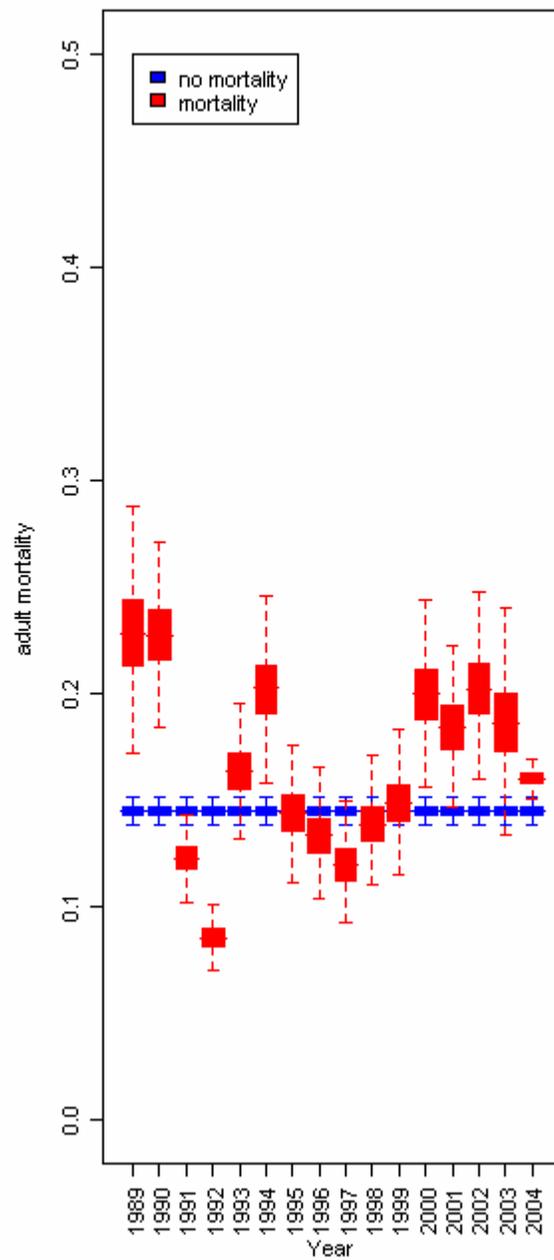
ASMR 3



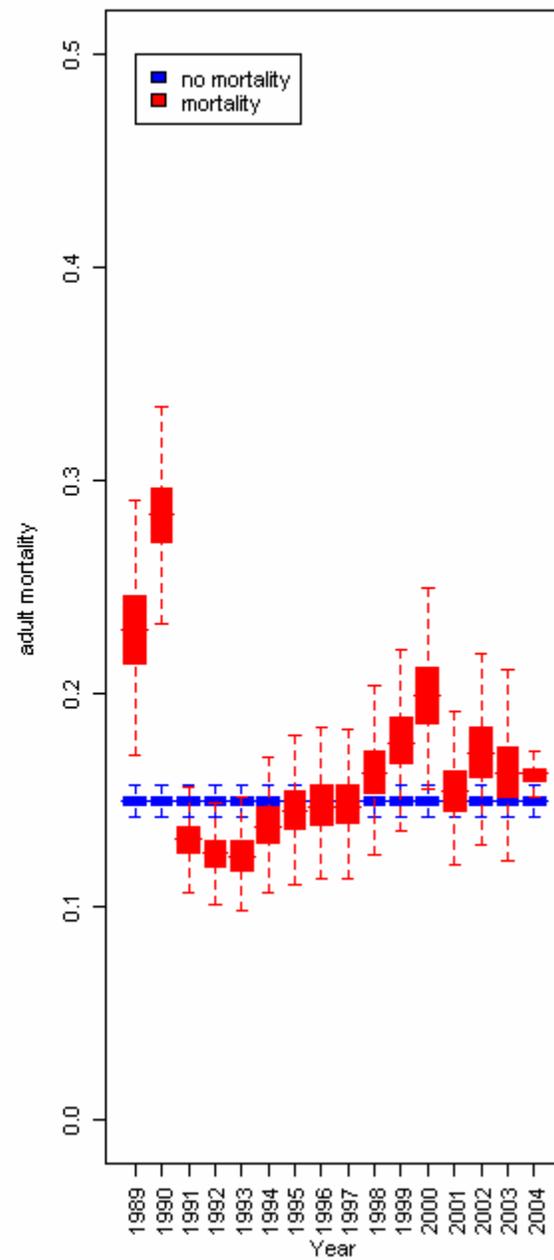
ASMR 1



ASMR 2



ASMR 3



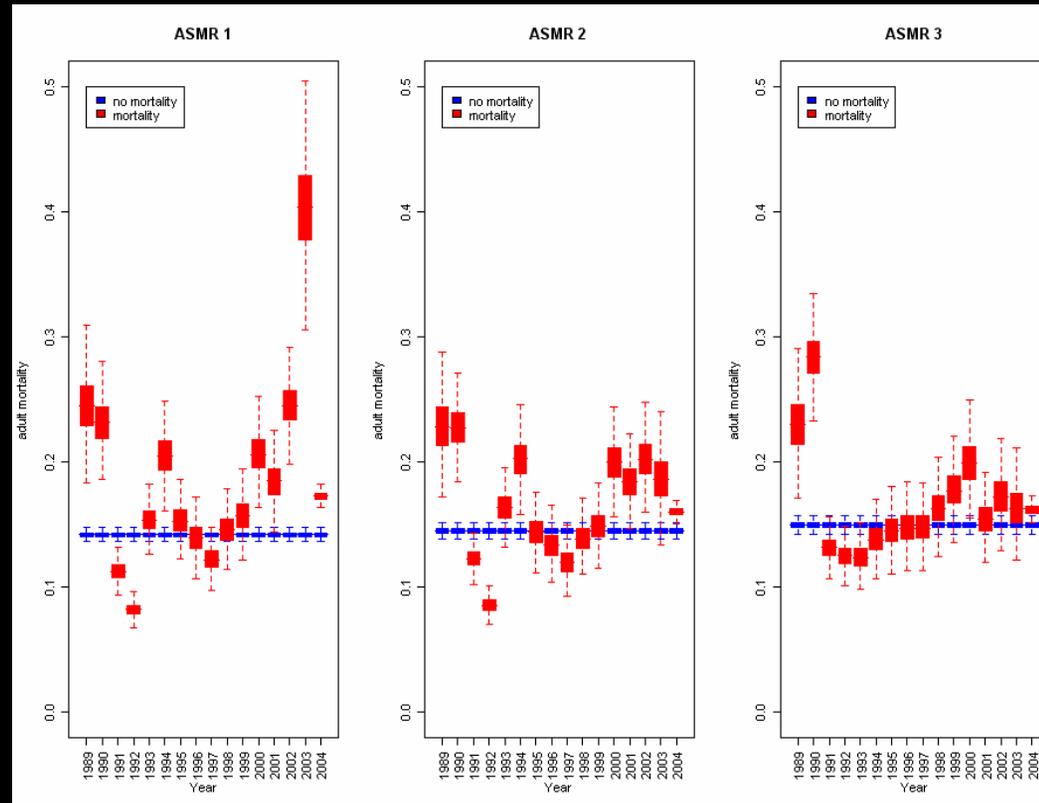
Recent findings very interesting...

- **GOOD**

- Mortality lower now than late 1980's - early 1990's

- **BAD**

- Adult mortality increasing?
- Model needs to consider changes in mortality
- Low capture probabilities make estimation tough
- 7F7's still around...



Retrospective Analysis

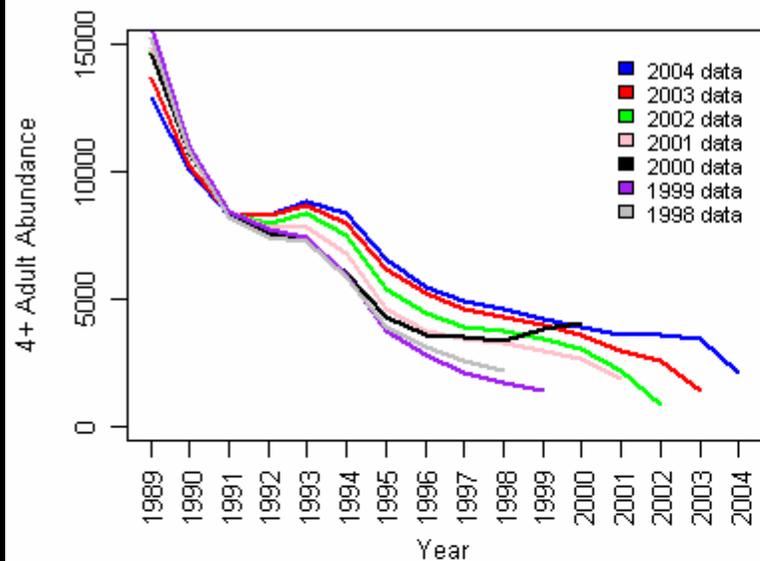
(Do we have to spend all this \$\$ to sample fish)

Overall thoughts...

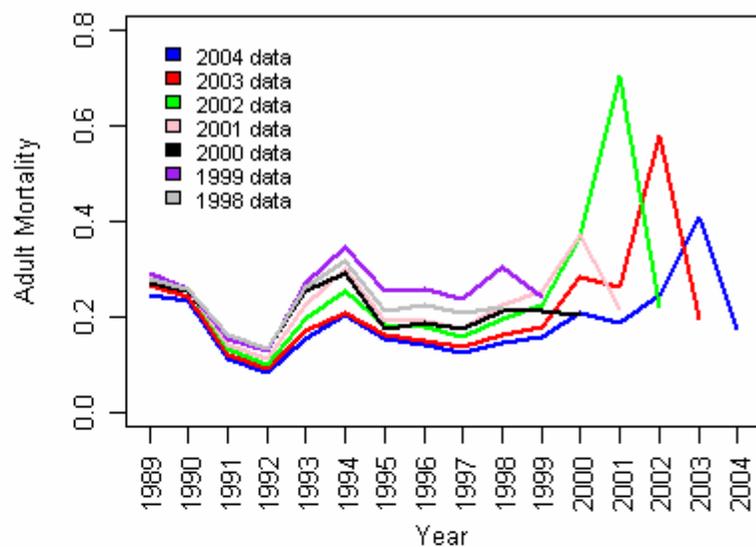
- Large abundance declines
- Populations stabilizing?
 - Strong YC moving through?
 - 4 long years
 - Age-0's key?
- Adult mortality?
 - Watch carefully
 - Chubs live forever
- Takes a lot of effort!
 - Stay the course with monitoring program
 - Give Lew a raise



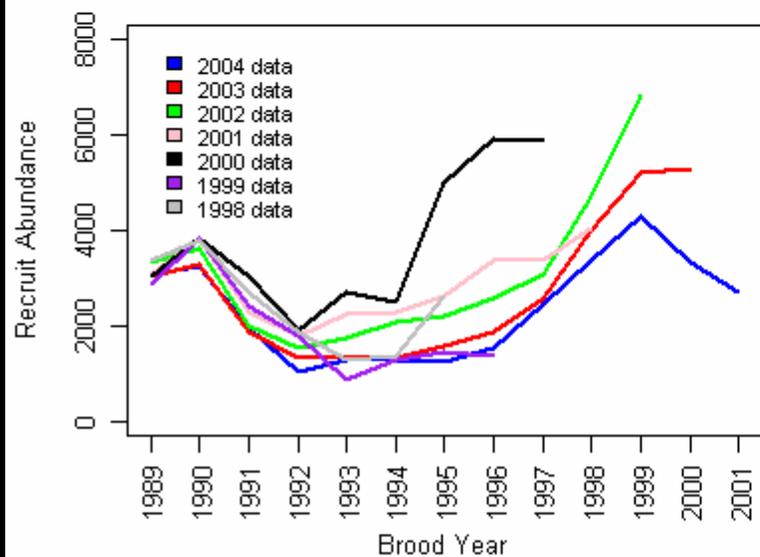
Adult Abundance, ASMR1-mortality



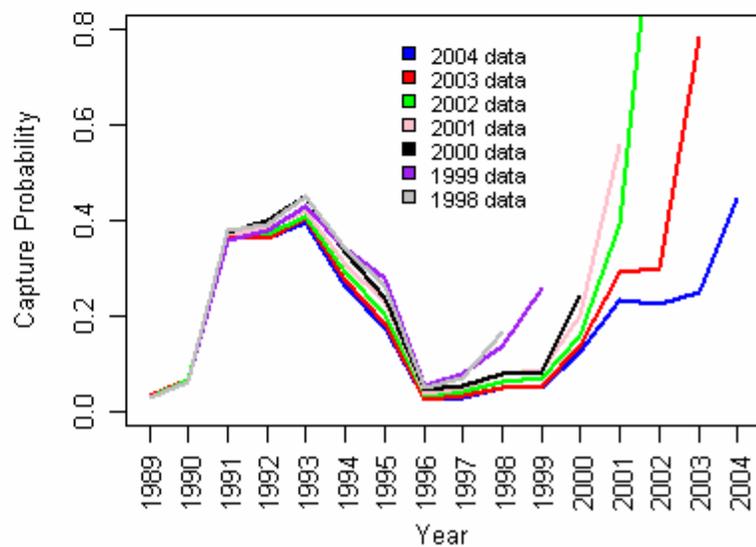
Adult Mortality, ASMR1-mortality



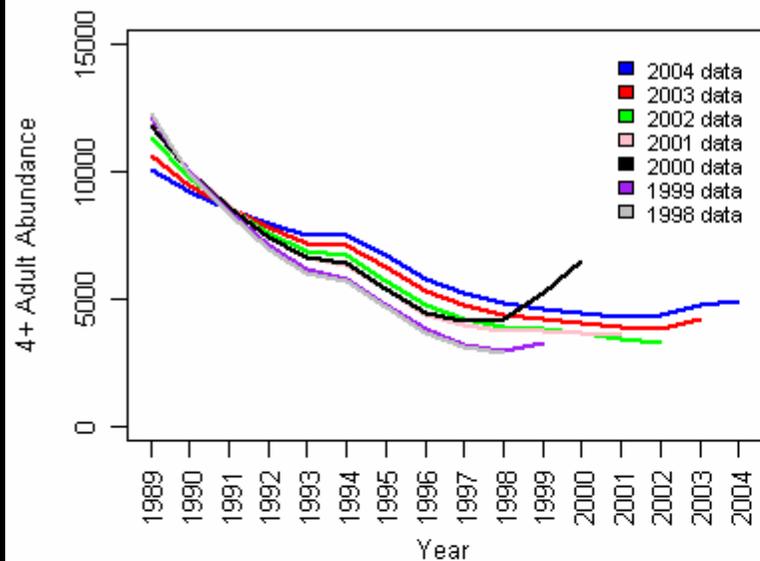
Recruit Abundance, ASMR1-mortality



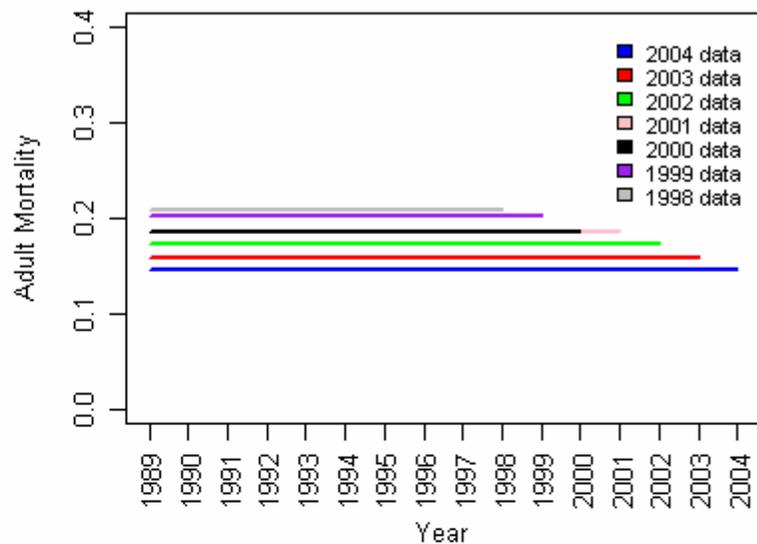
Capture Probability, ASMR1-mortality



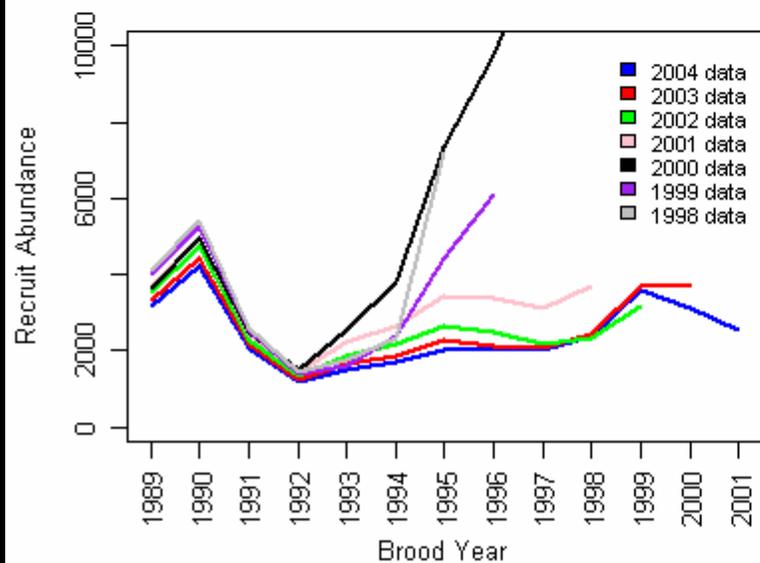
Adult Abundance, ASMR2-no mortality



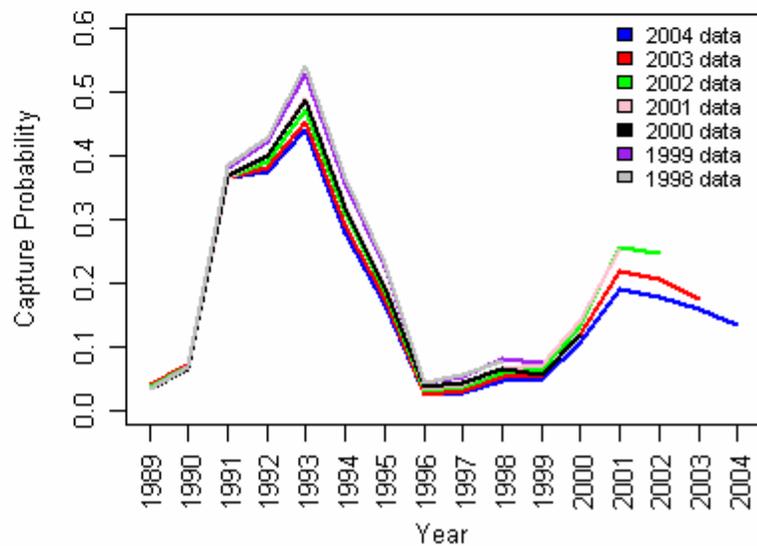
Adult Mortality, ASMR2-no mortality



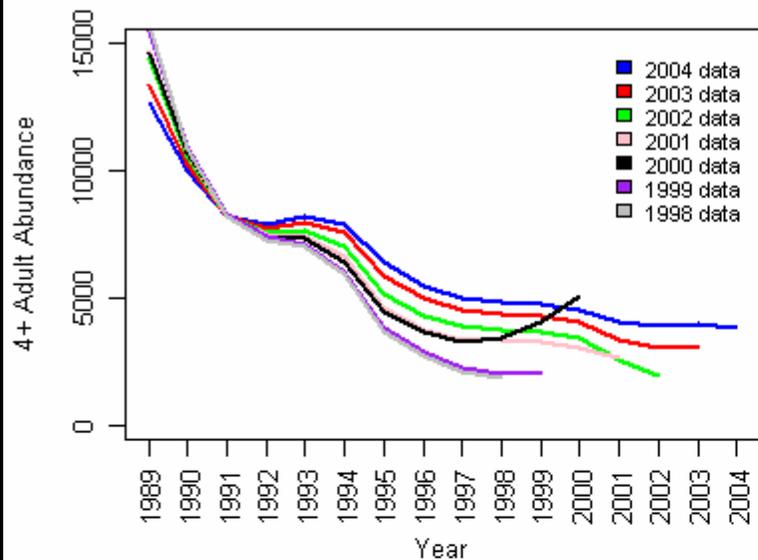
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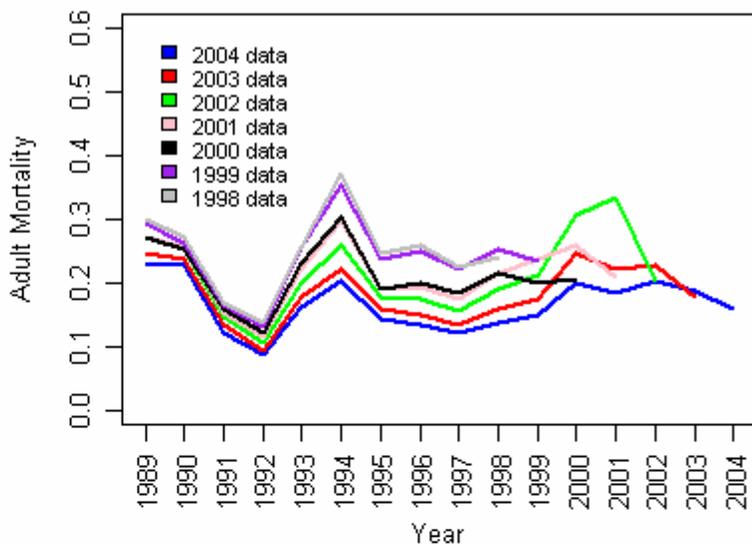
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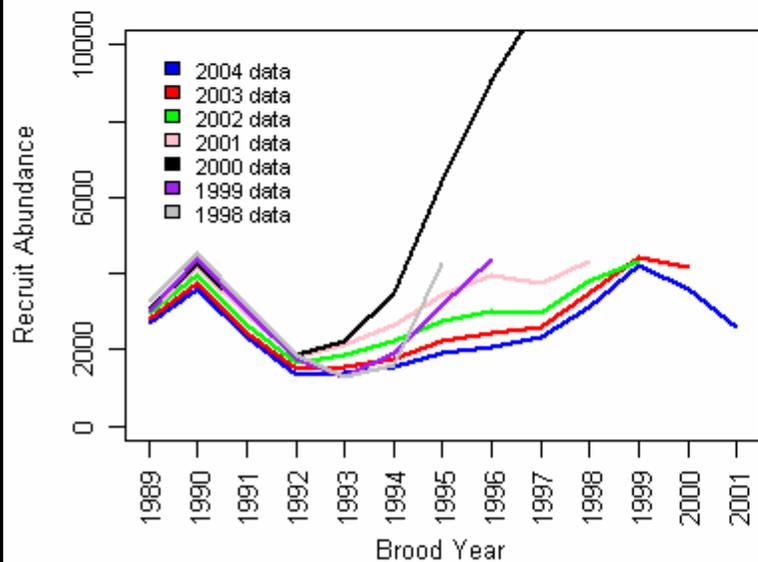
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