Modeling Long Term Effects of HFEs on Trout and HBC

Charles Yackulic
Southwest Biological Science Center
Grand Canyon Monitoring and Research Center
Humpback chub population dynamics
Outline

- General patterns – a rough sketch
- Temperature / Trout / Recruitment
- A historical perspective of lambda
LCR – typical values based on 2009-2012 data

A.) Quick growth to adulthood

Average number of months spent within size class:

<table>
<thead>
<tr>
<th>Size Class</th>
<th>11</th>
<th>7</th>
<th>11</th>
<th>17</th>
</tr>
</thead>
</table>

Average monthly survival rate:

- 0.9
- 0.91
- 0.96
- 0.96

Approximate chance of reaching certain sizes:

- ~11% chance of reaching 200 mm (from July of year 0)
- ~5% chance of reaching 250 mm

Yackulic, Yard, Korman and Van Haverbeke, 2014
Colorado River – typical values based on 2009-2012 data

Yackulic, Yard, Korman and Van Haverbeke, 2014
LCR – typical values based on
2009-2012 data

Yackulic, Yard, Korman and Van Haverbeke, 2014
Colorado River – typical values based on 2009-2012 data

Yackulic, Yard, Korman and Van Haverbeke, 2014
Outline

- General patterns – a rough sketch
- Temperature / Trout / Recruitment
- A historical perspective of lambda
Rainbow Trout Abundance in JCM reach

Juvenile Humpback Chub Survival

Comparison to annual estimates.
Fitted relationship between monthly size transition rate (~growth) of juvenile HBC and temperature at two different RBT densities.
Fitted relationship between monthly size transition rate (~growth) of larger HBC size classes and temperature.
Backcasting

- Relationships I just showed based on 2009 – 2013 data.
- How well do these relationships explain behavior between 1990 & 2009?

Preliminary Data Do Not Cite
Back-casted predictions are reasonably close to ASMR estimates (keep in mind that ASMR is known to smooth trends).
Outline

- General patterns – a rough sketch
- Temperature / Trout / Recruitment
- A historical perspective of lambda
Two scenarios that differ only in their starting population structure and the number of RBT.
The problem with time lags

Current state (adult abundance) or trends do not necessarily reflect whether conditions are negative, positive or neutral.
Population growth rate ($\lambda$)

Preliminary Data Do Not Cite
Measured temperature
Estimated RBT Recruitment (July) – 22K
Measured temperature
Estimated RBT Recruitment (July) – 22K
Trying to address title in Agenda
Five questions regarding RBT recruitment/flow and movement

- Is it the seasonality of HFE’s that matter or the amount of mouths already in the system (or fish condition)?
- Does the magnitude of HFE’s matter?
- Is it the large discharge or steadiness associated with equalization that led to 2011 response, or both?
Five questions regarding RBT recruitment/flow and movement

- How are movement rates downstream affected by extrinsic (e.g., turbidity) and intrinsic factors (e.g., fish condition)?
- Is there a tipping point where Marble Canyon begins to maintain a large self-sustaining RBT population?
Acknowledgements

- US Fish and Wildlife Service
- Near Shore Ecology Group
- NO/JCM crews
- Mike Yard, Josh Korman, Lew Coggins, Maria Dzul
- Glen Canyon Adaptive Management Group
- Bureau of Reclamation
- Navajo Nation Department of Fish and Wildlife
- National Park Service