Mate choice: hatchery vs. wild, mechanisms, current research and what’s next

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Why is mate choice interesting? Hatchery fish are less fit in the wild

**RRS: Relative Reproductive Success (H/W)**

- Effect more severe with more generations
- For many species
- Well documented for steelhead and coho
- Thériault et al., 2011 – Umpqua pedigree study

Negative effect = dragging down the fitness of the wild population

*Source: Recovery Implementation Science Team, report 2009*

**Araki et al. 2007, Science**

Steelhead, Oregon

http://www.kalyani.org/Loring/WWWwebsites.html/CT/D19744.jpg
How do fish select mates?

- Genetic and Behavioral Components
  Genetics – olfaction – specific genotypes can be detected and screened.
  Behavioral – dominance, size of males, female polyandry, visual cues.

- Is there an interaction between the two proposed mechanisms? Roberts et al. 2009
Genetics: The MHC as metric for mate choice

• Female mice prefer to mate with males that have dissimilar MHC genotypes. Roberts and Gosling, 2003.

• In three-spined sticklebacks suggested that there is an optimal level of MHC diversity preferred between mates. Kurtz et al., 2004.

• Chinook salmon that are heterozygous at MHC displayed higher pathogen resistance. Arkush et al., 2002.
Genetics: The MHC as metric for mate choice

• Mate selection based on increasing the heterozygosity of their offspring at the MHC. Landry et al. 2001.
• Non-random mating and mate choice preferences based off of increasing MHC heterozygosity of offspring. Neff et al. 2008.
• Mate selection based on MHC allelic profiles in Atlantic salmon, MHC and disease resistance. Consuegra and Leaniz 2008.

Linear relationship between MHC allelic sharing and reproductive success, i.e., more diversity = higher fitness?

Salmonids literature supports maximizing offspring MHC heterozygosity. Garner
Mate choice in wild coho on the Umpqua

• Determine whether wild coho discriminate immune-relevant genotypes when choosing their mates and whether that choice correlates to an increased RS.

• The inclusion of other immune-relevant loci in addition to the MHC will provide further insight on mate choice and differences in reproductive success within wild populations. Immune-related loci besides the MHC are also under different selective pressures and therefore likely affect offspring fitness. Sommer, 2005.
Mate choice in wild coho on the Umpqua

• Better our understanding as to what role mate choice mediated by immune-relevant loci may play in individual fitness.

• What is the Relevance:
   End up with candidate loci that increases fitness of offspring and allow prediction of desirable alleles in wild matings that should be present in hatchery fish; informed management.
Behavior: Aggression and Dominance

  - Hatchery fish competitively inferior to wild fish
  - Less aggressive, more submissive
  - Particularly males (intra-sexual selection more intense)

- Artificial breeding circumvents sexual selection
  - Allow less competitive fish to reproduce
  - Agonistic behaviors are heritable
  - Offspring: inherited behavior less fit in nature
Behavior: Correlations to Reproductive Success

• Environmental uncertainty (reproductive potential), competition, body weight Garant et al. 2001.
• Polyandry - females with more mates have a higher RS Garant et al. 2001.
• Length correlation Eizaguirre et al. 2009.
• Size of adipose fin in courtship Buckland-Nicks et al. 2011.
Genetics and Behavior Interactions

Multiple authors have shown that other assortative mating or other natural evolutionary processes (e.g., sperm competition) may obscure, constrain, or supersede mate choice based on MHC. Casalini et al. 2009; Garner et al. 2010; McCairns et al. 2011; Miller et al. 2009; Yeates et al. 2009.


Do observed mating patterns reflect a trade-off between MHC dissimilarity and other desirable traits which serves to dilute an underlying dissimilarity preference? Roberts et al. 2009
Future Work – what is next?

Patterns of mating in wild salmonid populations are not simple and are therefore not easy to predict because of complex interactions (Roberts et al. 2006).

Stream channel observations to incorporate behavioral aspects with genetic components – interdisciplinary.

Simulate various environmental conditions in stream channels and monitor mate choice of wild and hatchery fish.


What about jacks?

H Jacks are doing as well as wild fish...

• Being less aggressive and less dominant might not be detrimental for jacks as they use a sneaker reproductive tactic.

• Less aggression in adults does not necessarily mean less aggression in jacks.  
  *Garant et al. 2005.*
  - Aggression can vary with age and life-stage.  
    *Berejikian et al. 1996.*