Why it is silly to allow sex-specific values for natural mortality for young black rockfish.

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Disclaimer: The following opinions are expressed by David Sampson and may not reflect the opinions of other members of the black rockfish stock assessment team.

1. There is very strong theoretical support (in addition to empirical evidence) for the presumption that the sex ratio at birth is 50:50 (Charnov, 1982). The basis for the theoretical support comes from the Shaw- Mohler (1953) equation for the evolution of the sex ratio (r).

$$W_t \propto \frac{r'}{r} + \frac{1-r'}{1-r}$$

W_t is the fitness of a mutant female, r' is the sex ratio of a mutant female's offspring, and r is the sex ratio of a normal female's offspring.

- If $r > 0.5$ then mothers are favored who produce $r' < r$.
- If $r < 0.5$ then mothers are favored who produce $r' > r$.
- If $r = 0.5$ then fitness W_t does not change with r'.
- Selection moves the sex ratio to 50:50 and there is no effect of differential survival for sons versus daughters.

2. Given the standard exponential model for survival, the equation for the *Male*:*Female* sex ratio as a function of age can be written as follows.

$$\frac{Male_{age}}{Female_{age}} = \frac{Male_{at\ birth} \cdot exp(-Z_{Male} \cdot age)}{Female_{at\ birth} \cdot exp(-Z_{Female} \cdot age)}$$

If $Male_{at\ birth} = Female_{at\ birth}$ then the Male:Female ratio as a function of age is

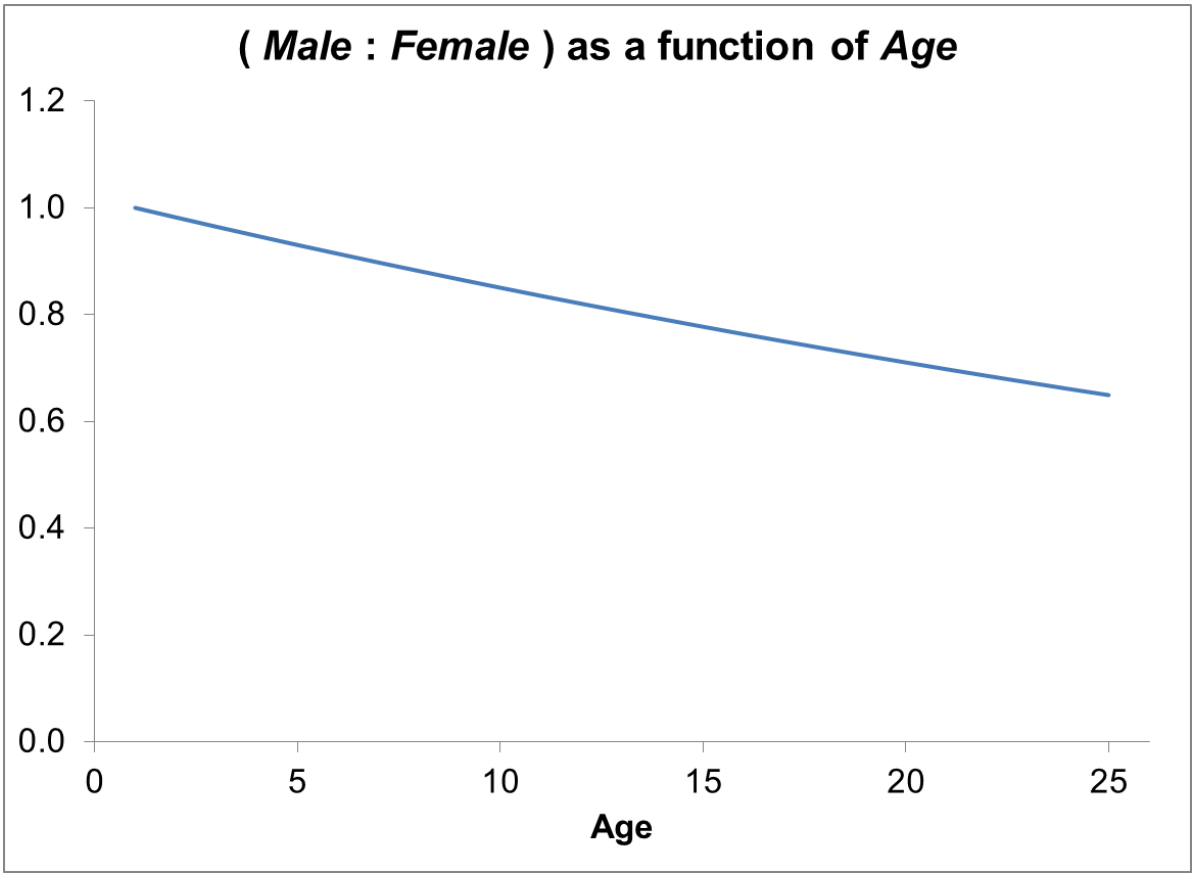
$$Male{:}\,Female(age) = exp[(Z_{Female} - Z_{Male}) \cdot age]\ .$$

3. The "reference model" requested by the black rockfish STAR Panel specified that the model for Oregon should use the median values from the lognormal prior probability distributions for the gender-specific values of M , which for the Oregon model are M_{Female} = 0.077 and M_{Male} = 0.095.

4. If there is no fishing mortality then M = Z and the *Male*:*Female* ratio as a function of age for black rockfish in Oregon can be expressed as follows.

$$Male{:}\,Female(age) = exp[(M_{Female} - M_{Male}) \cdot age] = exp[-0.018 \cdot age]$$

Here is the graph of the *Male*:*Female* ratio versus age for the Oregon model.



5. The reference model requested by the STAR Panel, which they claim is suitable to use as a potential base model for black rockfish, asserts that there are more female black rockfish than there are males in an unfished stock. In my opinion this is a totally implausible starting place for a population model for black rockfish in Oregon (or anywhere else for that matter). This model is needlessly complicated (why is the sex-ratio age-dependent?), there is no supporting evidence to support the complexity, and its predictions are totally contrary to the limited evidence that is available on the sex ratio at age for black rockfish. The models for black rockfish need to account for a deficit of females at older ages. The reference model predicts the reverse, that there is a deficit of males at older ages.

References:

Charnov, E. L. 1982. The theory of sex allocation. Princeton Univ. Press, Princeton, NJ.

Shaw, R. F., and J. D. Mohler. 1953. The selective significance of the sex ratio. Am. Nat. 837:337–342.