Models: After the examination of several modeling approaches, the two model groups we identified as fitting our criteria were the Schluter/Anderson1-3 fitness function and the Good, Dodoon, Meekeen, and Ryan2 fitness function.

Good, et al.: In this model for estimating size-selective mortality with regard to differing weather conditions the authors analysed shifts in the distribution of hatching size in the “before” and “after” populations were modeled as the product of two multinomial distributions:

\[
L_i(\pi_j) = \left( \frac{\pi_{j1}}{1+\pi_{j1}} \right)^{S_j} \cdot \left( 1 - \frac{\pi_{j1}}{1+\pi_{j1}} \right)^{100-S_j}
\]

where:

- \( \pi_{j1} \) is the probability of a fish occurring in the \( j \)-th size class at hatching (\( j=0,1,2 \ldots \)),
- \( S_j \) is the number of size-classes,
- \( S_j \) is the number of fish captured in the \( j \)-th period, and
- \( S_j \) is the number of fish captured in the \( j \)-th period in size-class \( j \) at hatching.

The probability of a fish surviving to time period 1 if it was born in size-class \( j \) is: 

\[
S_j = \left( \frac{S_j}{\pi_{j1}} \right) \left( \frac{1}{\pi_{j1}} \right)
\]

This model is useful because:

- It uses spline regression for generating trends and obtaining confidence intervals via bootstrapping; requires minimal assumptions.
- Sample size does not matter.

This modeling approach responds to the data as shown below, first in a simple example and followed by the outputs generated using the three situations of simulated data introduced above.

A simple example to follow Schluter/Anderson:

- \( S_1 = 100 \) fish
- \( S_2 = 50 \) fish
- \( S_3 = 10 \) fish
- \( S_4 = 0 \) fish

Good, et al.: In this model for estimating size-selective mortality with regard to differing weather conditions the authors analysed shifts in the distribution of hatching size in the “before” and “after” populations were modeled as the product of two multinomial distributions:

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L_i(\pi_j) = \left( \frac{\pi_{j1}}{1+\pi_{j1}} \right)^{S_j} \cdot \left( 1 - \frac{\pi_{j1}}{1+\pi_{j1}} \right)^{100-S_j}
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where:

- \( \pi_{j1} \) is the probability of a fish occurring in the \( j \)-th size class at hatching (\( j=0,1,2 \ldots \)),
- \( S_j \) is the number of size-classes,
- \( S_j \) is the number of fish captured in the \( j \)-th period, and
- \( S_j \) is the number of fish captured in the \( j \)-th period in size-class \( j \) at hatching.

The probability of a fish surviving to time period 1 if it was born in size-class \( j \) is: 

\[
S_j = \left( \frac{S_j}{\pi_{j1}} \right) \left( \frac{1}{\pi_{j1}} \right)
\]

This model is useful because it is:

- Biologically intuitive and mathematically tractable
- Works well with directional selection or no selection
- Good, et al.’s model responds to the data as shown below, first with an example containing data simulated using four categories and followed by the outputs generated using the three situations of simulated data presented above.

A simple example to follow Good, et al.:

- \( S_1 = 100 \) fish
- \( S_2 = 50 \) fish
- \( S_3 = 10 \) fish
- \( S_4 = 0 \) fish

Reference:


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