

# Age-structured model for Alaska herring stocks

Steve Martell

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## Abstract

## 1 Introduction

## 2 Methods

### 2.1 Input Data

### 2.2 Population dynamics

Estimated parameters for the population dynamics model include the initial abundance of ages 3-9+ for the initial year, abundance of age-3 recruits each year, and the natural mortality rate. In the original parameterization of the model, these initial recruitments and the vector of initial numbers-at-age result in creating  $(N + A - 1)$  scaling parameters. To reduce the potential confounding with other global scaling parameters, updates to the model code include estimation of two recruitment scaling parameters, and two vectors of deviates that represent deviations from the mean. This modification reduces the potential for parameter confounding among the many parameters that affect global scaling (i.e., catchability coefficients, natural mortality rates).

## References

Table 1: Notation and equations for population dynamics model.

Model parameters	
$\theta = \{\ln(M), \ln(\bar{R}), \ln(\ddot{R}), \ln(\alpha), \ln(\beta)\}$	(T1.1)
Initial States ( $t = 1$ )	

Table 2: Mathematical notation, symbols and descriptions.

Symbol	Description
<u>Index</u>	
$g$	group
$h$	sex
$i$	year
$j$	time step (years)
$k$	gear or fleet
$l$	index for length class
$m$	index for maturity state
$o$	index for shell condition.
<u>Leading Model Parameters</u>	
$M$	Instantaneous natural mortality rate
$\bar{R}$	Average recruitment
$\dot{R}$	Initial recruitment
$\alpha_r$	Mode of size-at-recruitment
$\beta_r$	Shape parameter for size-at-recruitment
$R_0$	Unfished average recruitment
$\kappa$	Recruitment compensation ratio
<u>Size schedule information</u>	
$w_{h,l}$	Mean weight-at-length $l$
$m_{h,l}$	Average proportion mature-at-length $l$
<u>Per recruit incidence functions</u>	
$\phi_B$	Spawning biomass per recruit
$\phi_{Q_k}$	Yield per recruit for fishery $k$
$\phi_{Y_k}$	Retained catch per recruit for fishery $k$
$\phi_{D_k}$	Discarded catch per recruit for fishery $k$
<u>Selectivity parameters</u>	
$a_{h,k,l}$	Length at 50% selectivity in length interval $l$
$\sigma_{s_{h,k}}$	Standard deviation in length-at-selectivity
$r_{h,k,l}$	Length at 50% retention
$\sigma_{y_{h,k}}$	Standard deviation in length-at-retention
$\xi_{h,k}$	Discard mortality rate for gear $k$ and sex $h$