Escanaba Lake Walleye Assignments

1 Initial Preparation, Get Data, and Simple Summaries

- Load all necessary packages
- Load the data in `WAE_Escanaba_2011_2014.csv` into an R data.frame. Examine the contents of the data.frame.
- Modify the data.frame in the following ways:
  - Remove the `Lake` and `Assessment` variables (they do not vary and will not be used in any analyses ... this simplifies the data.frame),
  - Rename the `inches` and `pounds` variables (to something better),
  - Change `sex` codes to words (note that 1=male, 2=female, 3=unknown),
  - Change the new `sex` variable to a factor variable (this is required for later analyses and can be done within `mutate()` as follows ... `sex=factor(sex)`),
  - Add a 1-in length bins variable,
  - Add logs of the length and weight variables,
  - Sort individuals by year, then age, then length, and
  - Examine the resulting data.frame.
- Produce some simple summaries that could be used to answer the following questions:
  - What is the mean length of all Walleye?
  - What is the standard deviation of Walleye lengths in each year?
  - How many fish were captured in each year?
  - How many fish of each sex were captured in each year?
  - [*Bonus*] What is the maximum length of Walleye for each sex in each year?

2 Create an Age-Length Key

- Create a new data.frame of aged female Walleye captured in 2014. [*Check your work*]
- Construct an age-length key (by 1-in length categories) for female Walleye captured in 2014.
- Examine the age-length key (both as a table and as a plot). Do you see any potential issues with this age-length key.
- Repeat the three previous steps for aged male Walleye captured in 2014.

3 Apply Age-Length Key (assign ages to unaged fish)

- Create a new data.frame of unaged female Walleye captured in 2014. [*Check your work*]
- Use the age-length key for female Walleye captured in 2014 (from above) to assign ages to all fish in this new data.frame.
- Create a data.frame that contains ALL (now with ages) female Walleye captured in 2014.
- Repeat all of the steps above for male Walleye captured in 2014.
- Combine the female and male data.frames from above into one data.frame that contains all (sexed) Walleye captured in 2014 (now with ages).

4 Estimate Mortality Rate

- Create a data.frame that contains the frequency (and log frequency) at age of female Walleye captured in 2014.
- Construct a plot and determine which ages define the "descending limb."
- Estimate (point and 95% confidence interval) Z (and A) using a weighted linear regression, but not using `catchCurve()`.
- Estimate (point and 95% confidence interval) Z (and A) using a weighted linear regression, using `catchCurve()`.
- [*Bonus*] What impact does the low catch of age-11 fish have on the estimate of Z (and A)?
- Estimate (point and 95% confidence interval) Z (and A) for male Walleye captured in 2014 using a weighted linear regression.

5 Compare Mortality Rates

- Create a data.frame that contains the frequency (and log frequency) by age of Walleye captured in 2014 separated by sex.
- Fit a weighted indicator variable regression to the descending limbs so that Z (i.e., the slopes) can be statistically compared between sexes. [*Note that this will require a careful filtering of the summaries produced above to isolate both descending limbs.*]
- Statistically test if the slopes (i.e., Z) differ between the sexes.
- Construct a "fancy" plot that demonstrates the catch-curves both sexes.

6 Fit Growth Model

- Create a plot of length versus age for all male Walleye captured in 2014. Comment on whether you think there will be any "problems" with fitting the von Bertalanffy growth function (VBGF).
- Fit the VBGF for male Walleye captured in 2014. Comment on assumptions from the residual plot.
- Comment on the correlations among parameter estimates.
- Construct profile likelihood confidence intervals for each parameter.
- Construct bootstrapped confidence intervals for each parameter.
- Predict, with a bootstrapped confidence interval, the mean length for a chosen age (you choose the age).
- Plot the best-fit VBGF over the observed data.
- Repeat the above for female Walleye captured in 2014.

7 Compare Growth Model Parameters

- Fit the ulimated full model to all male and female Walleye captured in 2014. Visually assess the assumptions.
- Fit the ultimate simple model and statistically compare it to the ultimate full model to determine if at least some of the VBGF parameters differ.

- Use model reduction methods to find the most parsimonious model. Interpret from this model which parameters differ between the sexes.
- Use AIC to identify the most supported model(s).
- Plot the best-fit VBGFs (according to the most parsimonious model or most supported models).

8 Compute Weight-Length Relationship

- Fit the weight-length relationship to male Walleye captured in 2014.
- Predict the weight for a fish with a chosen length (you choose the length).
- Construct a plot (with a prediction band) that demonstrates the model fit.
- Repeat the above analysis for female Walleye captured in 2014.

9 Compare Weight-Length Model Parameters

- Statistically compare the weight-length relationships between male and female Walleye captured in 2014.
- Construct a plot that demonstrates the model fit.