Age and Growth of Fishes

Fish Techniques Chapter 15

“We’re gettin’ old, Jake.”
Terms

- **Age**
  - Hours
  - Days
  - Years
  - Life stage

- **Growth**
  - Length
  - Mass

Figure 15.1  Common measurements of fish length—maximum standard, fork, and maximum total.
Why

- As before...
- Pop Size
- Movement dispersal
- Diet
Age Convention and Terminology

- Year class
- Age class
- Cohort
- Age-0
- Age-1
- Etc.

Figure: Illustration of fish age terminology adopted herein.
Conventions for age designations

2008 year-class
Age 0
Age-group 0
Young of year

Age 1
Age-group 1
Yearling

Age 2
Age-group 2

January May July January July January July
Hatched 1st “Hatch day” 2nd “Hatch day”

Figure Illustration of fish age terminology adopted herein.
3 Aging Methods for Fishes

1. 

2. Figure 16.1  Length-frequency distribution of catch of haddock, indicating the length-groups of fish caught and how ages were assigned. Note the difficulty in assigning ages to fish that are older than age 3 (from Lux 1971).

3. Figure 15.4  Common locations for removing scales include areas just posterior to the pectoral fin (A), just dorsal to the lateral line and ventral to the dorsal fin (B), and on the caudal peduncle (C).
1. Direct Observation

- Catch, tag/mark, release, recapture

- PIT
- Coded wire
- Alpha tags
- VIE
- Telemetry
  - Acoustic
  - Satellite
  - Radio
- Standard
  - Clips
  - marks
  - T-bar
2. Length Frequency Analysis
Length Frequency Analysis

- Peaks = age groups

**Figure 16.1** Length-frequency distribution of catch of haddock, indicating the length-groups of fish caught and how ages were assigned. Note the difficulty in assigning ages to fish that are older than age 3 (from Lux 1971).
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2. Length Frequency Analysis

Considerations:

- Assumes length at age is uni-modal
- Bin size effects modes
Example with Creek Chubs
2. Length Frequency Analysis

Considerations:

- Assumes length at age is uni-modal
- Bin size effects modes
- Year class failures may affect interpretation
Year Class Failure (A)  
Overlapping (B)
2. Length Frequency Analysis

Considerations:

– Assumes length at age is uni-modal
– Bin size effects modes

– Year class failures may affect interpretation
– Difficult for old ages
Overlap

Older fish grow slower in length

Figure 16.1 Length-frequency distribution of catch of haddock, indicating the length-groups of fish caught and how ages were assigned. Note the difficulty in assigning ages to fish that are older than age 3 (from Lux 1971).

FIGURE 8.16 Length frequency for a black crappie sample obtained during spring using a modified-fyke net. Horizontal lines indicate the length range for each age group (1–5). As the fish age, there is more overlap in length between age groups (cm = centimeters).
Length Frequency Analysis

What can cause the “blending?”

– Same as for humans (in part)
  - Determinant vs. In-determinant growth
– growth rate varies with individuals or sex
2. Length Frequency Analysis

Best for:

– Younger age classes
2. Length Frequency Analysis

- Low cost, easy
3. Hard parts

Examples

1.

Secondary Radii
Lateral field
Ctenii
Anterior field
Focus
Primary Radii
Lateral field
Circuli
Posterior field

2.

4.

5.

6.
How it works

Collect and store in coin envelopes or water:ethanol
Scales

- Used a lot
- Non-lethal, convenient
- May show false years

- DOES NOT work for what kind of fishes???
Which scales to take?

- Depends
- Avoid lat line and regen scales
16.2.3.2 Techniques for Using Hard Parts

Features of Scales:

Figure 16.7. Cycloid scale of a haddock.
16.2.3.2 Techniques for Using Hard Parts

Scales:

Figure 16.8. Ctenoid scale of a yellowtail flounder.
Figure 15.2  Cycloid (left) and ctenoid (right) scales and morphological characteristics important for estimating age and growth of fishes.
Scale Preparation

16.2.3.2 Techniques for Using Hard Parts

Squash scale in acetate slides
Microscope projector

Figure 16.3 A scale press (from Smith 1954).
Some Examples

210 mm

Bluegill
Some Examples
Example of why we avoid lateral line
Otoliths

- Earstones
- Lethal
- Can be better than scales
Otolith Location

- Catostomid X-ray
- Lapilli and Asteriscus
- Sagittal (largest)
Otoliths

16.2.3.2 Techniques for Using Hard Parts

Features of Otoliths:

Figure 16.6 Otolith from Pacific hake, showing position of transverse section used for age determination (from Beamish 1979).
Spines

Catfish lack scales and have small otoliths.

Fig. 16.8

Location to take cross-sections of spines & rays:

(A) Channel catfish spine indicating the location at which to section.
(B) Diagram of a fin ray (biserial) showing the location for sectioning after filaments are separated.
Other hard parts

- Prepared Opercles
- Prepared Cleithra
- Pectoral Fin Rays
Structure Preparation

Choose Method to Maximize Readability

- Read whole or make impression
- Boil
- Section
- Crack and Burn
- Chem burn and stain
Ageing Guidelines/Comments

- More Than 1 Reader
- Generate a **Consensus Age**
- Don’t spend > 1 min
Ageing Guidelines/Comments

- It’s an art, subjective
Working with Age Data

- Back calculating size-at-age to estimate growth
So we can estimate past size/growth

Box 16.4 Back-Calculation of Past Growth

Back-calculation is a technique that allows fisheries biologists to obtain information on past growth of a fish based on the relationship between the radius of a hard part and fish length. If the relationship is directly proportional, then it can be graphically demonstrated as follows.
Box 16.4 Back-Calculation of Past Growth

Back-calculation is a technique that allows fisheries biologists to obtain information on past growth of a fish based on the relationship between the radius of a hard part and fish length. If the relationship is directly proportional, then it can be graphically demonstrated as follows.

[Diagram showing the relationship between fish length and scale radius, with labeled edges and nucleus.]
Back-calcualting size

Assuming growth rate is similar

\[
\frac{L_c}{S_c} = \frac{L_i}{S_i}
\]

Fish Length

Hard part Length

Fish Length some time before \( X \)

Hard part Length at some time before
\[
\frac{L_c S_i}{S_c} = L_i
\]
We might age bluegill from a lake and find:

\[
\begin{align*}
\text{Age-1} &= 116 \text{ mm} \\
\text{Age-2} &= 143 \text{ mm} \\
\text{Age-3} &= 170 \text{ mm} \\
\text{Age-4} &= 185 \text{ mm} \\
\text{Age-5} &= 200 \text{ mm} \\
\text{Age-6} &= 205 \text{ mm}
\end{align*}
\]

From this data we can estimate the growth for age-1 to age-2 as:

\[
= (L_2 - L_1) \\
= (143 - 116) \\
= 27 \text{ mm per year}
\]

OR

\[
\frac{27}{365} \text{ d} = 0.074 \text{ mm/day}
\]
Growth

- Usually yearly:
  - Change in Mass or Length over a year
  - From a yearly fish assessment, etc.

- With age
  - Growth by age group and / or sex
Lab

- **Read / Age Scales**
  - Back calculating length at age
  - Estimating growth
  - Compare growth for bass

- **See Web Page for Age and Growth of fishes**
  [http://jcsites.juniata.edu/faculty/merovich/FishAge_Growth](http://jcsites.juniata.edu/faculty/merovich/FishAge_Growth)
  - (Prepare and) Read Lapillus Otoliths
  - (Prepare and) Read Sagittal Otoliths
  - Thanks to Ryan Braham and Andy Hafs