Alaska Department of Fish and Game

Age Determination Unit

By

Kara Hilwig, Interim Lab Supervisor

Kevin McNeel

April Rebert

Rob Dinneford

Dion Oxman, MTALab Director

09/10/2013

What is ADU?

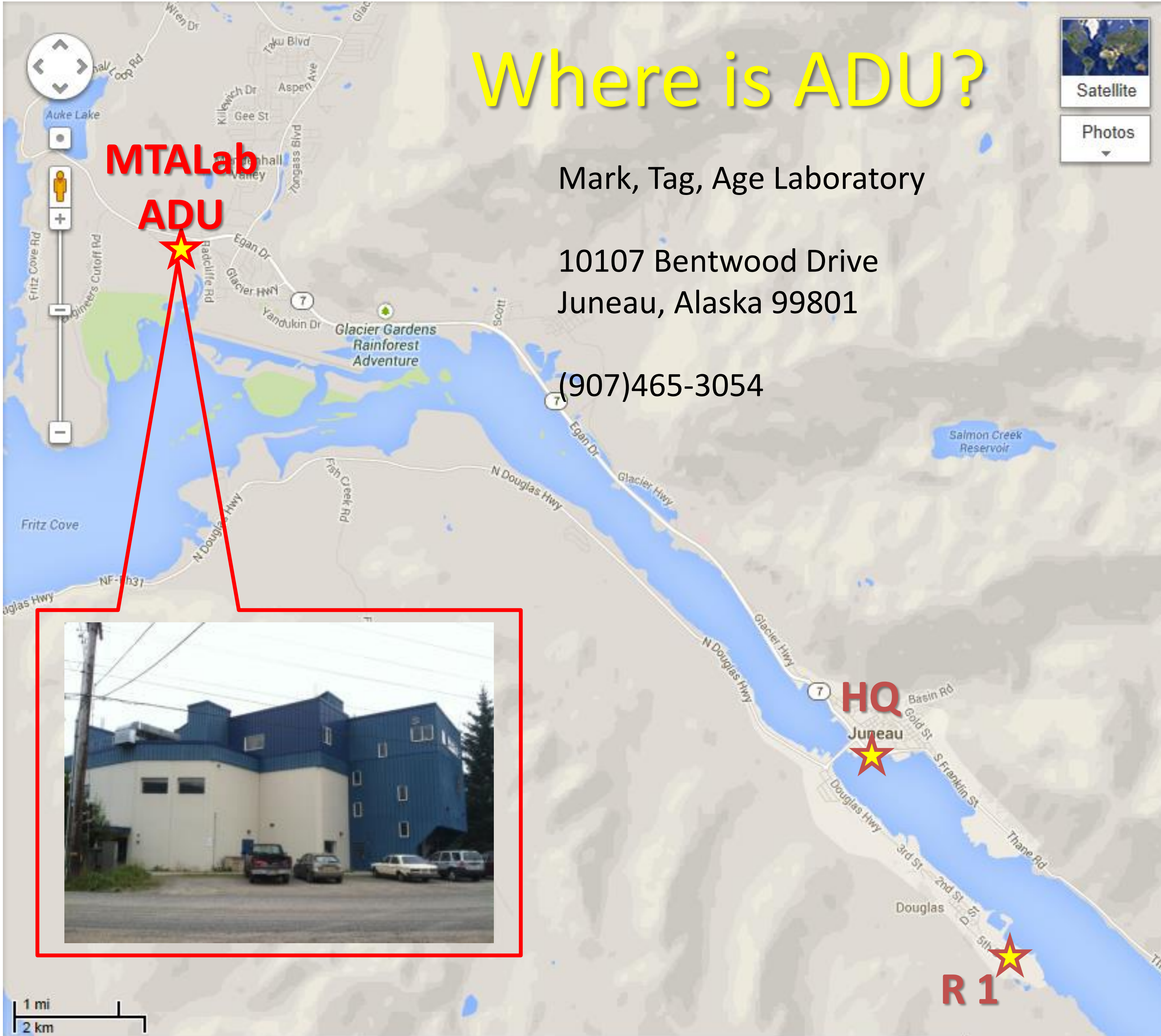
- Alaska Dept. of Fish and Game
- Statewide groundfish and invertebrate age reading lab
- Operates under Headquarters in Juneau, AK
- A division of the Mark, Tag and Age Lab
  - Age Determination Unit
- Collaborate with other ADFG Age Readers
  - Based in Regions II and IV

Where is ADU?

Mark, Tag, Age Laboratory

10107 Bentwood Drive
Juneau, Alaska 99801

(907)465-3054



What does ADU do?

- Produce age data for fish and invertebrates
- Receives samples from commercial and sport fisheries, mariculture program, surveys and research projects
- Assist in port sampling and survey work
- Collaborate to standardize age reading criteria
- Age validation studies
- Age structure morphometrics

Who is ADU?

Rob Dinneford

- Sample handling, receiving, and archiving
- Age Structure Measurement Specialist
- Data Entry Specialist
- Consumables Request Coordinator
- Inventory Specialist
- Age Reader in Training

Who is ADU?

April Rebert

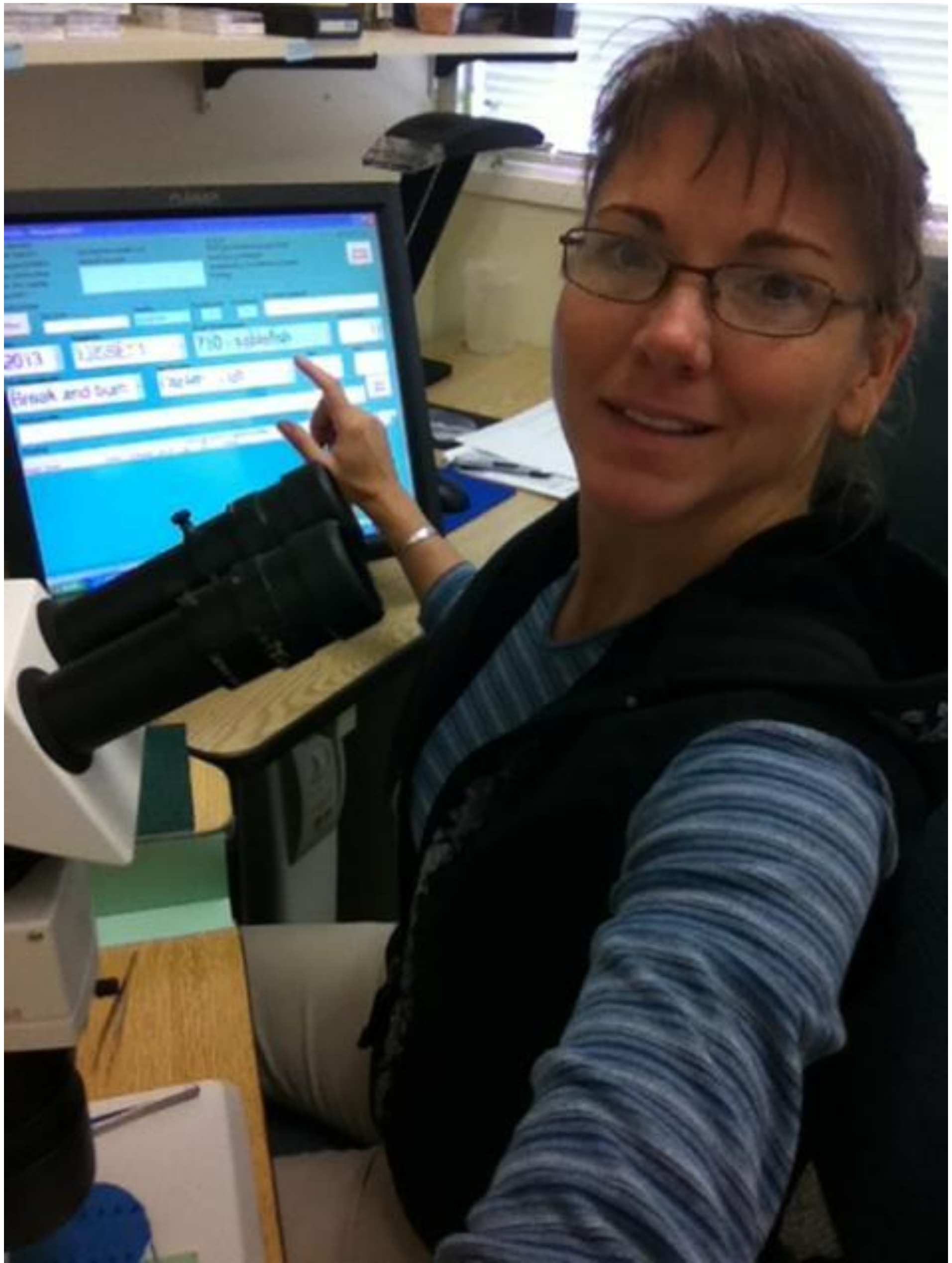
- Production Age Reader
- Database Steward
- Invertebrate Specialist
- Ergonomics Specialist

Who is ADU?

Kevin McNeel

- Production Age Reader
- Database Steward
- Sablefish and Rockfish Specialist
- Imaging Specialist
- Biochronology Specialist

Who is ADU?



Kara Hilwig- (907)465-3054

(FB III Recruitment Pending)

- Interim Lab Supervisor
- Director of Operations
- Career Experience:
    - 18 yrs Fish Conservation and Invasive Species Management in Grand Canyon and Western US
    - 3 yrs Age Reading in AK
- Production Age Reader

Who is ADU?

?

To Be Determined

Biometrician II

(Biometrician II Recruitment Pending)

- Mark, Tag, and Age Lab Statistician
- Statistical liaison for age readers and end users
- Analysis support for age validations, biochronologies, etc

Who is ADU?

Dr. Dion Oxman

- Mark, Tag, and Age Lab Director
- Research and Collaboration Coordinator
- Career Experience:
    - Salmon Ecology
    - Sclerochronology
    - Elemental Analysis
    - Quantitative Genetics
    - Stress Physiology

Please send correspondence to:
Dion.oxman@alaska.gov
(907)465-3499

ADFG Age Data Production Process

- Regions and Researchers give us a heads up on anticipated specimen numbers and species

  ~6 mo-1yr lead time please
- Samples collected, ADU staff assistance
- Regional samplers invoice to us online thru OASIS

http://mtalab.adfg.alaska.gov/ADU/SignOn.aspx?ReturnURL=OASIS.aspx

- Data goes into Oracle Database
- Samples shipped, logged in, labeled
- Structures measured and aged
  - through custom designed application screens
- Data Distributed to User **(due dates discussed)**
- Samples Archived at ADU

OASIS Screen Shot

OASIS User Information

Agency: ADFG

Region: 1

Sender: AARON BALDWIN

Sender Location: DOUGLAS

Invoice Number: 000146

Sample Information To Add/Edit

Sample Date: mm/dd/yyyy

Regional Sample ID:

Regional Project Code:

Regional Trip #:

Regional Effort #:

Capture Location:

Management Area:

Fishery Type:

Gear Type:

Sample Location:

Species:

Start Specimen #:

End Specimen #:

Age Structure: Otolith

Add to Sample Invoice

Clear Sample Information

Samples To Be Invoiced

	Sample Date	Regional Project Code	Regional Trip Number	Regional Effort Number	Regional Sample ID	Management Area	Sample Port/Location	Capture Port/Location	Fishery Type	Gear Type	Start Specimen Number	End Specimen Number	Species Code	Age Structure	
Edit	07/10/2013		13LC4120		13LC4120	SSEI	Ketchikan Port		Commercial	Longline	1	33	sablefish	Otolith	Delete
Edit	07/03/2013		13LC4115		13LC4115	SSEI	Ketchikan Port		Commercial	Longline	1	25	sablefish	Otolith	Delete
Edit	06/25/2013		13LC4114		13LC4114	SSEI	Ketchikan Port		Commercial	Longline	1	18	sablefish	Otolith	Delete
Edit	06/24/2013		13LC4113		13LC4113	SSEI	Ketchikan Port		Commercial	Longline	1	14	sablefish	Otolith	Delete
Edit	06/19/2013		13LC4111		13LC4111	SSEI	Ketchikan Port		Commercial	Longline	1	10	sablefish	Otolith	Delete
Edit	06/18/2013		13LC4110		13LC4110	SSEI	Ketchikan Port		Commercial	Longline	1	31	sablefish	Otolith	Delete

The ADU Archive and Oracle Database
Riches within!

- 214,503 Specimens
- 39 species (fish, inverts)
- From 7,303 Samples taken across Alaska
- Earliest capture year: 1981
- Age Range = 0 – 205 years old
- Birth years = 1795 - 2012
- Age data released = 158,611 records
- Age Structure Measurements = 128,698

Mostly data for specimens aged at ADU, few data for specimens aged by Regional readers

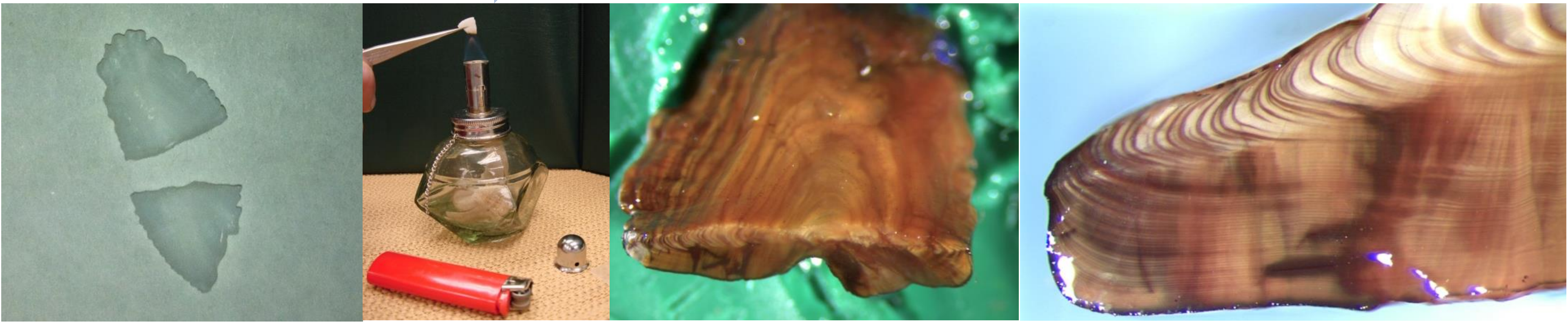
The ADU Archive

Bursts at the seams!

Whole otolith, clean and dry → Measured → Weighed → Broken

GROUNDFISH OTOLITH PREP

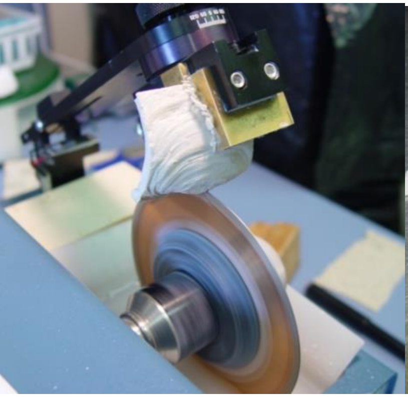
Burned → Oiled → Specimen ready to read!

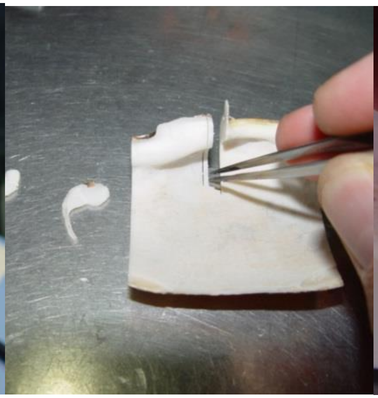


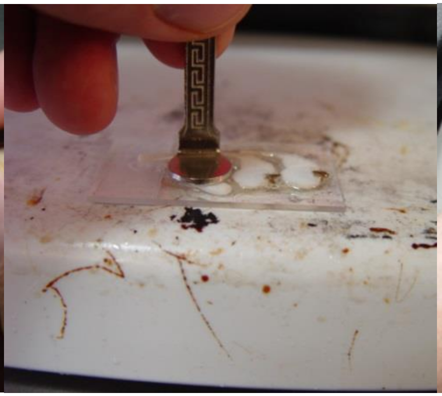
Whole valve, clean and dry → Weighed → Measured → Hinge piece removed

VALVE SPECIMEN PREP

Thin sections of hinge plate cut at umbo → Serial thin sections removed → Thin sections mounted → Thin sections ground and polished → Specimen ready to read!







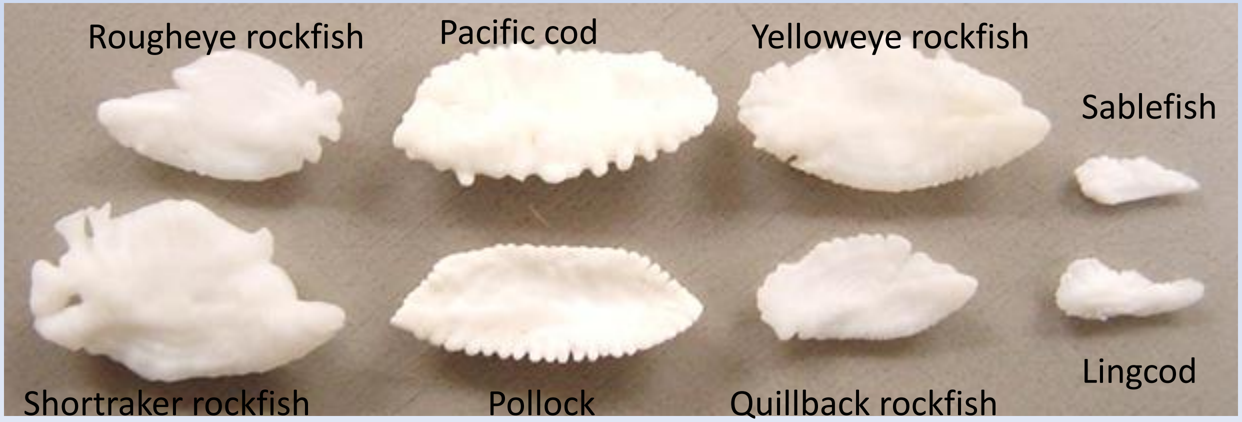
Standardization of Methods

Committee of Age Reading Experts (CARE)

- International, state and federal agencies
  - PSMFC, NOAA-NMFS AFSC,CDFO, ODFW, ADFG, WDFW, CDFG, and IPHC
- Affiliated with the TSC (Technical Subcommittee of the Canada-U.S. Groundfish Committee)
- Standardize and improve age determination techniques and activities for Pacific Ocean fish species
  - The Manual On Generalized Age Determination Procedures For Groundfish (2006)
  - Biannual meetings
  - Online forum
  - Age structure exchanges

ADFG Age data

- Other age readers: Regions II and IV
- Age Structure Exchanges
  – Compare are reading criteria
- Rap and Burn – Desire to make annual event!
  – Gathering at ADU
  – Literature update
  – Food and after hour fun!
  -- Standardize criteria
  -- Novel Species

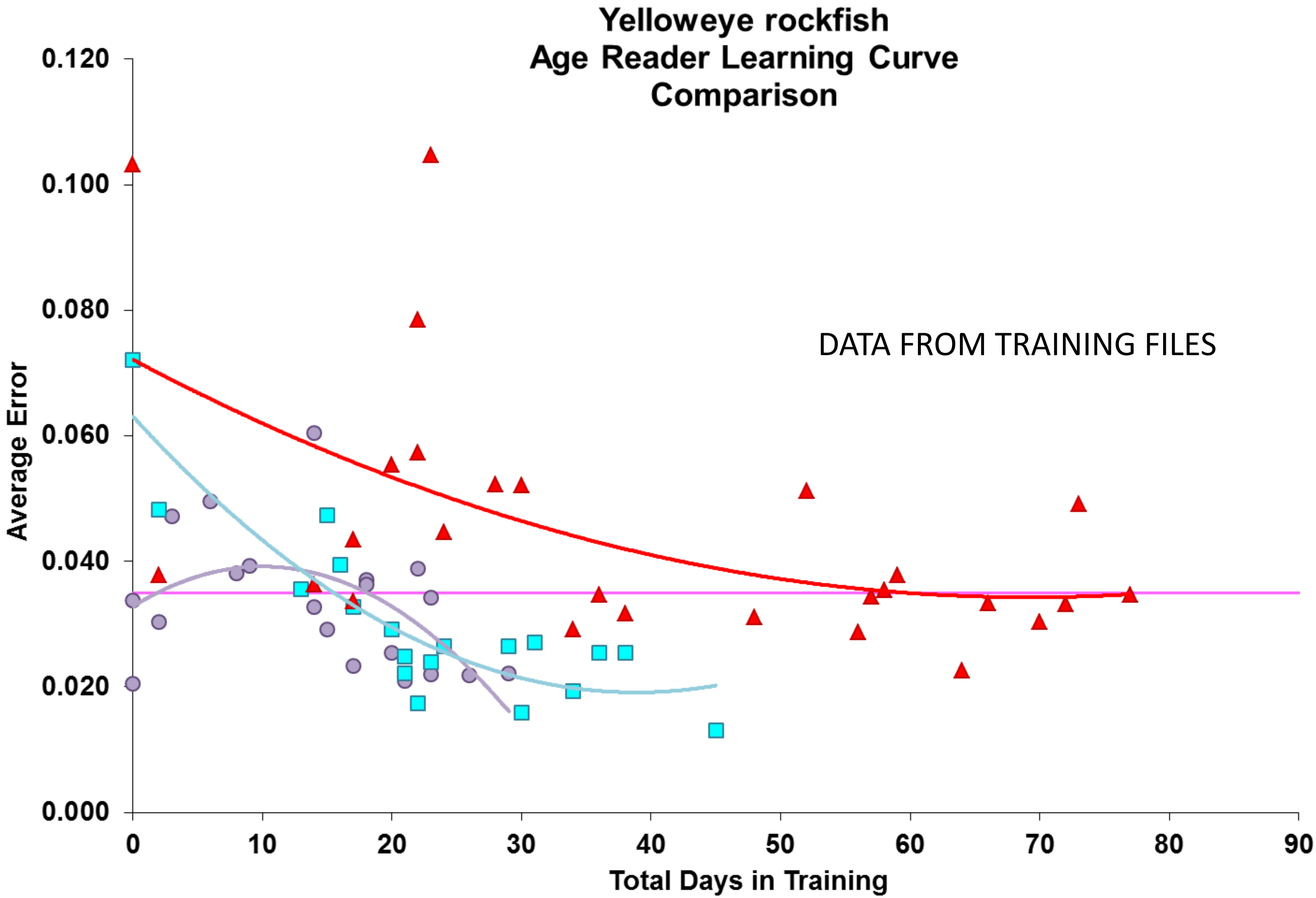


Age Reader Training

- Mentorship from experienced reader
- Age reading criteria (CARE, training scope, image library, manuals)
- Training files to track APE and CV (Avg. % Error)

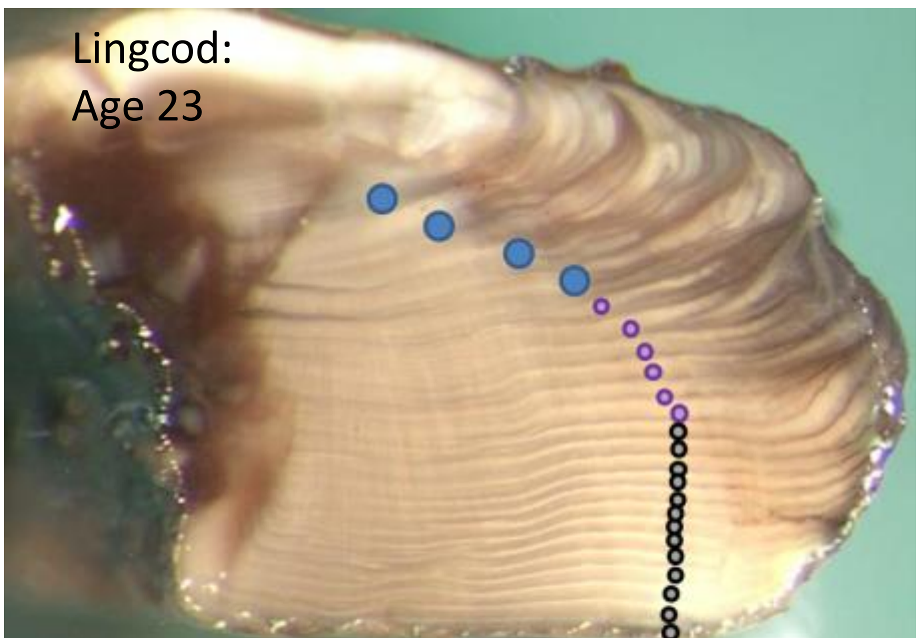
APE is a measure of the difference between two readers' age estimates

- Species specific threshold values for APE
- Once achieved, new reader 2nd reads an experienced reader, then eventually becomes primary reader

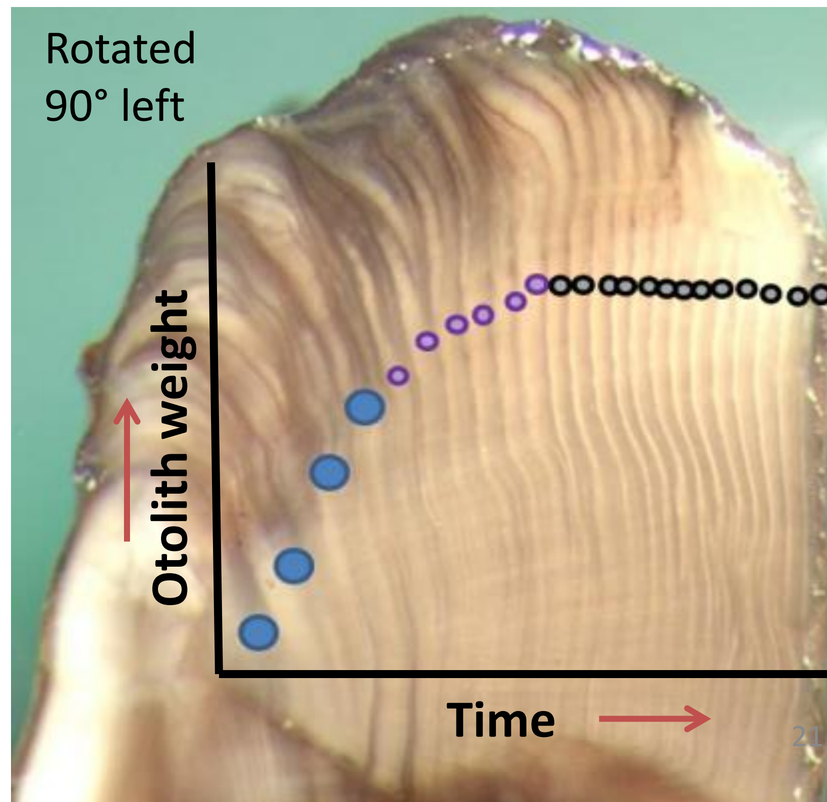

Yelloweye rockfish
Age Reader Learning Curve
Comparison
DATA FROM TRAINING FILES
Average Error
0.120
0.100
0.080
0.060
0.040
0.020
0.000
0
10
20
30
40
50
60
70
80
90
Total Days in Training

ADU's Otolith Accretion Model applied to age reading

- Otolith growth fundamentally follows a VonBertalanffy growth equation
  - Fast early growth, transitional growth, maintenance
- Observed in otolith as growth increment spacing or annual accretion

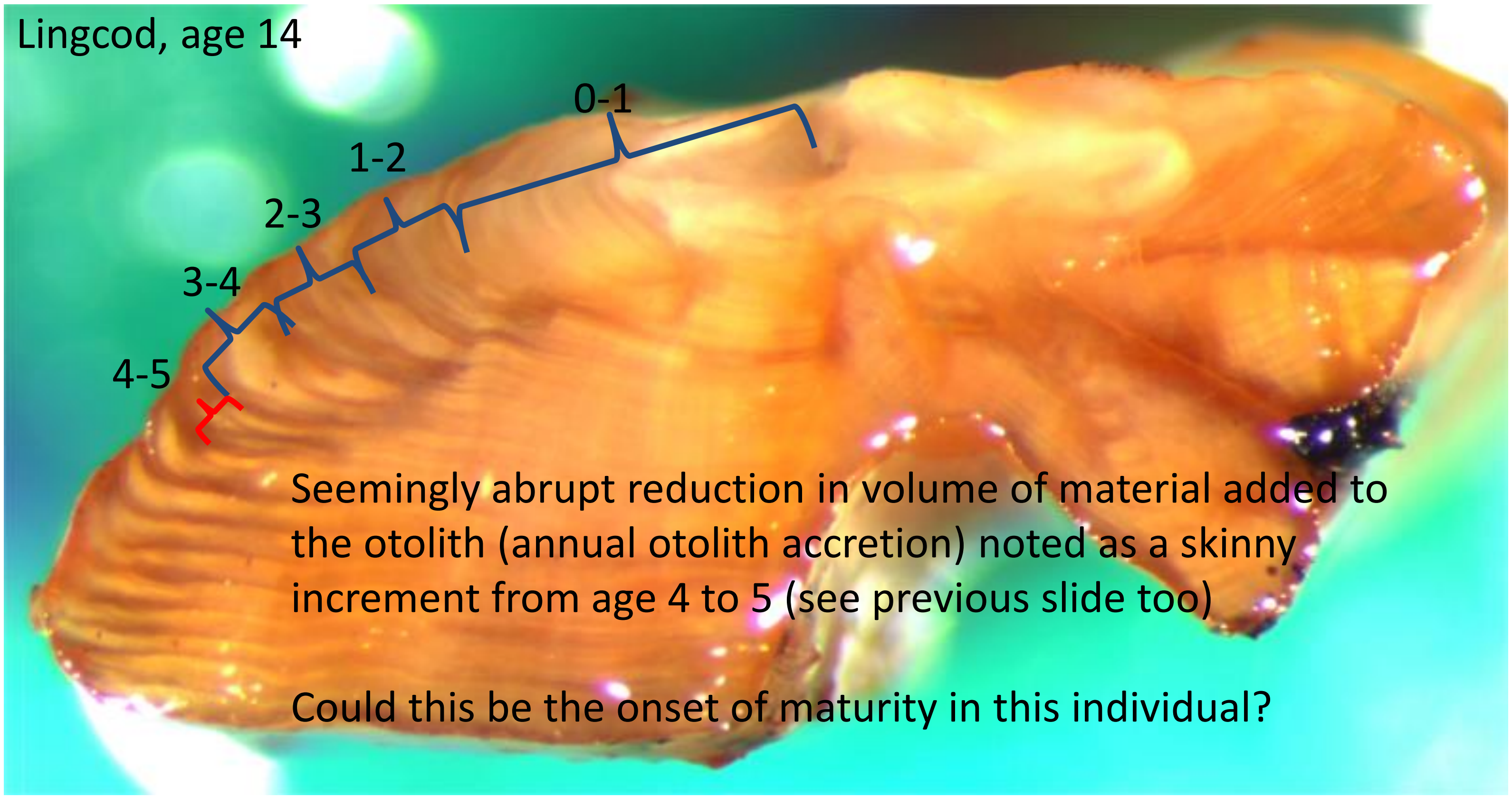


Warning: Exceptionally easy specimen chosen to demonstrate



Life History applied to age reading

- Life history events expressed in common otolith growth patterns?



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Life History applied to age reading

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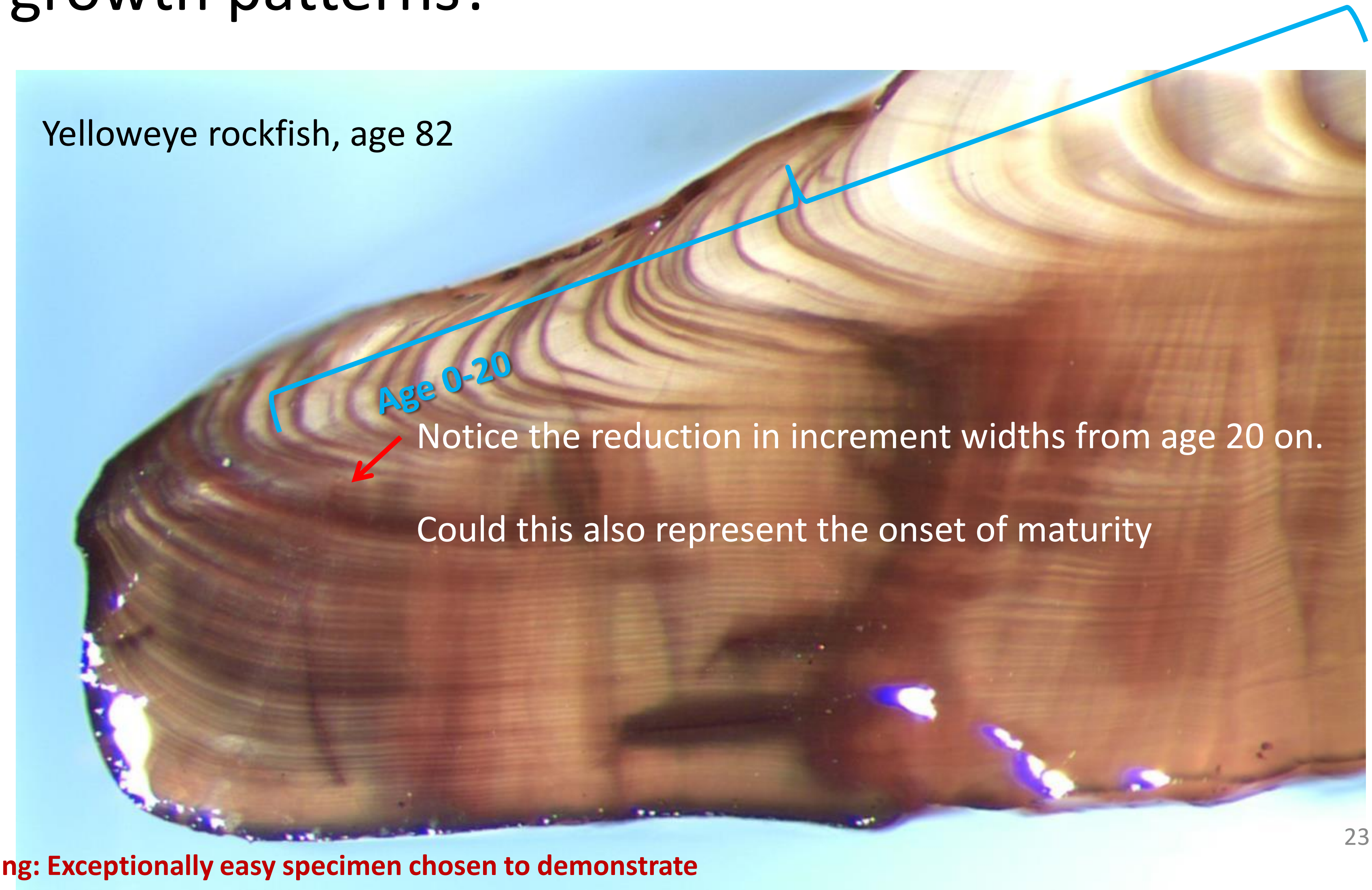
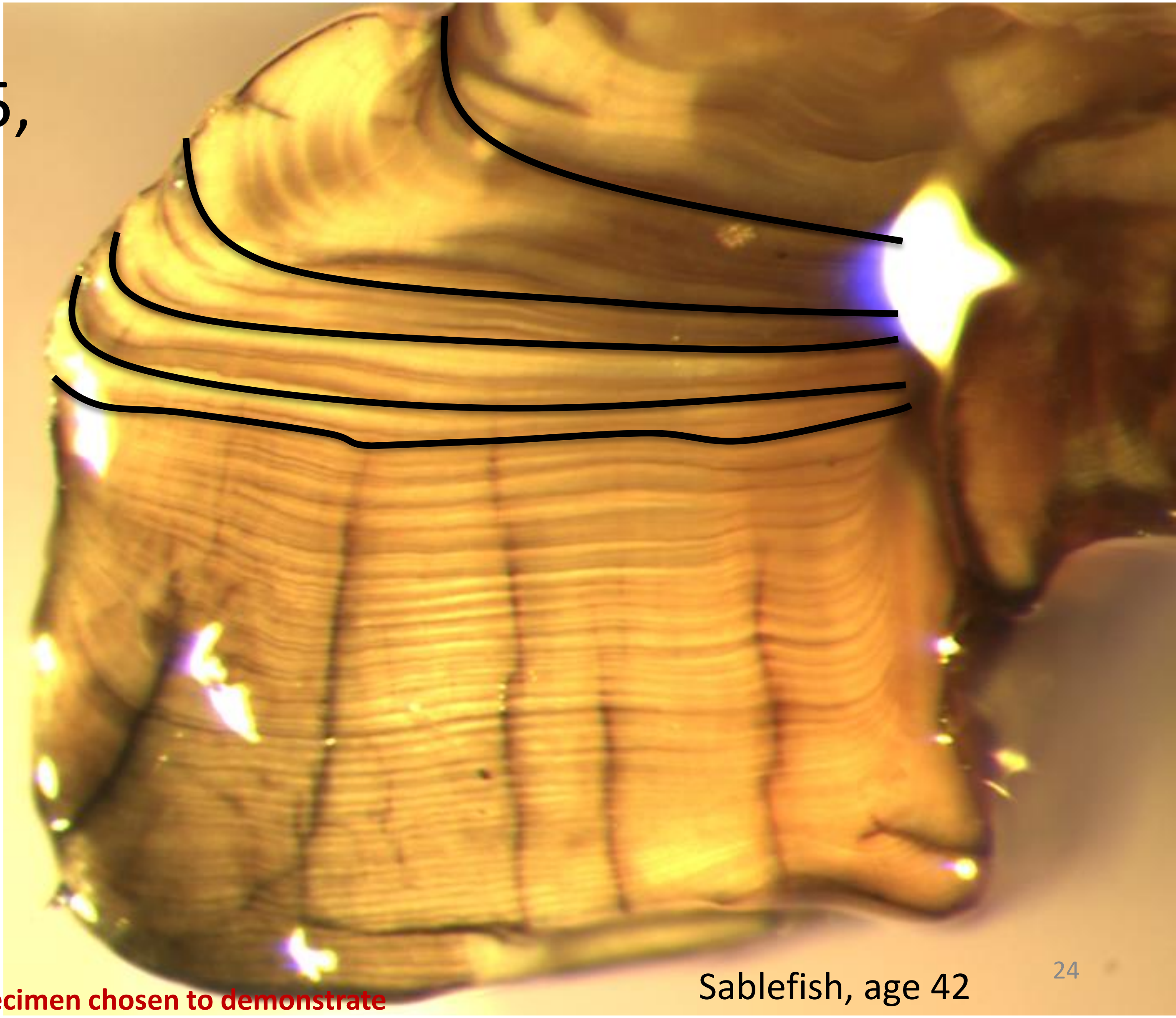


Warning: Exceptionally easy specimen chosen to demonstrate

Life History applied to age reading

Transition at 5, which is the reported age of maturity.



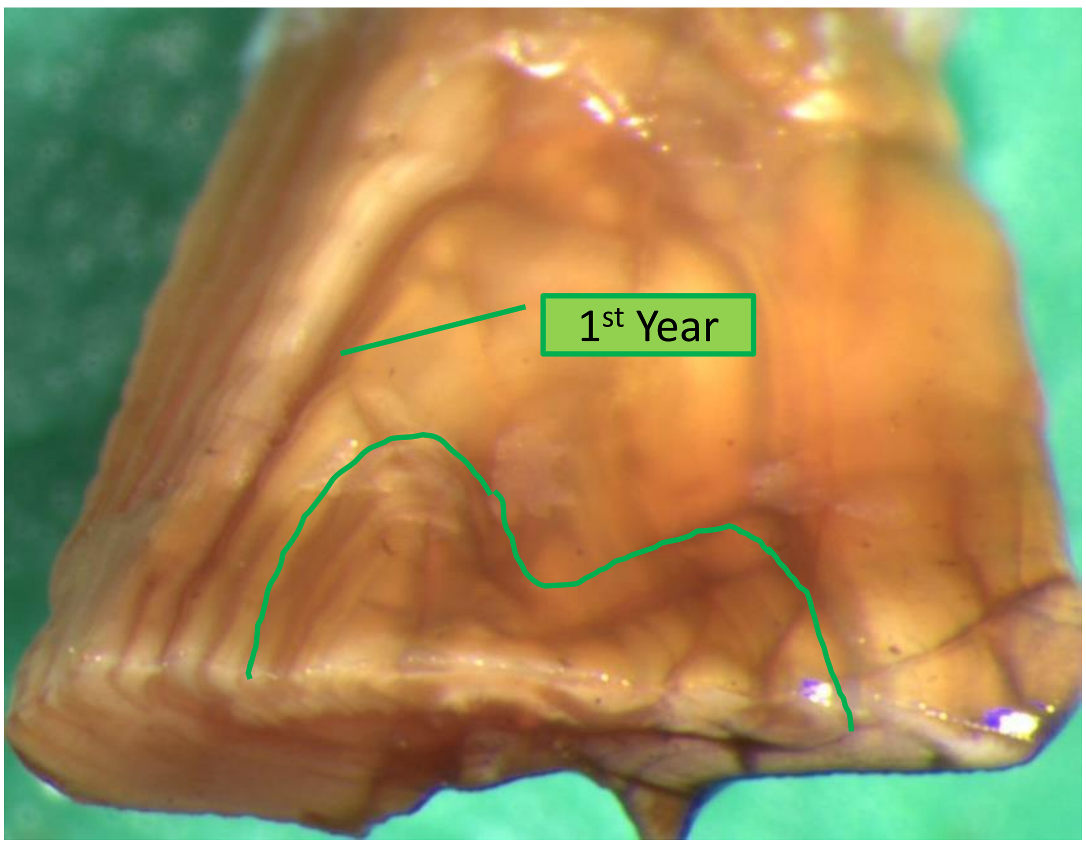
Sablefish, age 42

Warning: Exceptionally easy specimen chosen to demonstrate

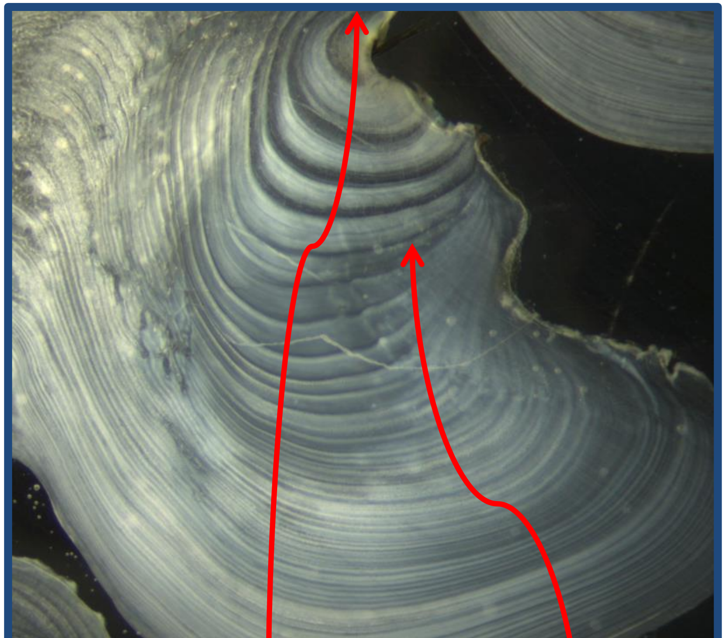
Life History applied to age reading

A common feature on sablefish within the first year of growth. Visible feature, but lacks annual character. It is not as prominent as the first annulus. Could this be a feature that occurs with **settlement**?

“The Butterfly”

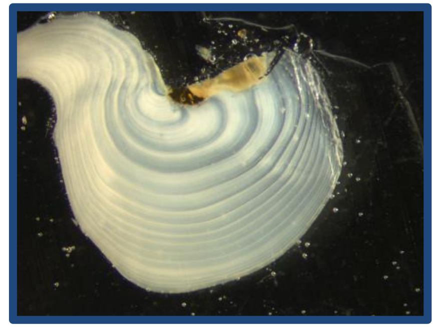


Life History applied to age reading

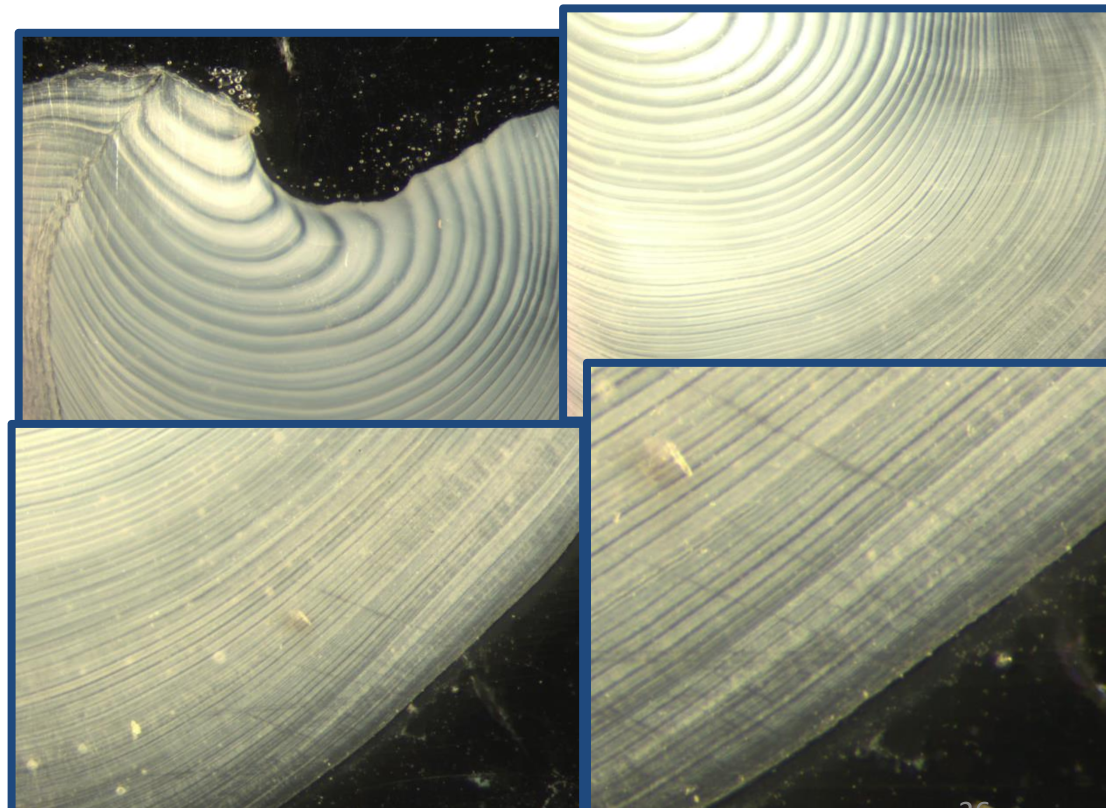


- Settle in 1st year
- Fast growth in first 5 years
- Mature at 5 years

Geoduck



17 years old; Born in 1995



74 years old; Born in 1938

Age Structures

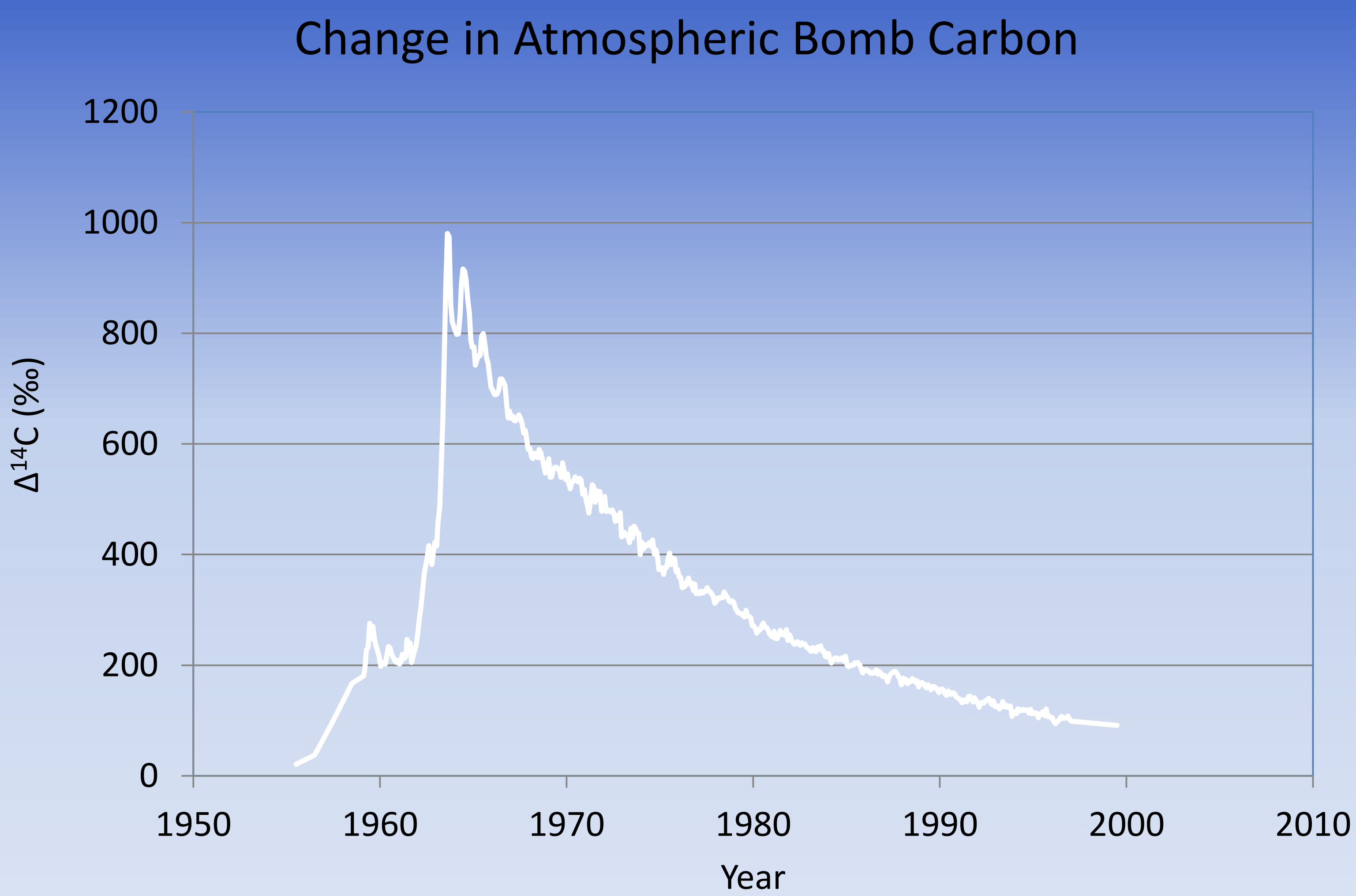
Have *so much more* to tell us

…than…

just an age estimate

Age Validation using Bomb Carbon

Atmospheric testing of nuclear weapons created a signal



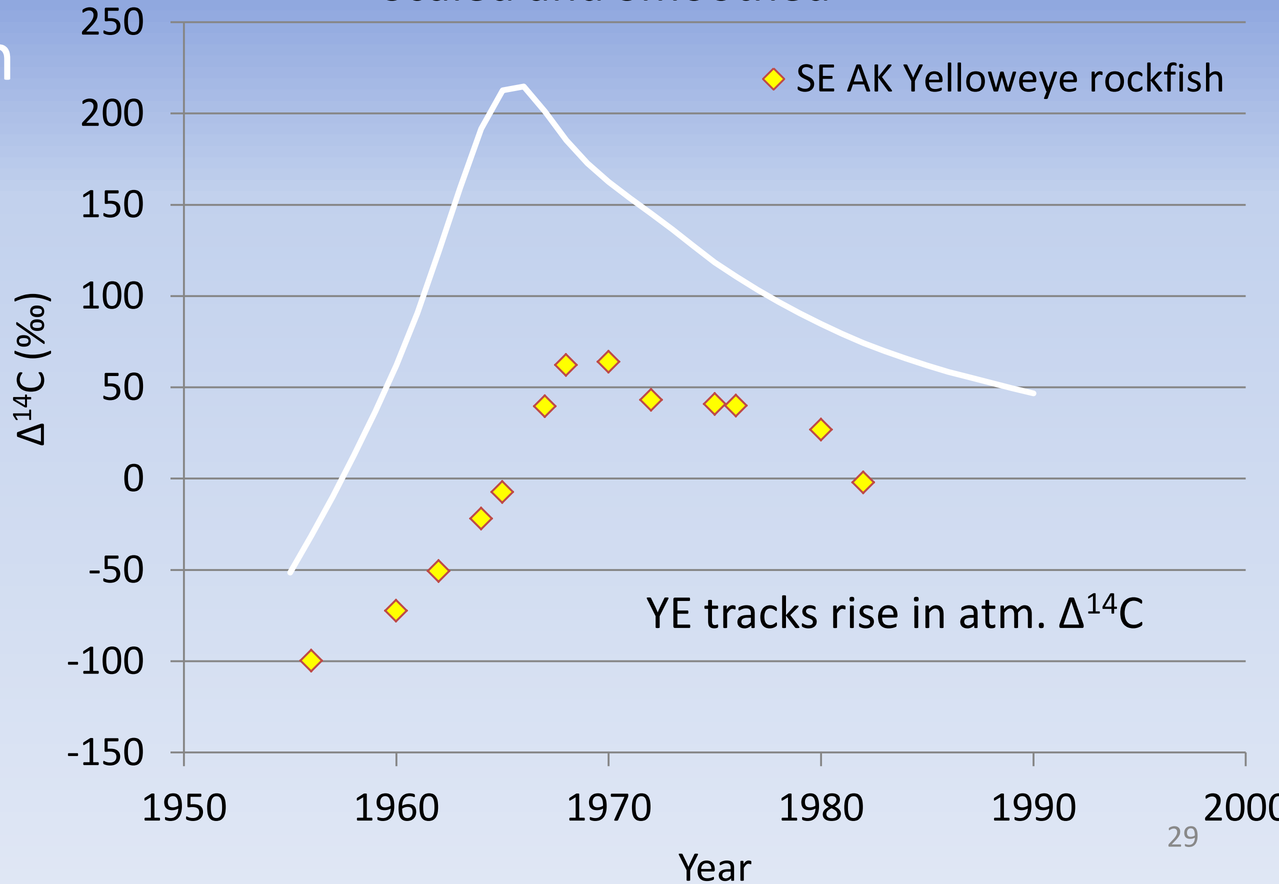
Northern Hemisphere – NH1 data

Age Validation using Bomb Carbon

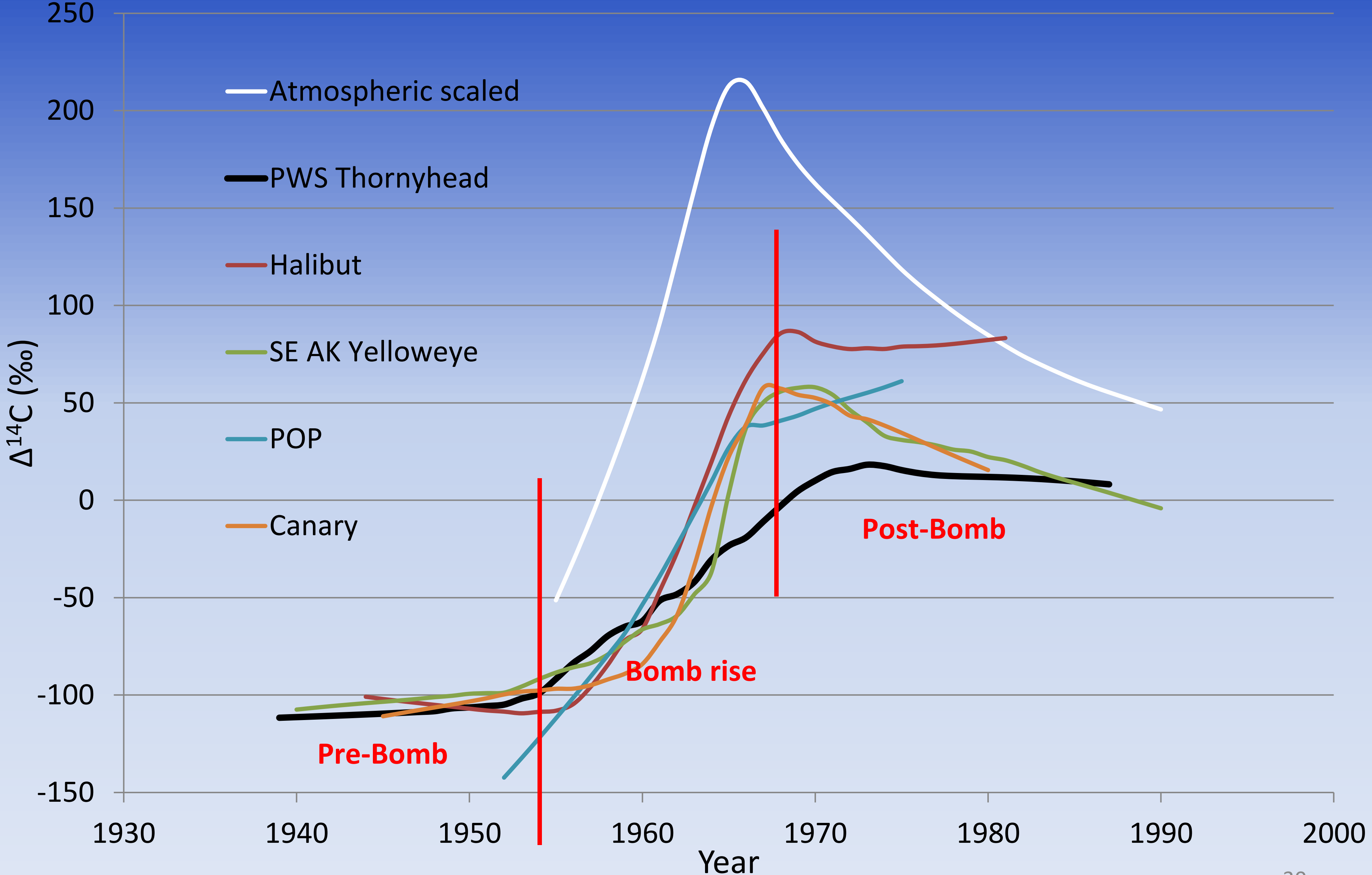
- Signal appears in most anything containing carbon
- Bore out the center of the otolith to get $\Delta^{14}C$ level for the first year of life.
- Gets at birth year validation

Birth Year Estimate	$\Delta^{14}C$
1956	-99.8
1960	-72.4
1962	-50.7
1964	-22
1965	-7.4
1967	39.6
1968	62.2
1970	64
1972	43.1
1975	40.8
1976	39.9
1980	26.8
1982	-2.1

Change in Atmospheric Bomb Carbon – Scaled and Smoothed



Bomb Carbon – LOESS curves



Biochronology – adapted from Dendro

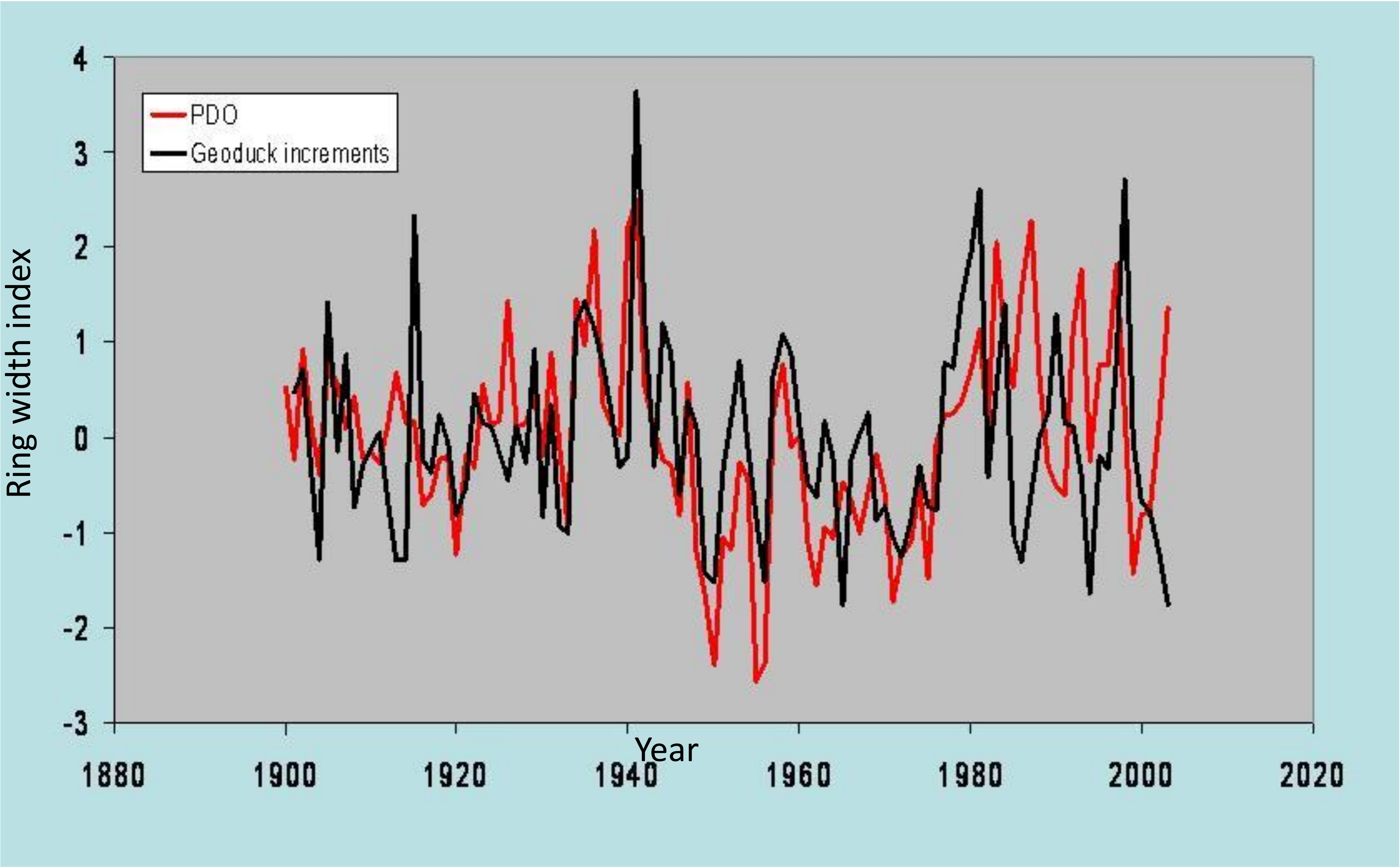
- Age specimens
- Measure growth increments
- Identify 'marker years'
- Correlate year specific increment values to environmental measures
  - e.g. SST, Chloro, Upwelling
- Overlap marker years from multiple specimens
- Extend chronology back in time with old specimens
- Historical environmental conditions

Historic recruitment dynamics

Good growth year, large whitish increment

Annotated for demonstration, not actual year

Geoduck chronology and the Pacific Decadal Oscillation



From CDFO Sclerochronology Group 2006

Alaska Dept. of Fish and Game's
Age Determination Unit
has one of
the largest collection of
Age Structure Measurements
within the age reading industry
WORLD-WIDE

N = 128,698

Age Structure Measurements

GREAT POTENTIAL

for discovering

INSIGHTS into:

- life history, physiology?
- individual and population growth?
- unknowns and uncertainties?
- better modeling ?
- better management?

See what you think !

Exploratory ASM data summaries presented to demonstrate concepts, error bars excluded for clarity of concepts

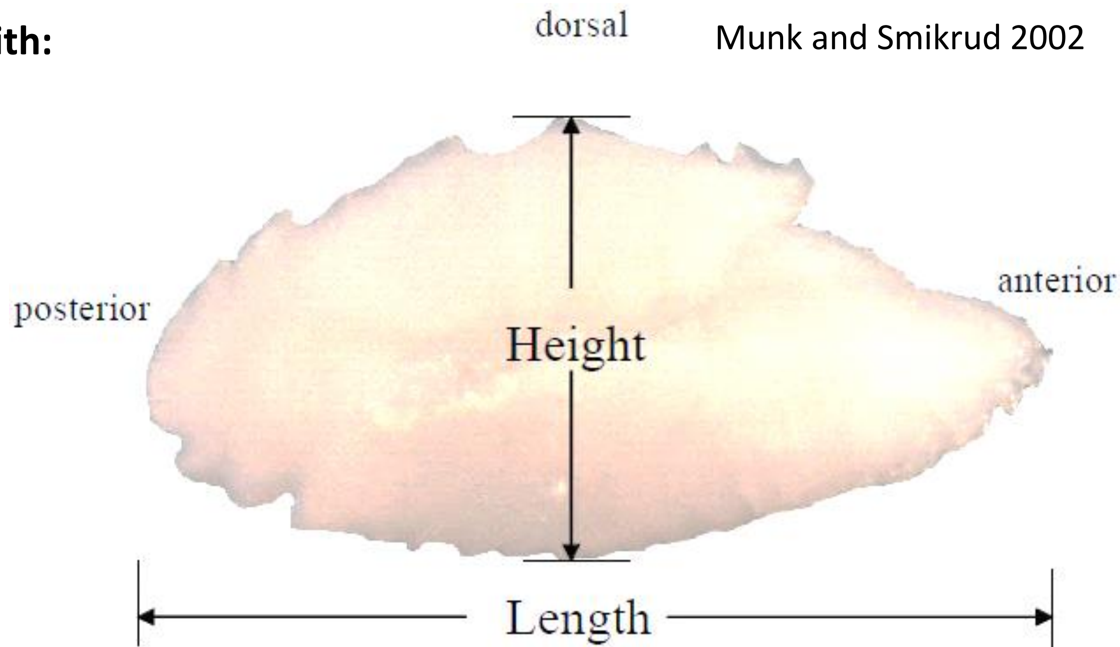
Structure Measurement

- Otolith
  - Weight
  - Length
  - Height

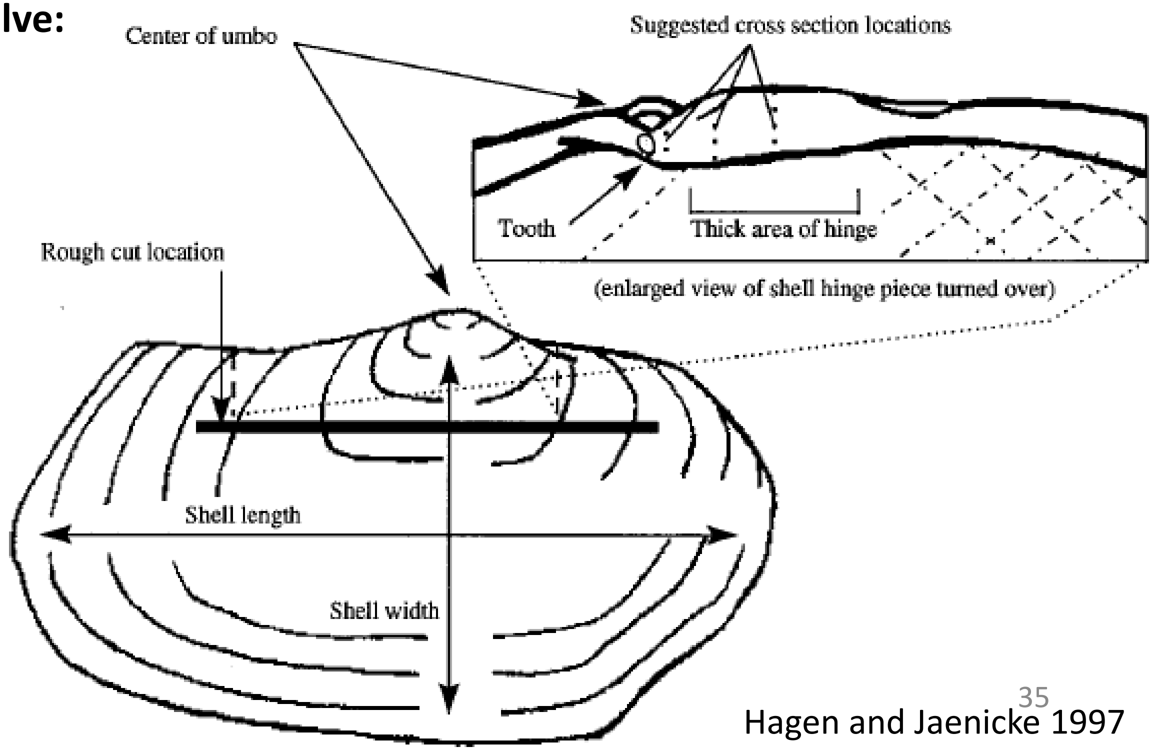
- Valve
  - Weight
  - Length
  - Width
  - Hinge Thickness

Otolith:

Munk and Smikrud 2002



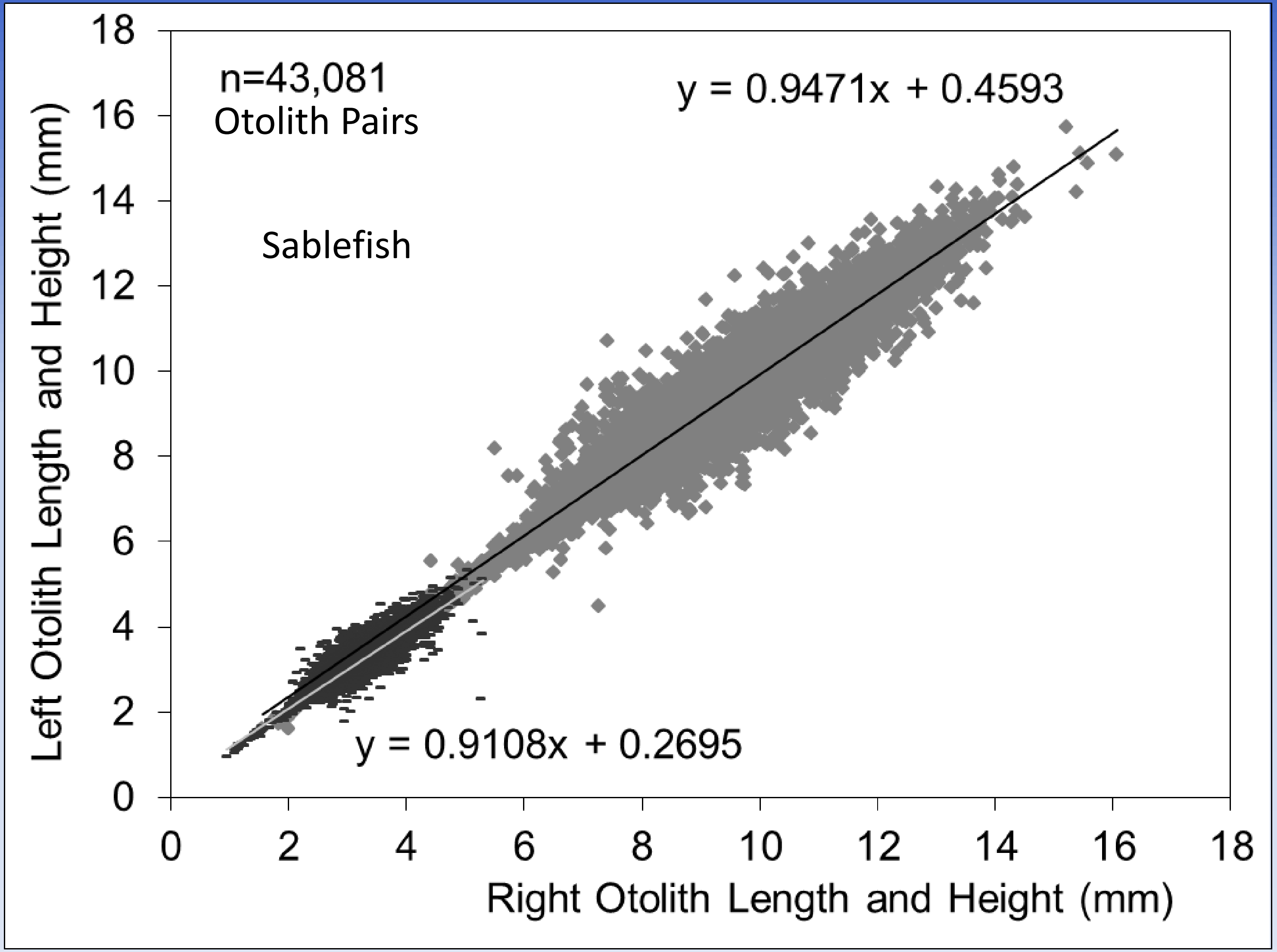
Valve:



Hagen and Jaenicke 1997

Age Structure Measurements

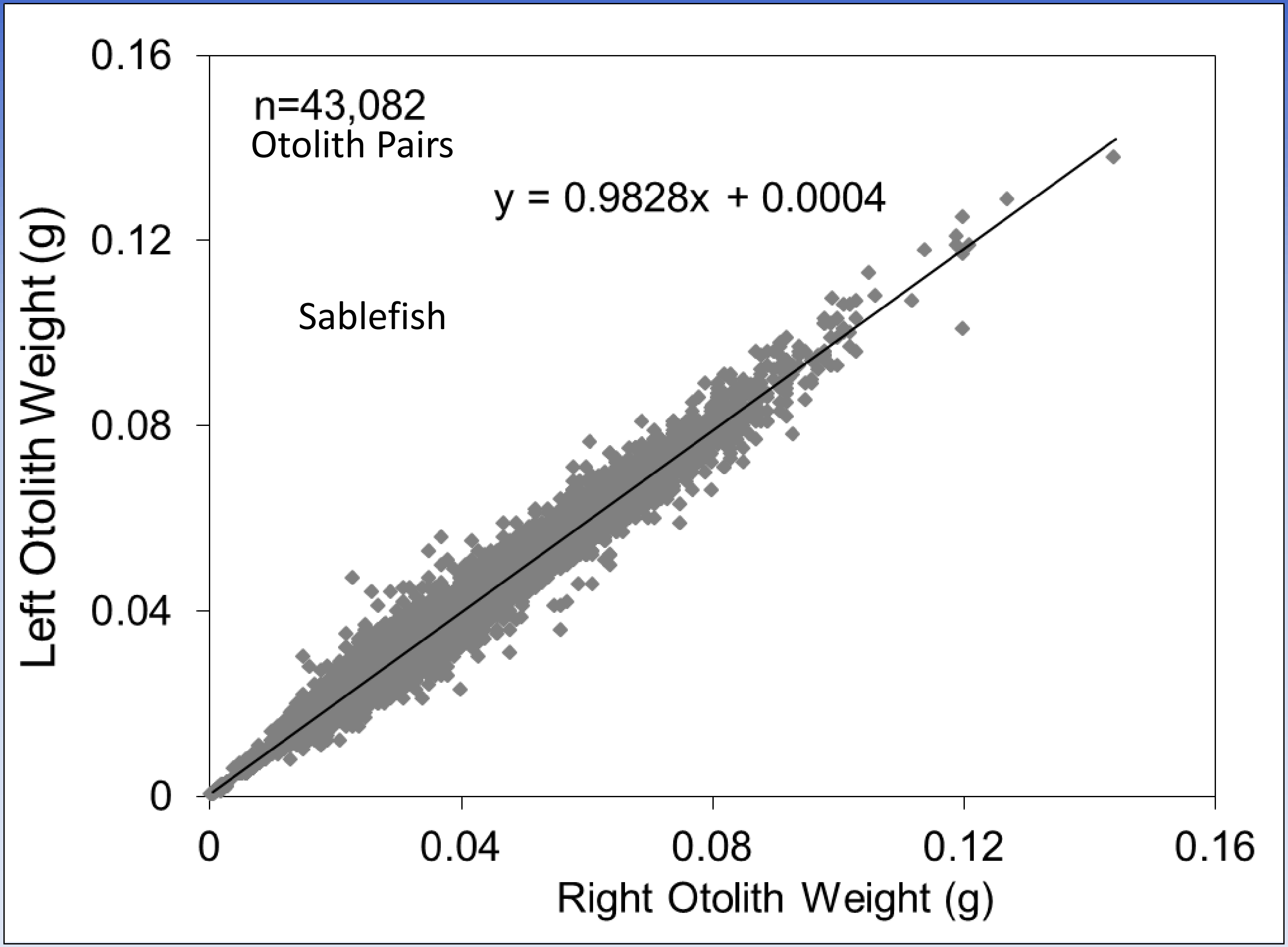
Symmetry of Otoliths



Munk 2012

Age Structure Measurements

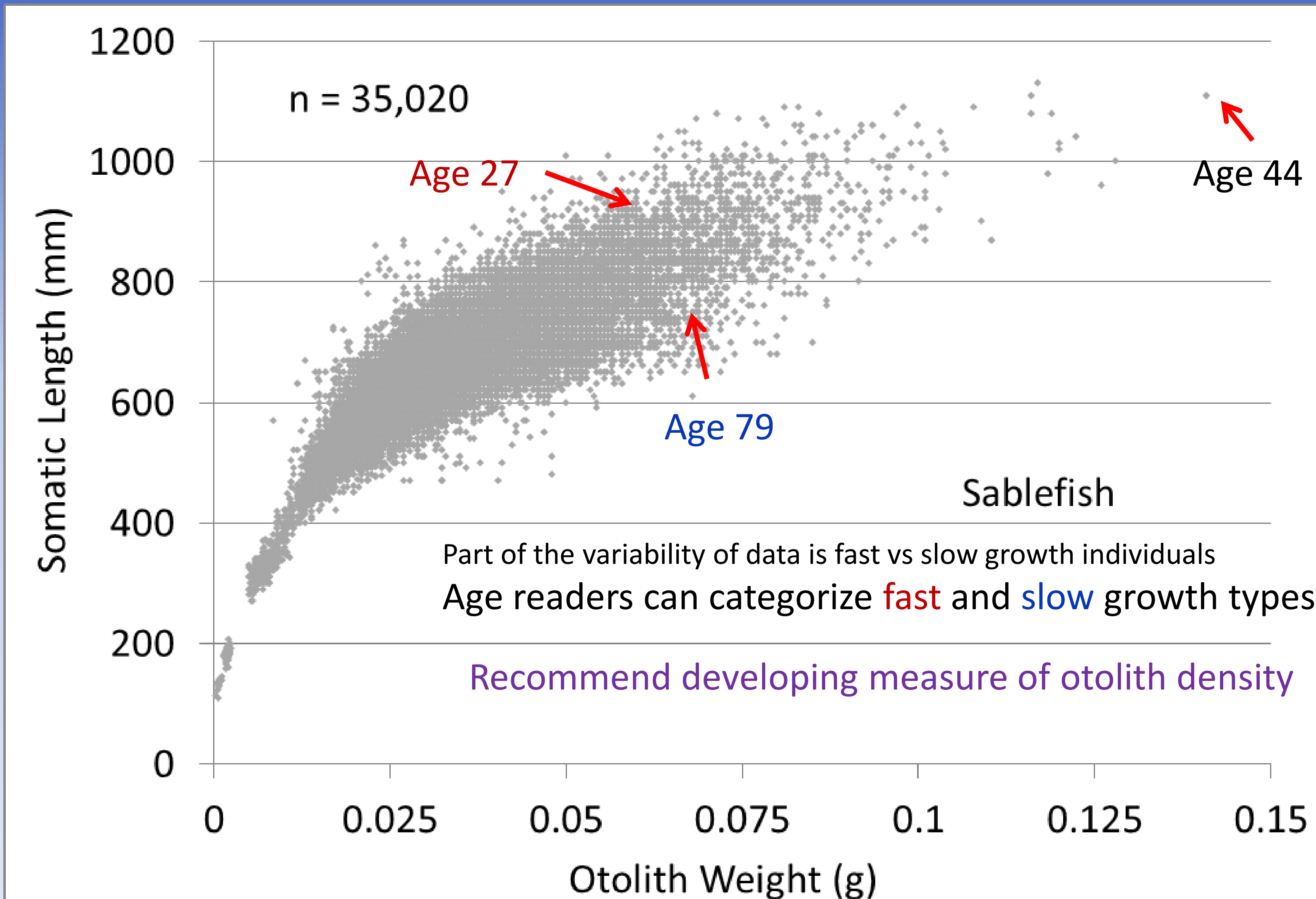
Symmetry of Otoliths



Munk 2012

Age Structure Measurements

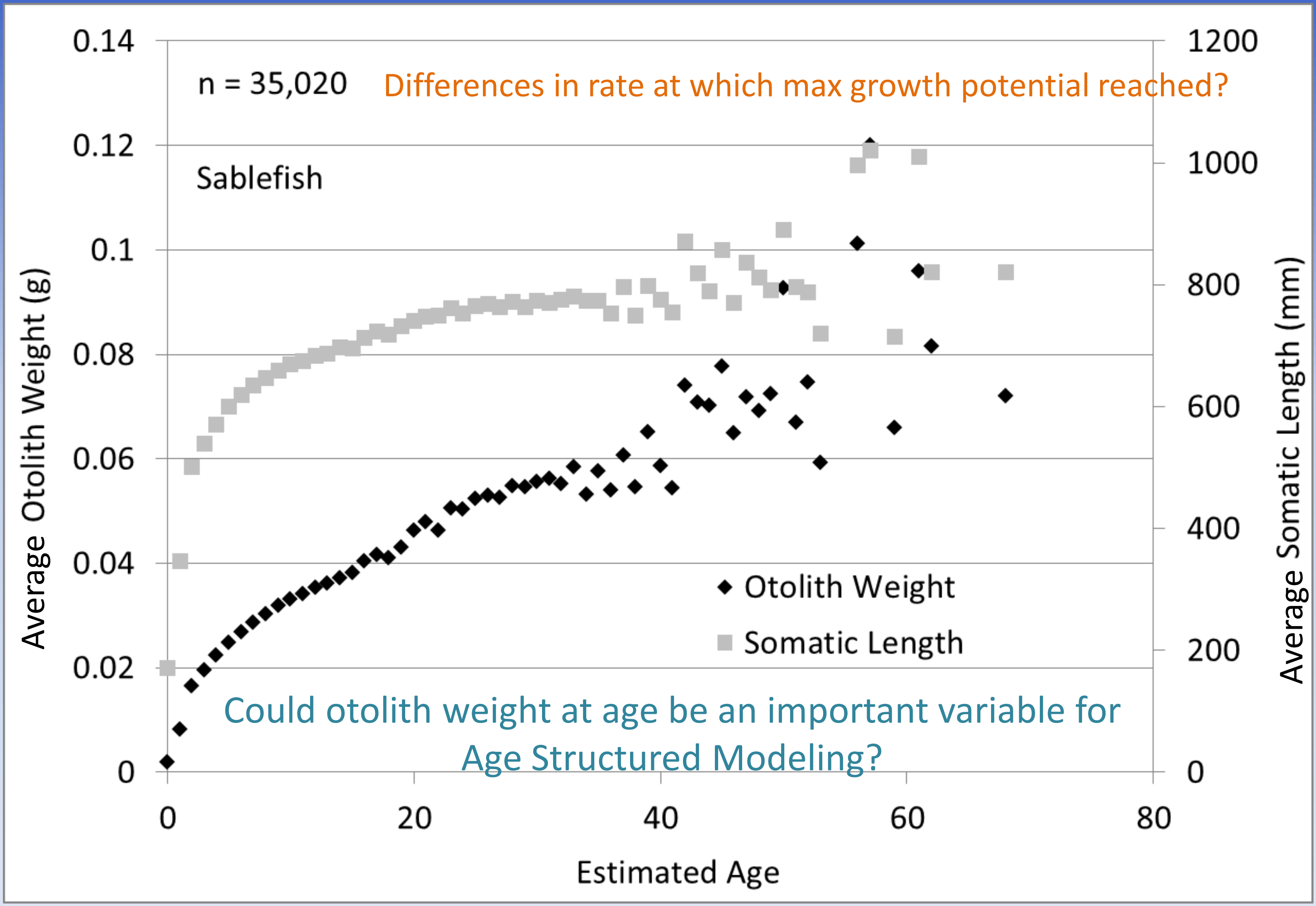
Relationships between Otolith and Somatic measures



Munk 2012

Age Structure Measurements

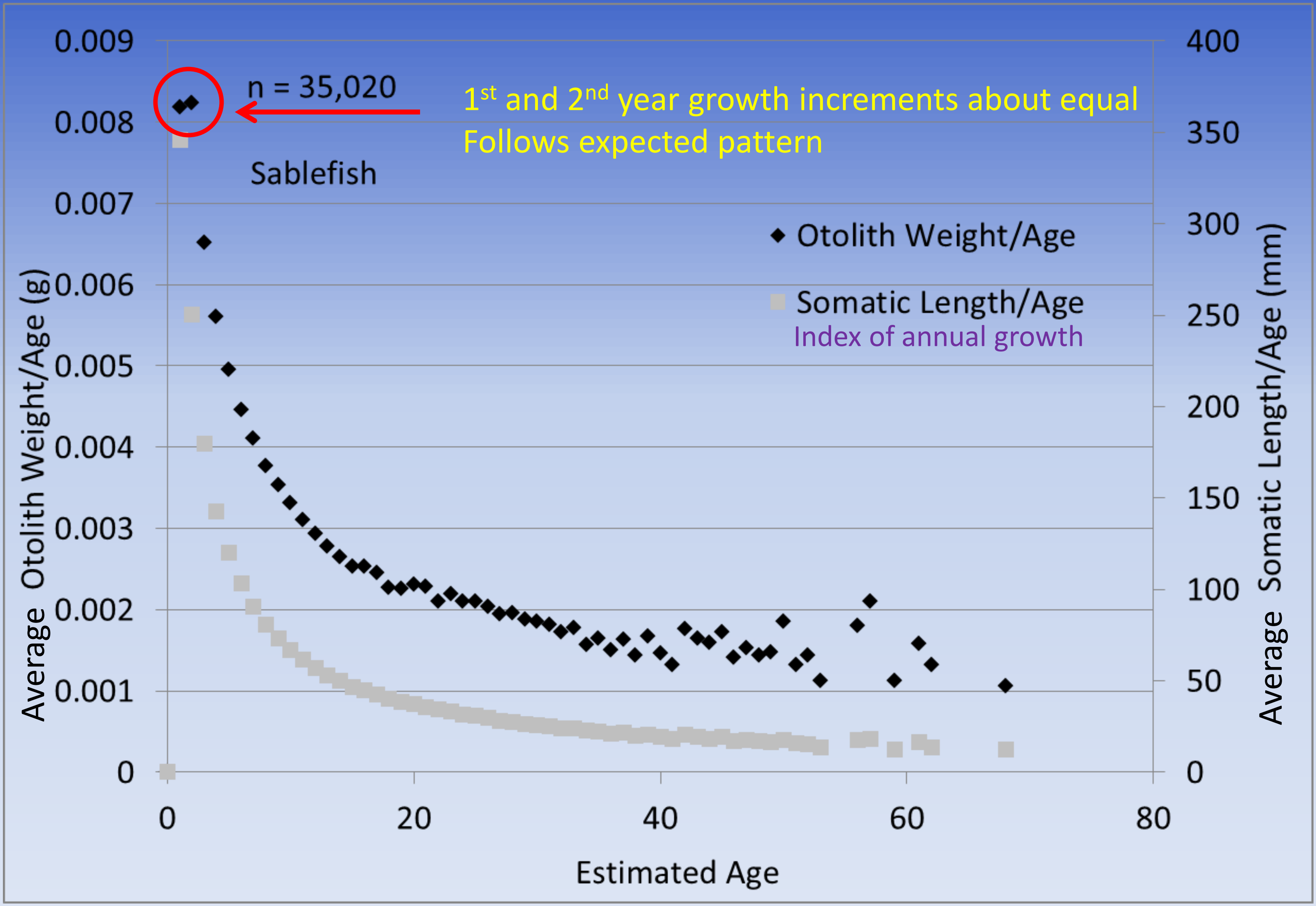
Generalized Otolith and Somatic relationships with Age



n < 20 for age categories > 36

Age Structure Measurements

Perceivable (qualitative) patterns quantified



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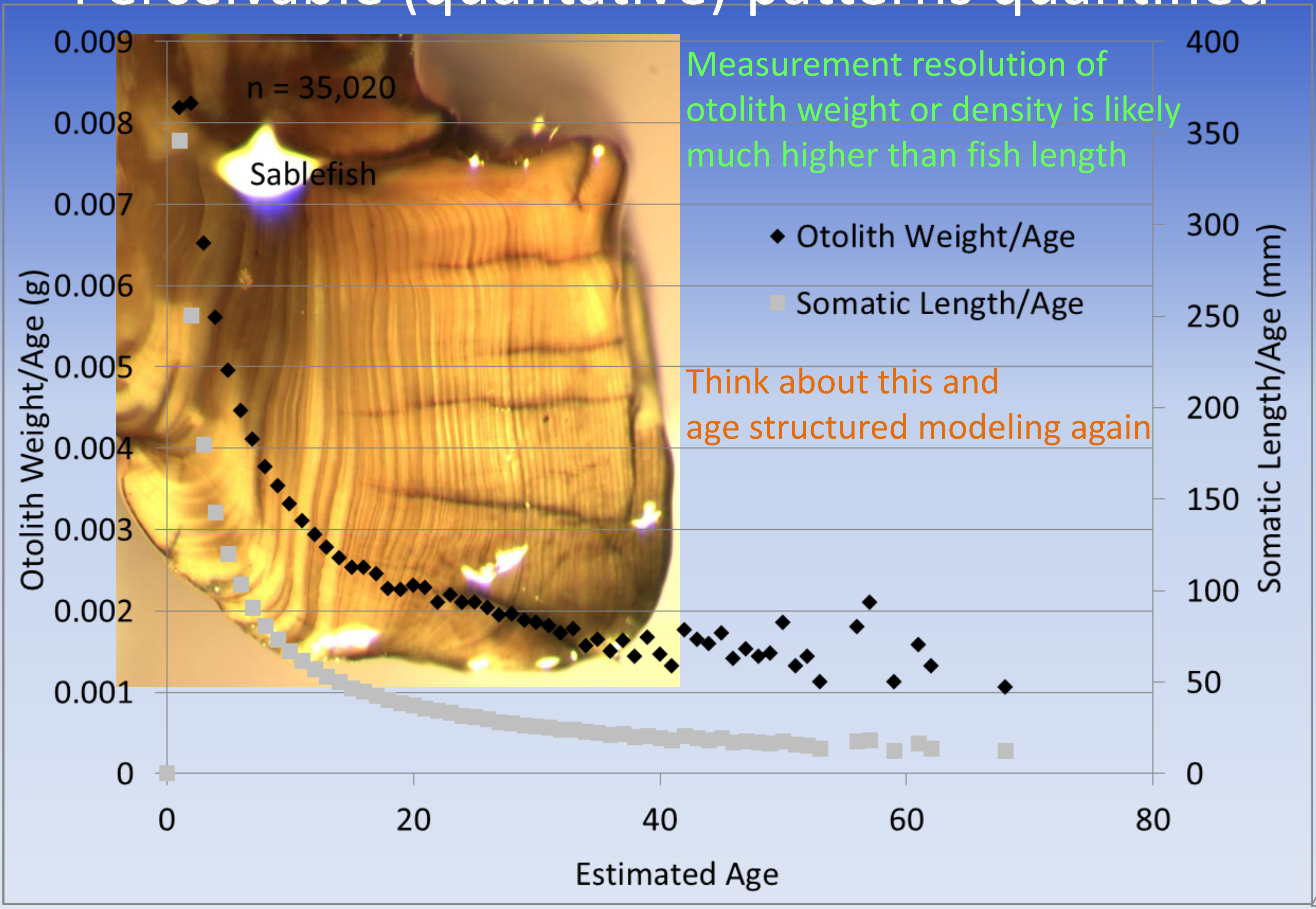


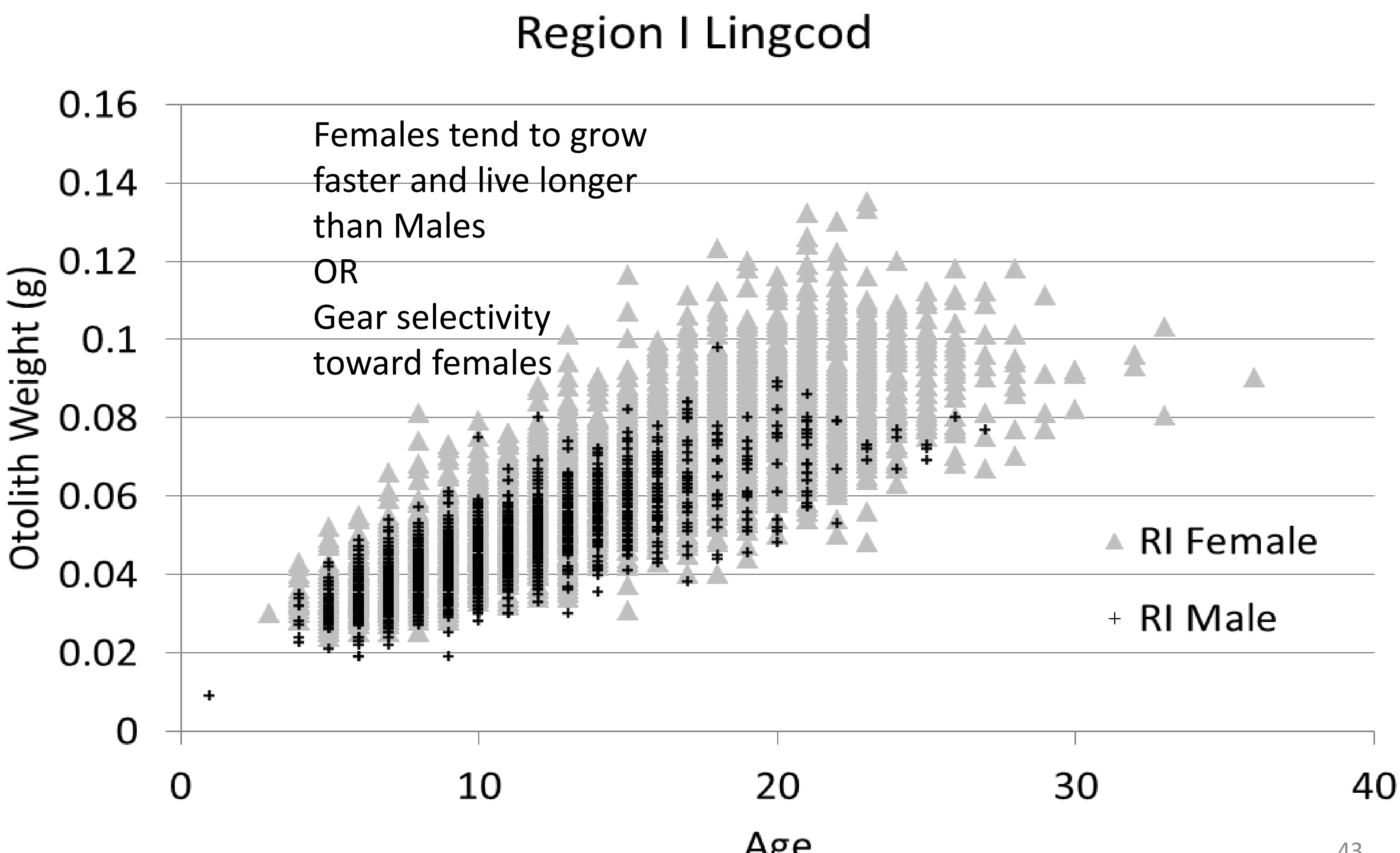
n < 20 for age categories > 36

Age Structure Measurements

Population Characters expressed in otoliths

Age Structure Measurements

Population Characters expressed in otoliths



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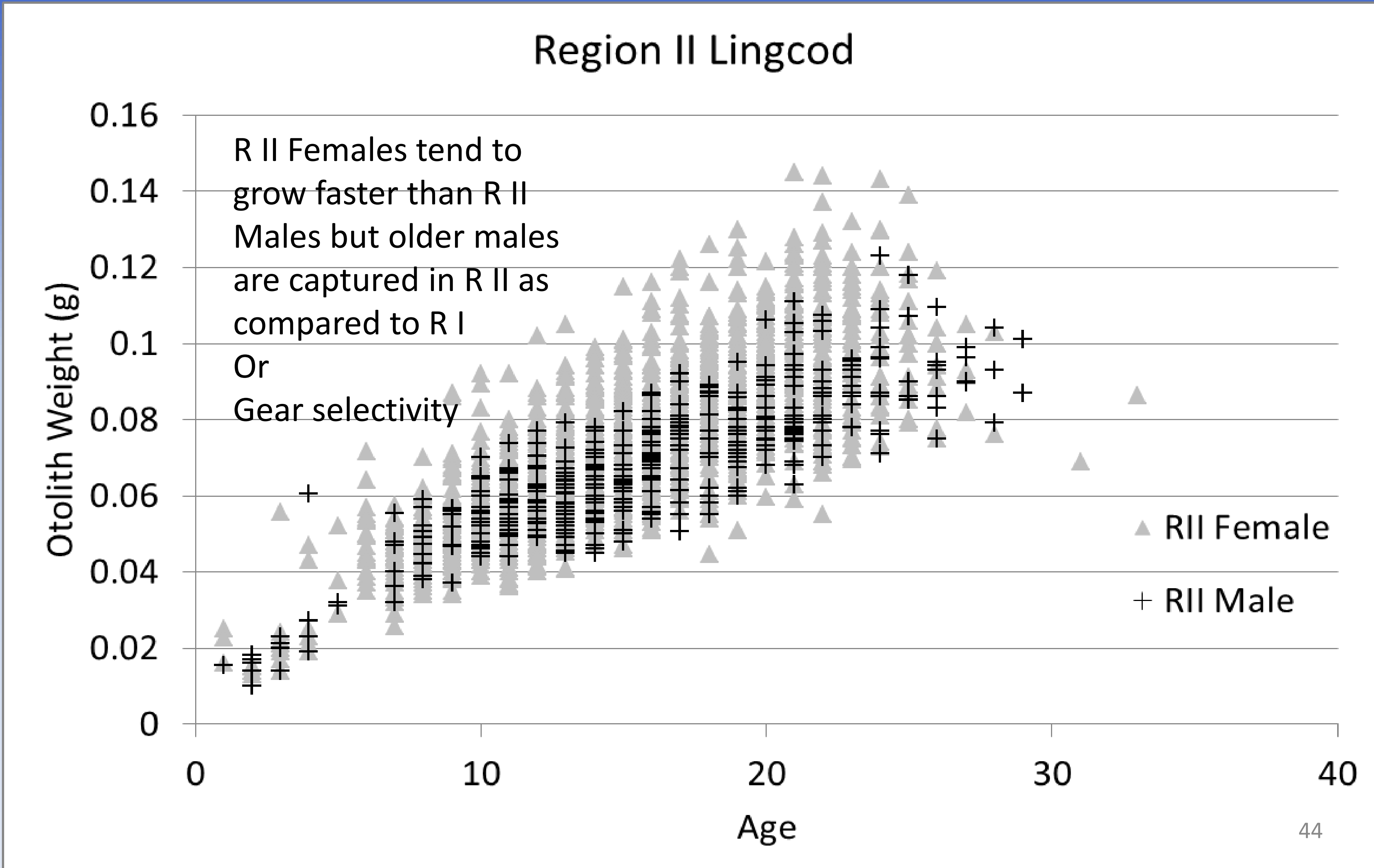
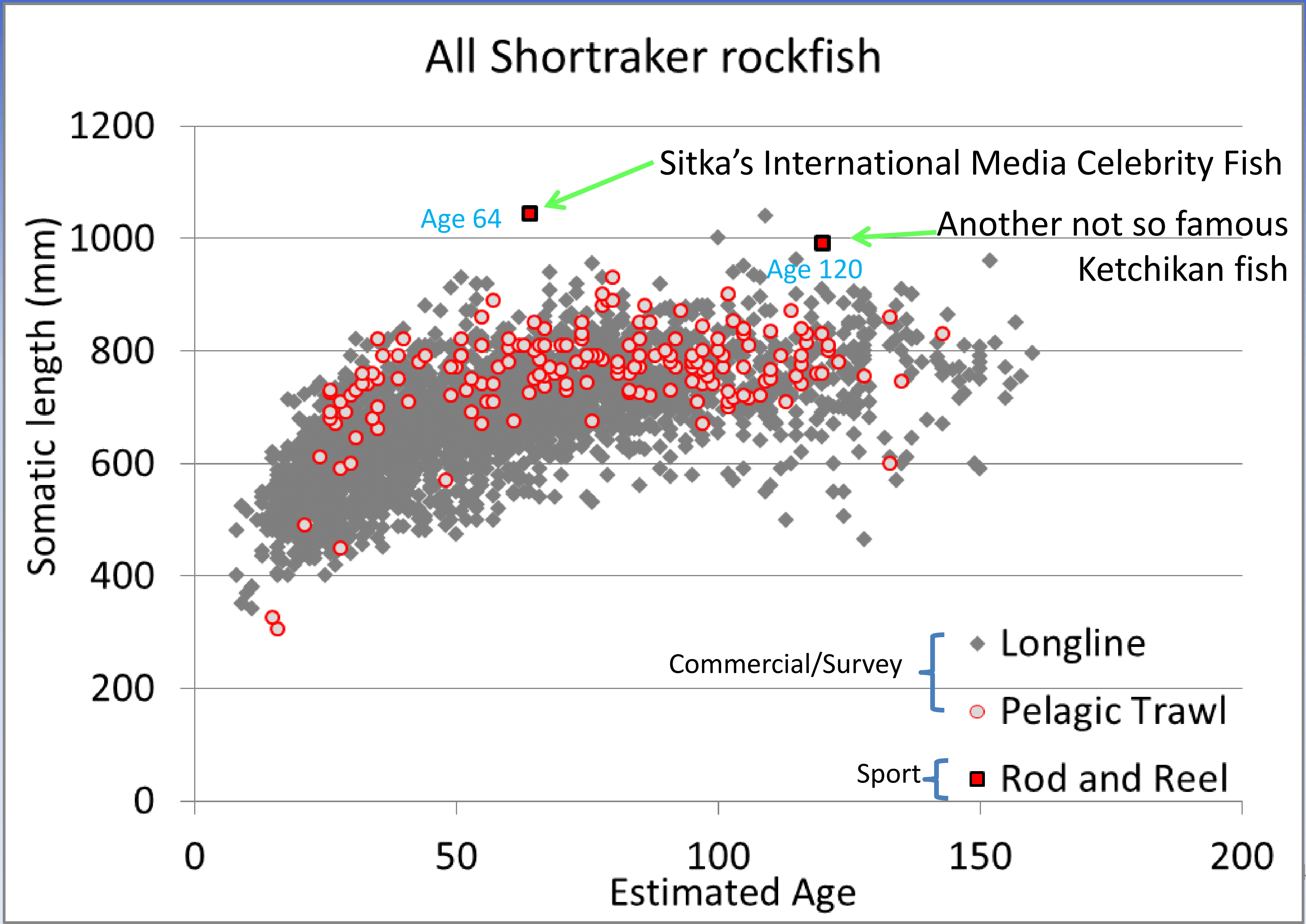


Age Structure Measurements

Shortraker rockfish in the news!



Age Structure Measurements

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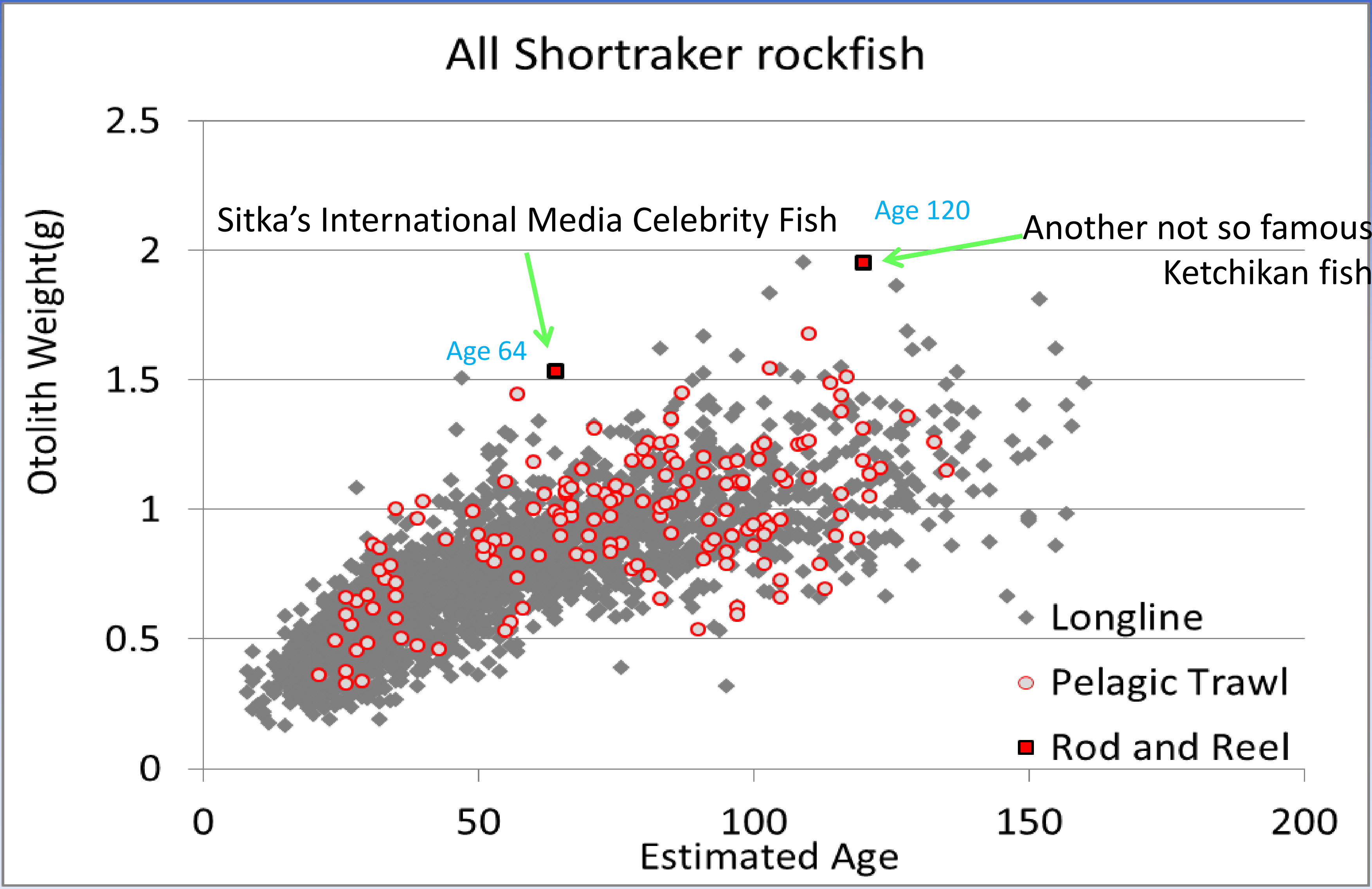
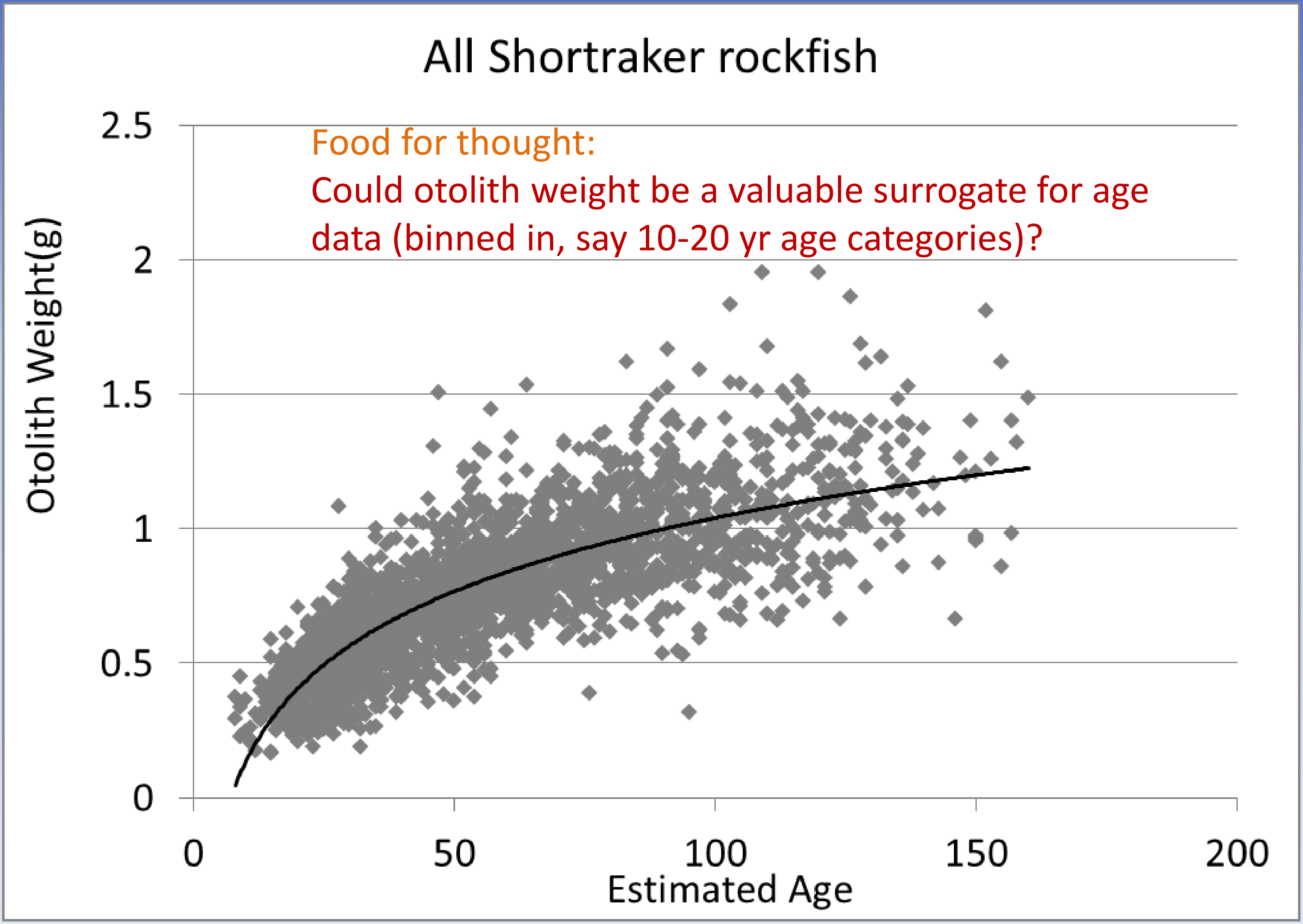


Age Structure Measurements

Modeling Age Composition with Age Structure Measurements



Closing remarks

- Familiarize folks of services we provide
- Advertise ADU's database and its wealth of info
- Generate critical thought among ADFG scientists:
  - Age structure measurements
  - Age data/modeling
  - Other uses of age structures
- Encourage collaboration and research
- Looking forward to future opportunities
  - Fish (marine and freshwater)
  - Inverts (mollusks, urchins, crab)

Discussion

Please send Data Requests to:

Dr. Dion Oxman
Dion.oxman@alaska.gov
(907)465-3499