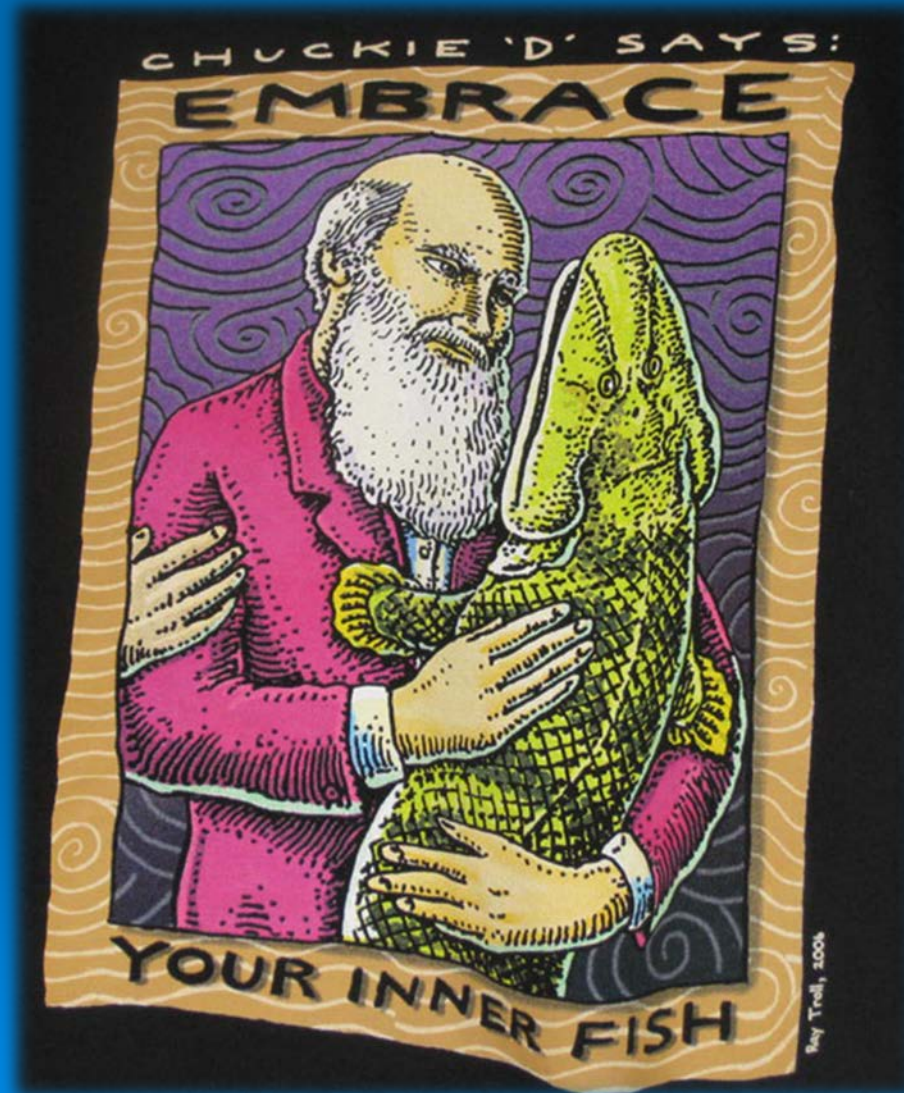


# Otoliths!



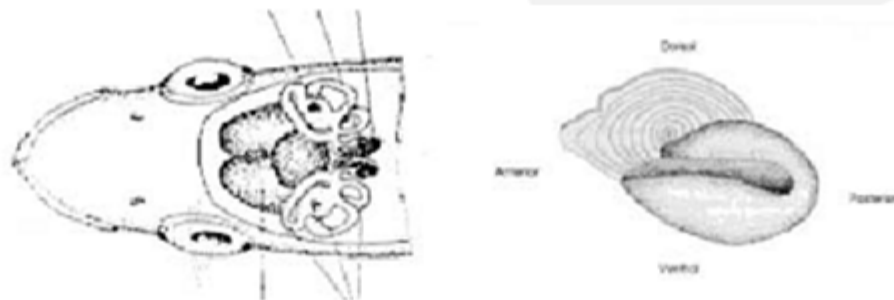
A microscopic view of numerous otoliths, which are small, white, elongated, and somewhat spindle-shaped structures. They are densely packed and appear to be resting on a light-colored, possibly yellowish, surface. The otoliths vary in size and orientation, with some showing a distinct core and concentric growth layers.

# Growth and Nature of the Otolith as it relates to Thermal Marking

Diana L Tersteeg  
Douglas Island Pink  
& Chum

## What are Otoliths?

Otoliths or "fish ear bones" consist of three pairs of small carbonate bodies that are found in the head of teleost (bony) fish. Otoliths are used by fish for balance, orientation and sound detection, thus they function similarly to the inner ear of mammals.



These pairs of otoliths differ in location, function, size, shape, and structure. The three pairs of otoliths are most commonly called the lapilli, asterisci, and sagittae.

In Pacific salmon, the asteriscus and lapillus are usually quite small, only a millimeter in size, but the sagittae are much larger, ~5 mm. Thus, the sagittae are the most studied. They are often referred to as "the otoliths," although this term more correctly applies to all three structures.

The otolith is a crystal; consequently, it grows by the precipitation of ions on its exposed surfaces. During this process, protein and calcium carbonate are laid down on the surface of the otolith, although the relative amounts vary with time and season.

Thin sections of an otolith reveal a detailed microstructure consisting of bands of opaque and translucent material, sort of like the rings on a tree trunk. Fisheries biologists have discovered that they can extract a variety of information about a fish by looking at changes in these patterns. In some cases, these patterns are a natural record; in other cases they are induced by man.

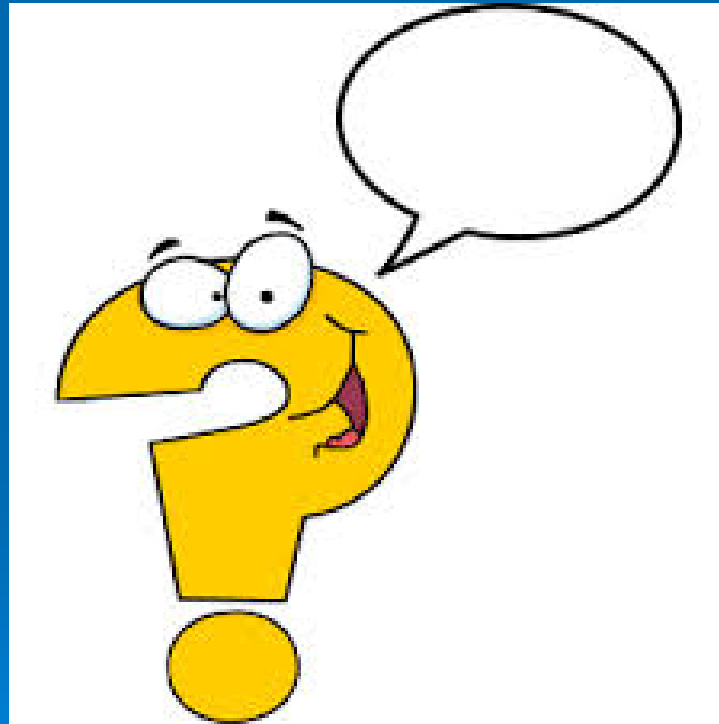
Because otoliths provide useful information on age, growth rate, life history, recruitment, and taxonomy, they are widely used in fisheries management. Fisheries biologists like to think of otoliths as information storage units; a sort of CD-ROM in which the life and times of the fish are recorded. If we learn the code, we can learn about that fish.





Pink Salmon otoliths are quite small

# Why do hatcheries use otolith marking?



# Overview:

- Different Marking Systems
- Basic Marking Lingo
- Otolith Growth & What Affects It
- Mark Cycle Timing
- Look at some Examples

# Otolith Growth & What Affects It



- Made of calcium and protein
- How do you think water temperature affects it?



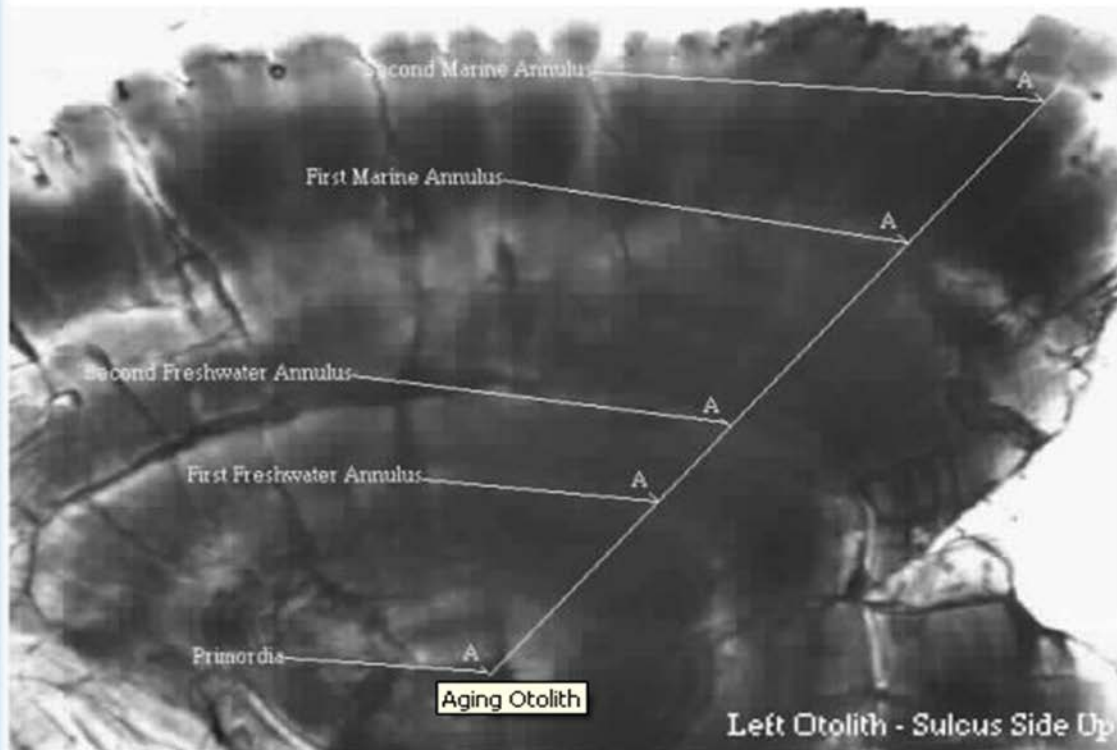
# Otolith Growth & What Affects It

- Otolith lays down Daily increment rings.
- Temperature and Growth affect the pattern of these rings.
  - Warmer water = faster growth = wider rings
  - Cooler water = slower growth = closer rings
- Any type of activity will impact the rings
  - What kinds of activities have we discussed during egg incubation?

# Otolith markings are a natural phenomenon

▲ Top of Page

## Aging a Ground Otolith (sockeye salmon)

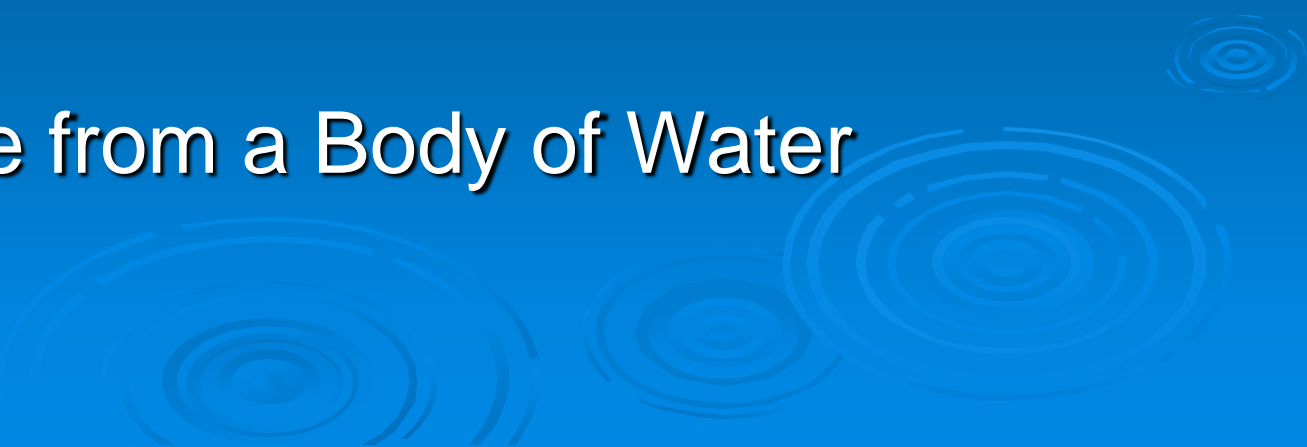


This photograph shows a sagittal otolith from a sockeye salmon that was 2.2 years of age (i.e. two years of freshwater growth and two years of marine growth). This otolith was polished on a grinder down to the primordia so that light could pass through it and allow the ring structure to be observed. Each annual growth zone consists of two bands: a wide ring of dark material (spring and summer growth) and a narrow ring of relatively clear material (autumn and winter growth). The clear ring is

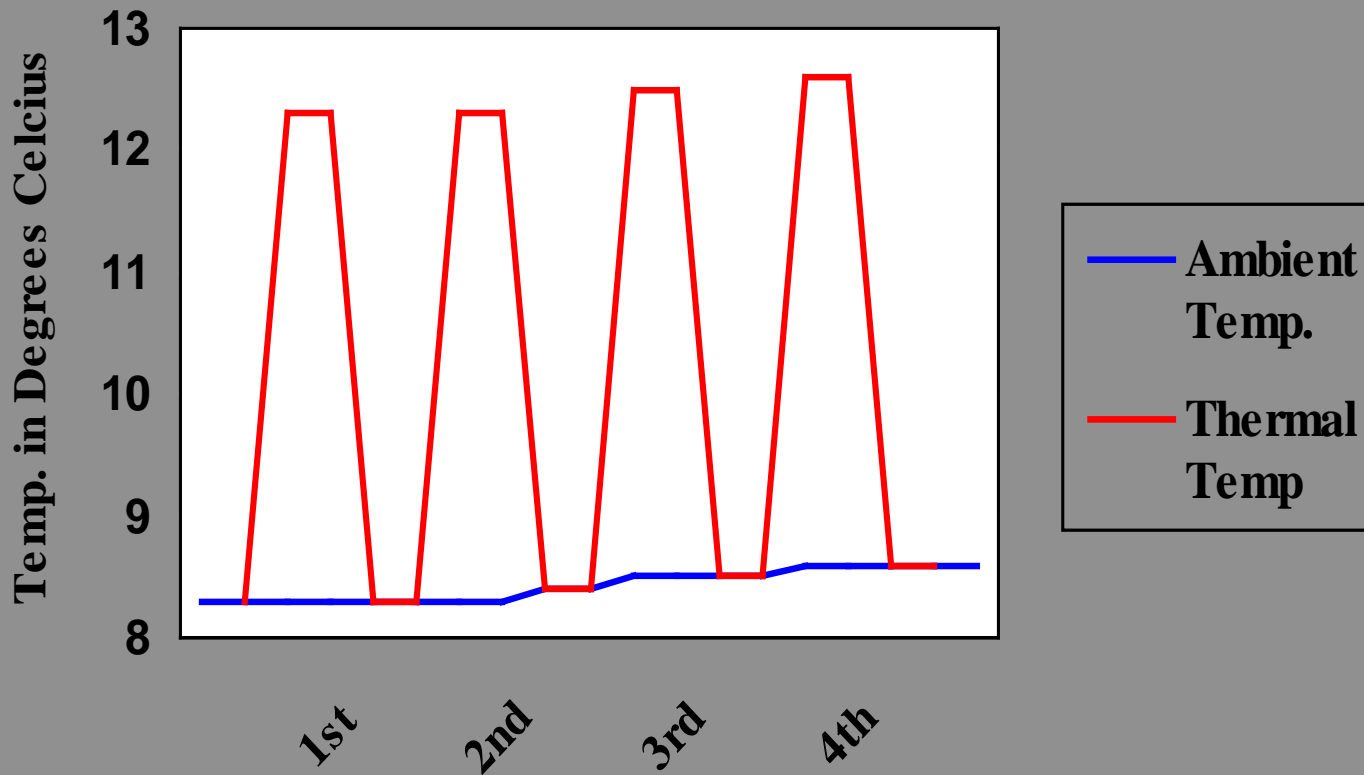
# How can hatcheries control water temperature?



# Laying down a mark in the hatchery: types of systems

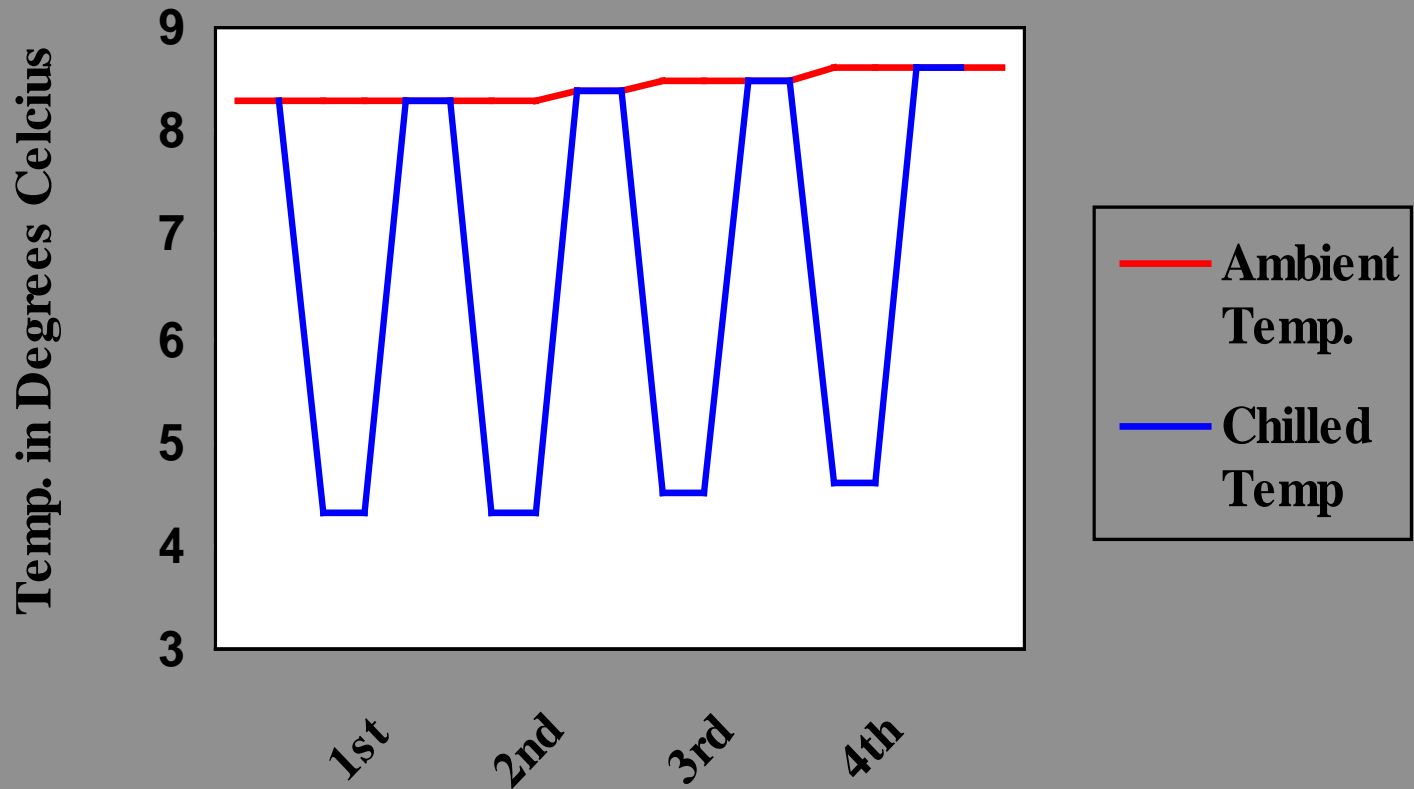
- Heating
  - Chilling
  - Combo of Both
  - Dual Intake from a Body of Water
- 

# Heating Systems



In a heating system, the ambient temperature is considered your “cool cycle” and where the dark band is placed. Therefore, you will start with a light band and end with a dark band

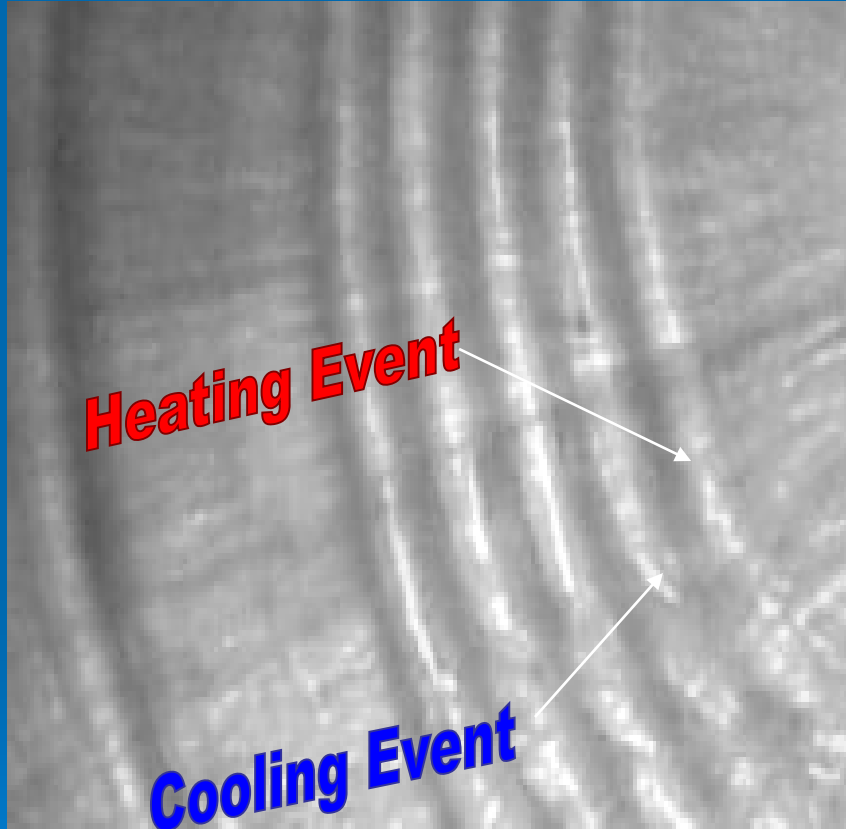
# Chilling Systems



In a chilling system, the ambient is your “heated” cycle, therefore, you will have a dark band followed by a light band and end with a light band

# Thermal Mark Close Up

(heating system)



- Calcium
  - lighter band
  - heating event
- Protein
  - darker band
  - cooling event

Do not chill your water before beginning the heating event or will place a band before – you want ambient before and after.

# Dual Intake System

- MUST monitor  $\Delta T$  and ensure it remains above 3.5°C.
- Why might this system be an issue? What might go wrong?
- How might you assure a good mark with a dual intake system?

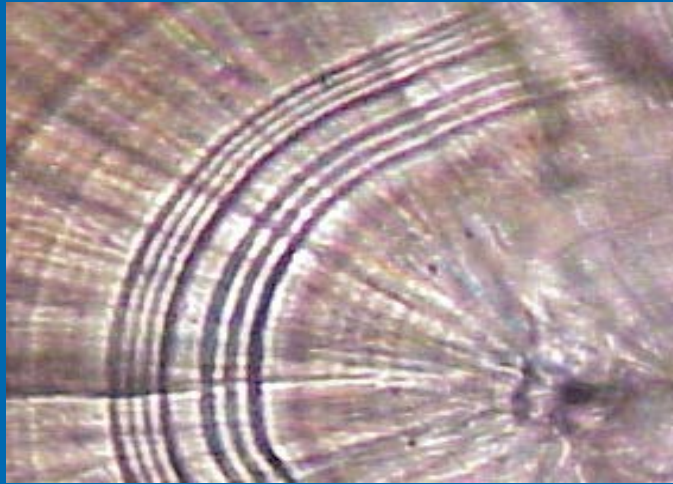


# Hatch Code – more commonly used

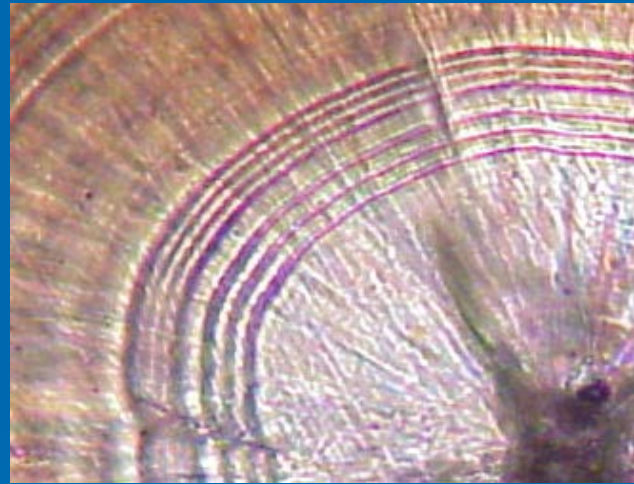
- Very simple to use and understand
- “H” denotes the time of hatch – anything before denotes pre-hatch and anything after it denotes post-hatch
- Numbers represent the number of rings in a band
- The “,” indicates the next band is starting
- **Some examples:**
  - 1,2,1,2H (1<sup>st</sup> band = 1 ring, 2<sup>nd</sup> band = 2 rings, 3<sup>rd</sup> band = 1 ring, 4<sup>th</sup> band = 2 rings, all before hatch)
  - 2H1 (1<sup>st</sup> band = 2 rings and is before hatch, next band has 1 ring and is post-hatch)
  - 4,2,1H
  - 5,4H

# Variations in time using Sockeye

➤ 72 hours



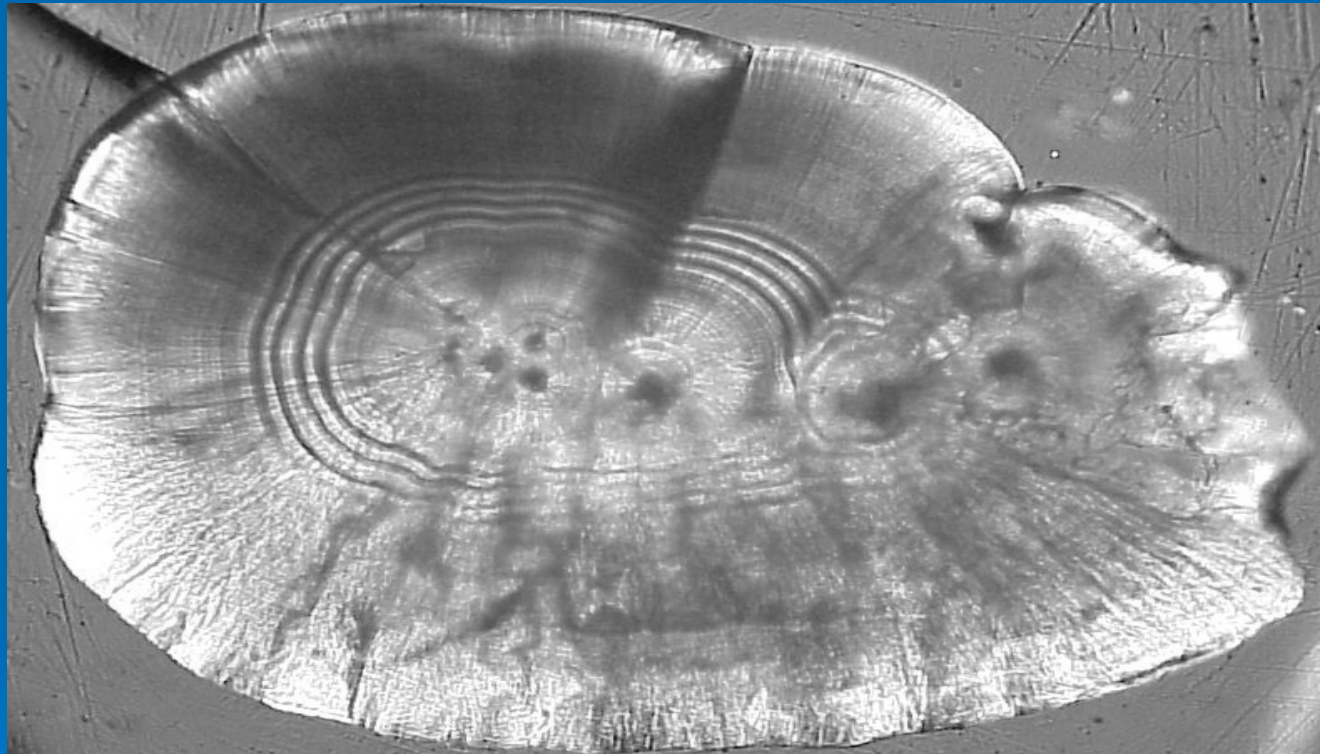
➤ 48 hours

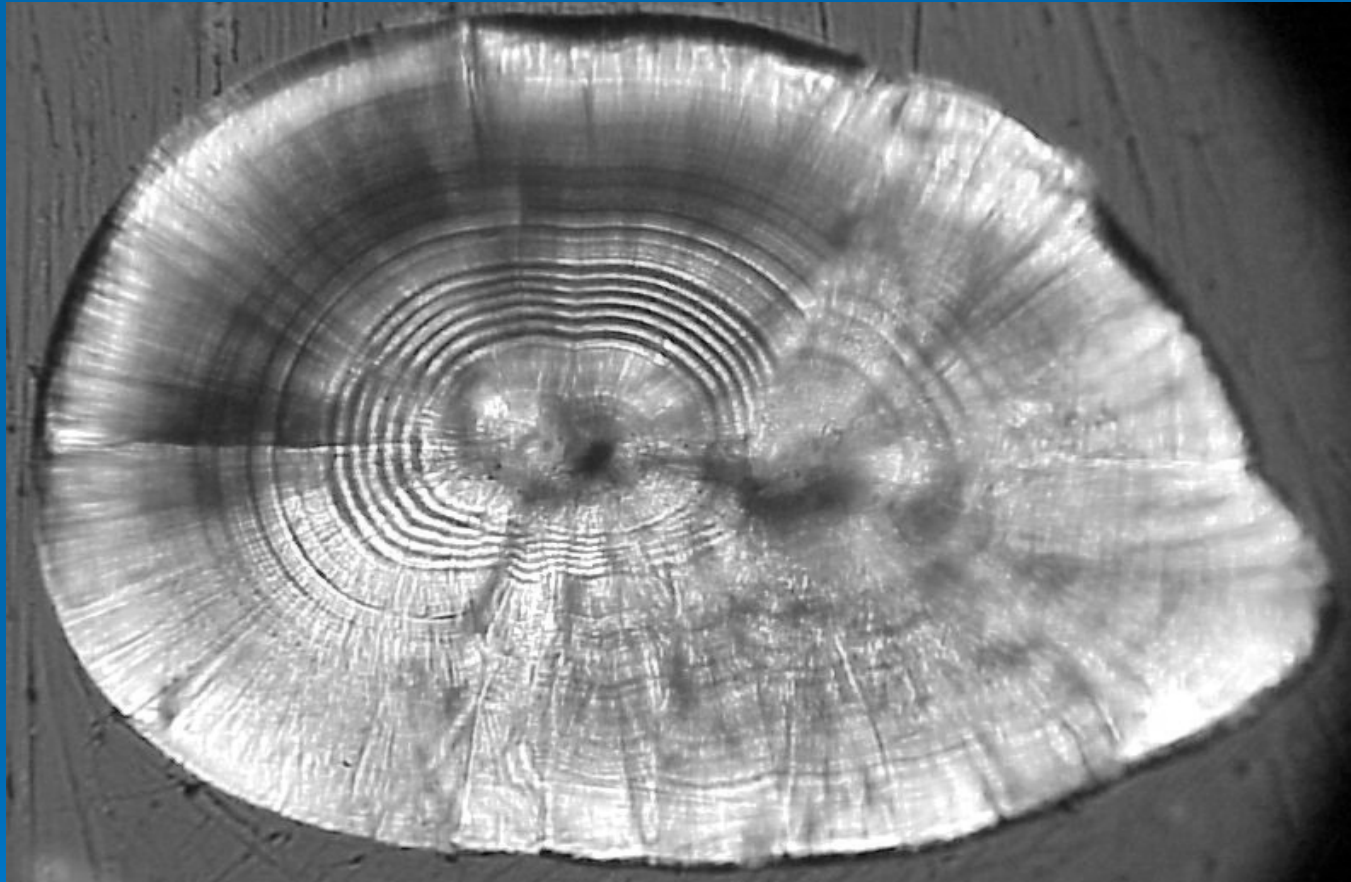


Note differences in band spacing with an  
additional 24 hours

What hatch code would this be?

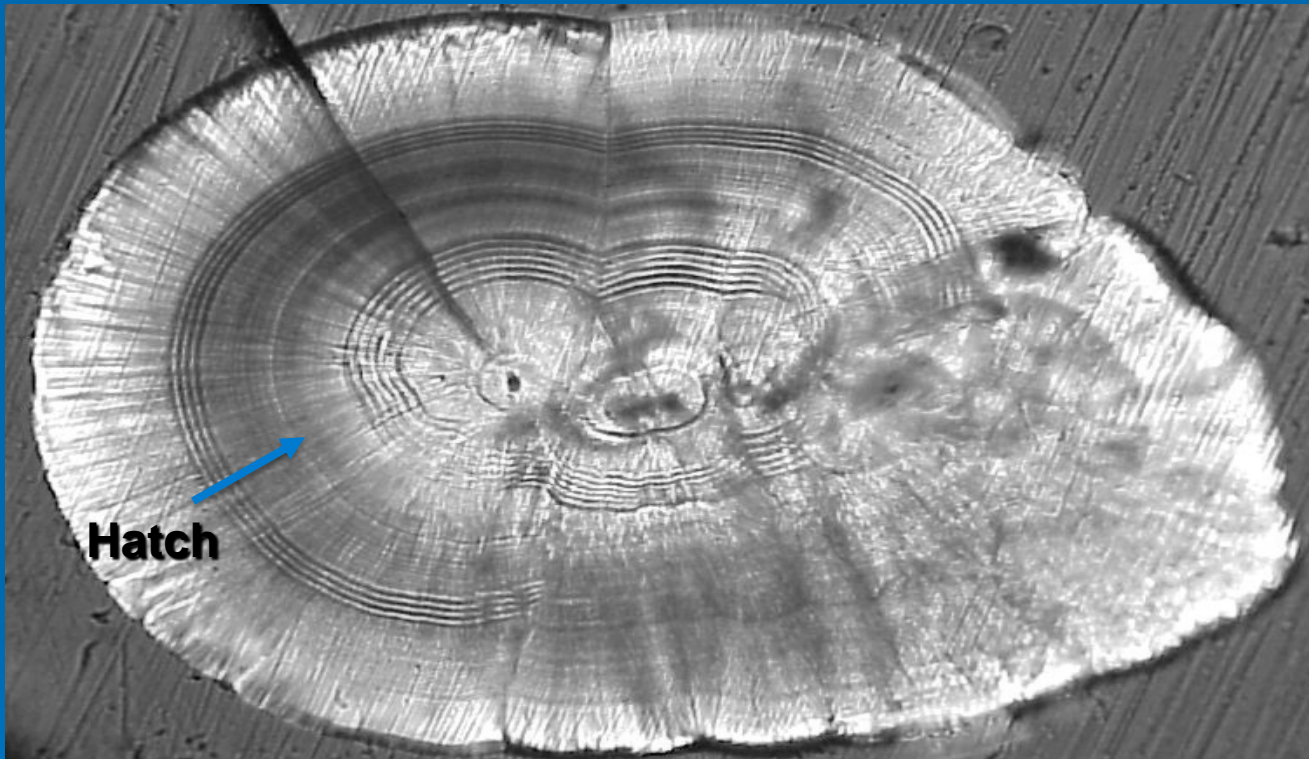
Name that hatch code....





# 18/18 & 24/24 Chum

With 9° C & 5.8° C Ambient Temperatures



# Central agencies for locating marks

## Find Mark Information

Use this Find Mark Information form to locate details and images of marked releases stored in the Mark Repository. Select the appropriate filtering criteria by clicking on the boxes below. If you check no boxes for a particular attribute, then that attribute will not restrict the items retrieved.

Click the "List Marks on File" button to create a summary table of marks that match your criteria. This table also allows access to detailed marking records. Click on "Run full grid report..." to generate a grid of detailed information for each matching mark. Click on "Create full grid..." to build a file of details that may be downloaded and opened with Excel.

List Marks on File

Run full grid report to Screen

Create full grid report as downloadable file

Mark Types:

M  
 Dry  
 Calcein  
 Alizarin

[tagotoweb.adfg.state.ak.us](#)

[CF Home](#) > [MTA Home](#) > [Thermal Mark Lab](#) > [Thermal Mark Summary](#)



**Thermal Mark Laboratory**  
ADF&G - Division of Commercial Fisheries

[Comm Fish Home](#)

[MTA Home](#)

[Mark Reports](#)

[Glossary](#)

2006  2005  2004  2003  2002  2001  2000  1999  1998   
1995  1994  1993  1992  1991  1990  1989  1988

2006  2005  2004  2003  2002  2001  2000  1999  1998

## Find Voucher Information

Use Find Voucher Information to locate details of the original marking processes done by Alaskan agencies. This report returns a list of marks that were induced, fitting the filter criteria you specify. Those items on the list for which we have detailed "voucher" information are shown as hyperlinks. Clicking a link on the list will show the Mark Characteristics for that particular marking effort, including typical images.

### Instructions:

Use the following fields to narrow the scope of your report. Use the checkboxes to select acceptable values for each field. Leaving a given field blank (not selecting any checkboxes or not entering any text) will allow all possible values of that field to be included. When you are done, click the "Run Report to Screen" or "Run Report to File" buttons. For code values, term definitions and possible values for selected fields, click on the "Glossary/Decoder" button or the Glossary link.

Run Report to Screen

### Brood Years:

2008  2007  2006  2005  2004  2003  2002  2001  2000  1999  1998   
 1997  1996  1995  1994  1993  1992  1991  1990  1989  1988

### Species:

Species are highlighted by the brood year in which they were used.

CHINOOK  CHUM  COHO  DOLLY VARDEN  PINK  RAINBOW TROUT  SOCKEYE

Agencies:

•AK has it's own site due to large geographic region

•Rest fall under NPAFC

# Pre Hatch Marking

- Don't start too early!
- Don't run too late!
- Can you think why this might be a challenge?

# Post Hatch Marking

- *Ensure ALL hatching is complete.*
- *Increase marking cycle times.*
- *Do not mark too far post-hatch.*






# For All Marking

- Group your marking lots so that each marking unit is developmentally similar.
  - Otoliths will form and hatch will occur at similar times.
  - The mark will be laid down in a similar area for all marking groups.
- Be Aware of:
  - Ambient temperatures (especially in irregular years).
  - Any manipulation by you, of the fish around marking time.

# Timing of cycles

- The cycle duration you can use will depend on your ambient temperatures.
  - Warmer ambient water system (~8deg C) can use shorter cycles.
  - Colder systems (<5deg C) must use longer cycles.
- 
- The background of the slide features several faint, concentric circular ripples, resembling water droplets, scattered across the bottom half of the blue background.

# Why to Send and Keep Vouchers

- Need a representative group sent in.
  - Each marking group over the different egg take days at or before ponding.
  - Good and Bad need to be represented. Why?
- Important to keep a representative group preserved at your hatchery.

# Be aware of...

- Type of System (heat, chill, dual intake)
- Amount of hot or cold water you can utilize during the mark
- Condition of your systems (i.e. boilers and heat exchangers)
- Amount of training and understanding of the mark your crew has

# Because it all comes down to...

## ➤ Mark Recoverability

- Faster more accurate information requires a uniform, error free mark.
- Anything less could rendering your efforts fruitless and a waste of your time and money because...
  - a poor mark = poor recovery

## ➤ Quality in = quality out!



# Marking methods

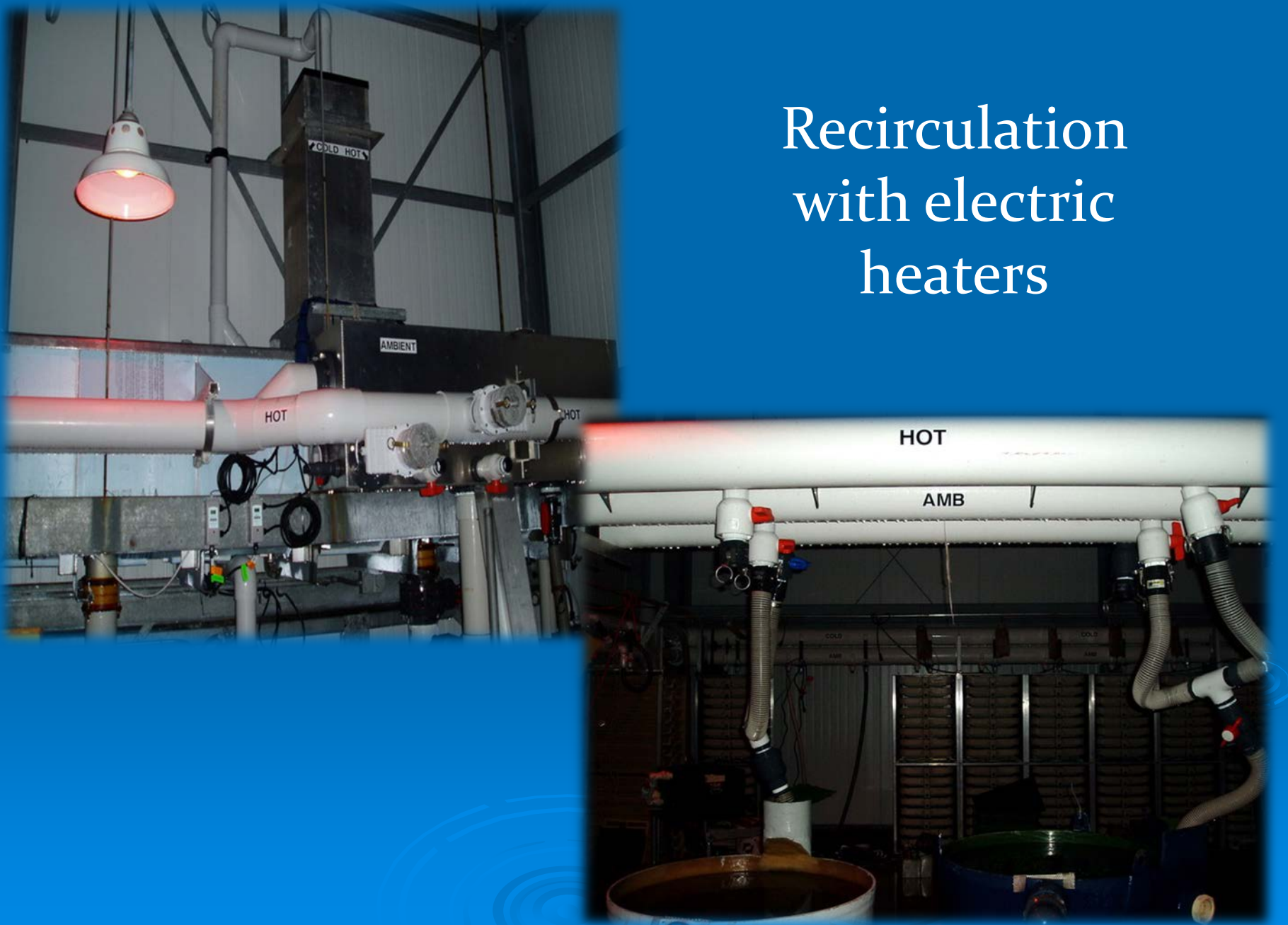


Chilled / recirculated system

# Oil fired boilers to heat water



# Recirculation with electric heaters

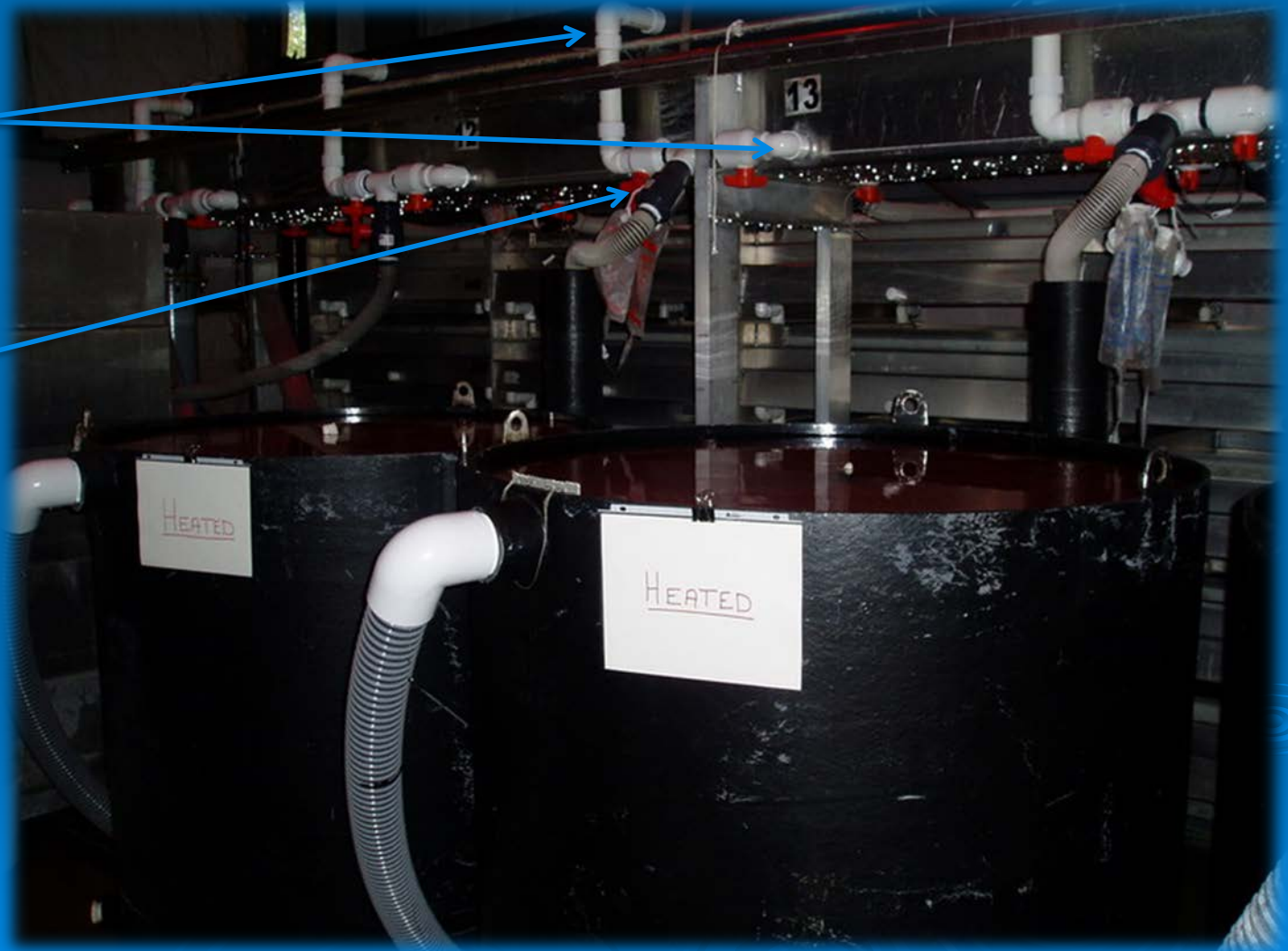




# Heat Exchanger / single pass system at Medvejie

Dual water  
supplies

Flow  
control  
valve



# Otolith removal, preparation and reading / adults

## Online Otolith Lab

UAS FISHERIES TECHNOLOGY PROGRAM

### Analysis: Reading The Age

Remember that you can determine the age of a fish either by using the annuli of the otolith, or by viewing the thermal mark (assuming a thermal mark is present and you are able to read it). The left otolith is preferred for reading a thermal mark, and the right otolith is preferred for aging via annuli.

In this section, we'll discuss the techniques for aging whole otoliths as well as ground otoliths.



Image courtesy of Alan Murray, SSRAA

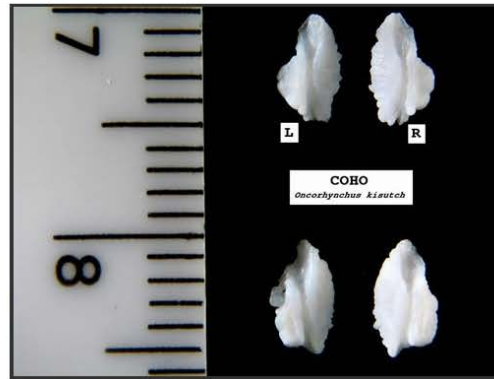


Image courtesy of Alan Murray, SSRAA

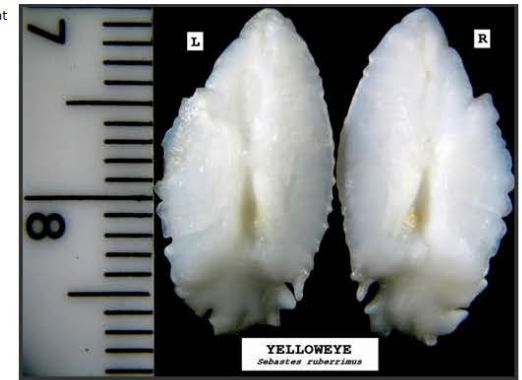


Image courtesy of Alan Murray, SSRAA



Image courtesy of Alan Murray, SSRAA



Image courtesy of Alan Murray, SSRAA

Expand All | Collapse All

Home

What Is An Otolith?

What Can Otoliths Tell Us About Age?

Thermal Marking Otoliths

Otolith Collection

Intro To Lab Equipment

+ Extraction Of Otoliths

Handling Of Otoliths:

Cleaning And Storage

Handling Of Otoliths:

Preparation For Reading

Mounting Otoliths On Petrographic Slides

Grinding Mounted Otoliths

Oil

Break And Burn

- Analysis: Reading The Age

OVERVIEW

Whole Otolith Aging

Ground Otolith Aging

Challenges

Validation

+ Learning Activities

Acknowledgements

# Watch videos on removal

- Watch:
  - Otolith removal from arctic grayling
  - Otolith from salmon – parallel cut
  - Otolith removal – vertical cut
- What are the differences in techniques
- Why would you choose one method over the other?

# Otolith extraction from chum salmon





# A splitting headache.....









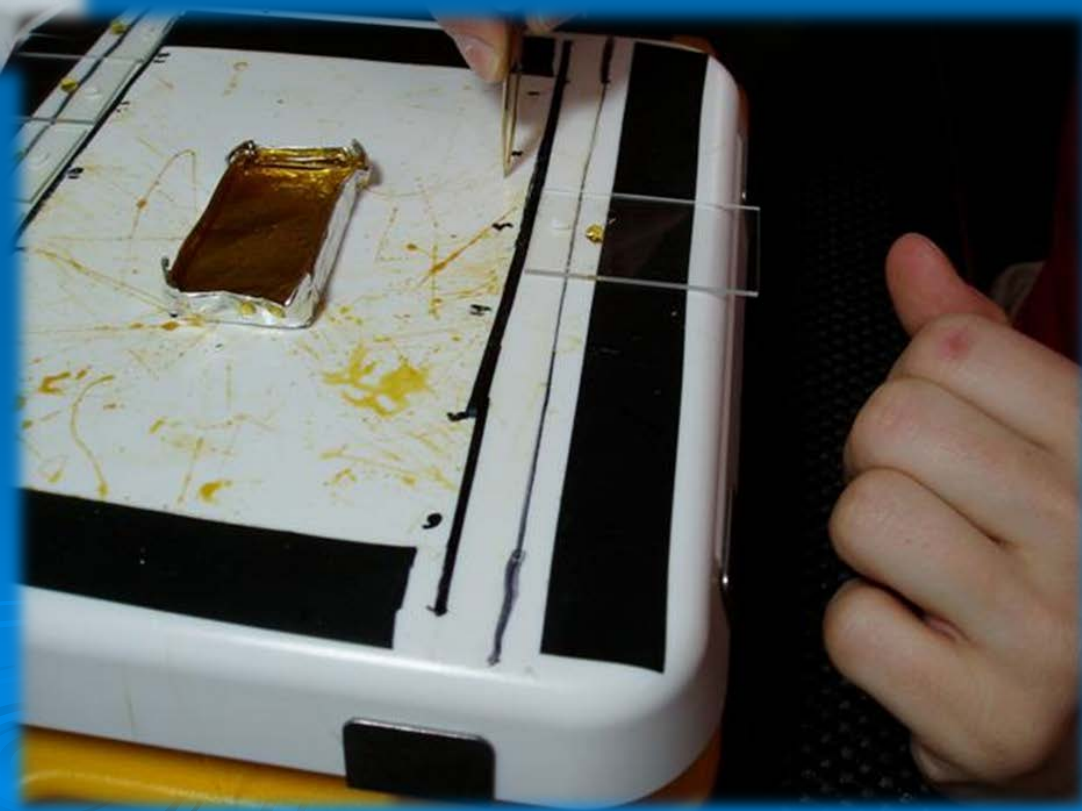
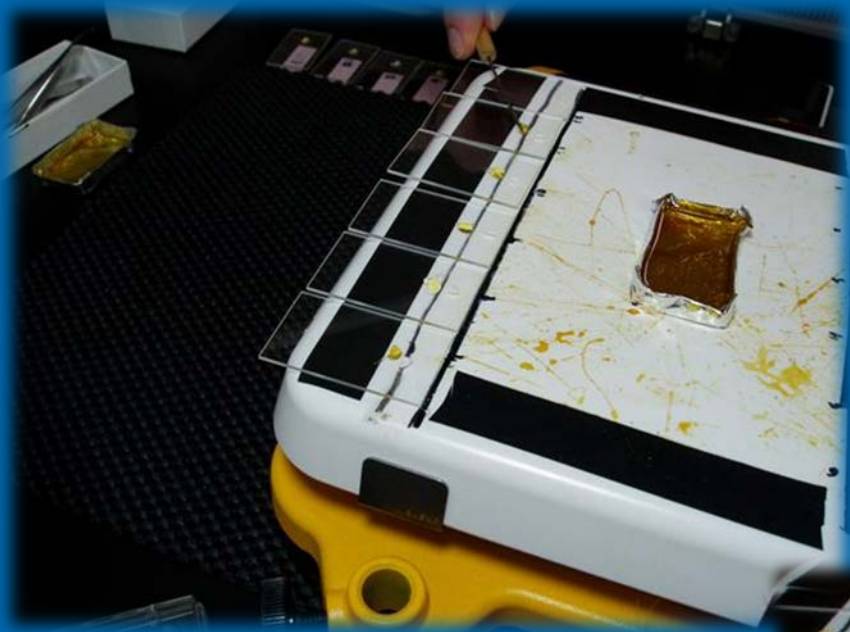


# Otoliths into trays and then to lab

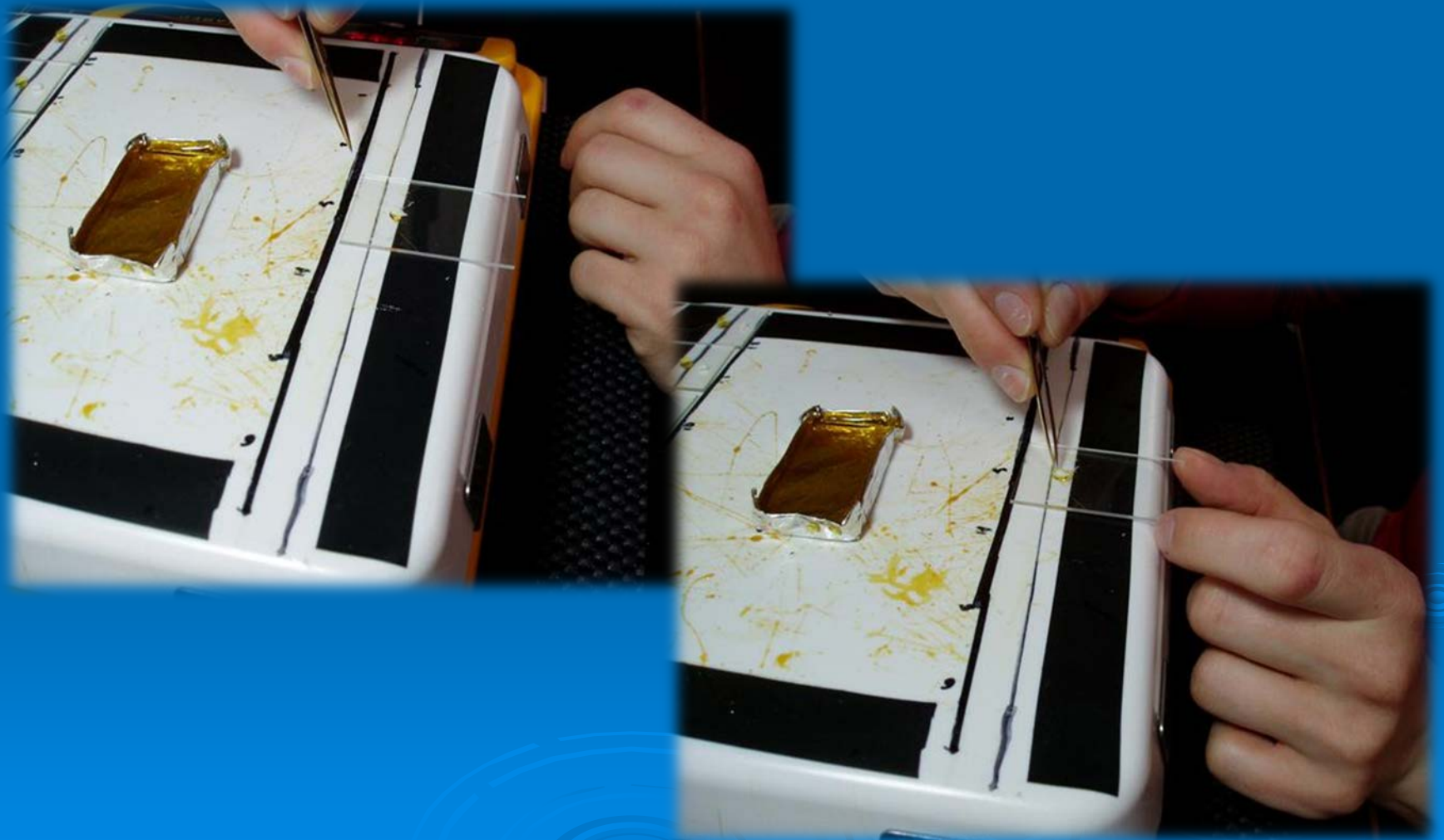


At lab, otoliths are laid out on slides  
and then mounted in resin

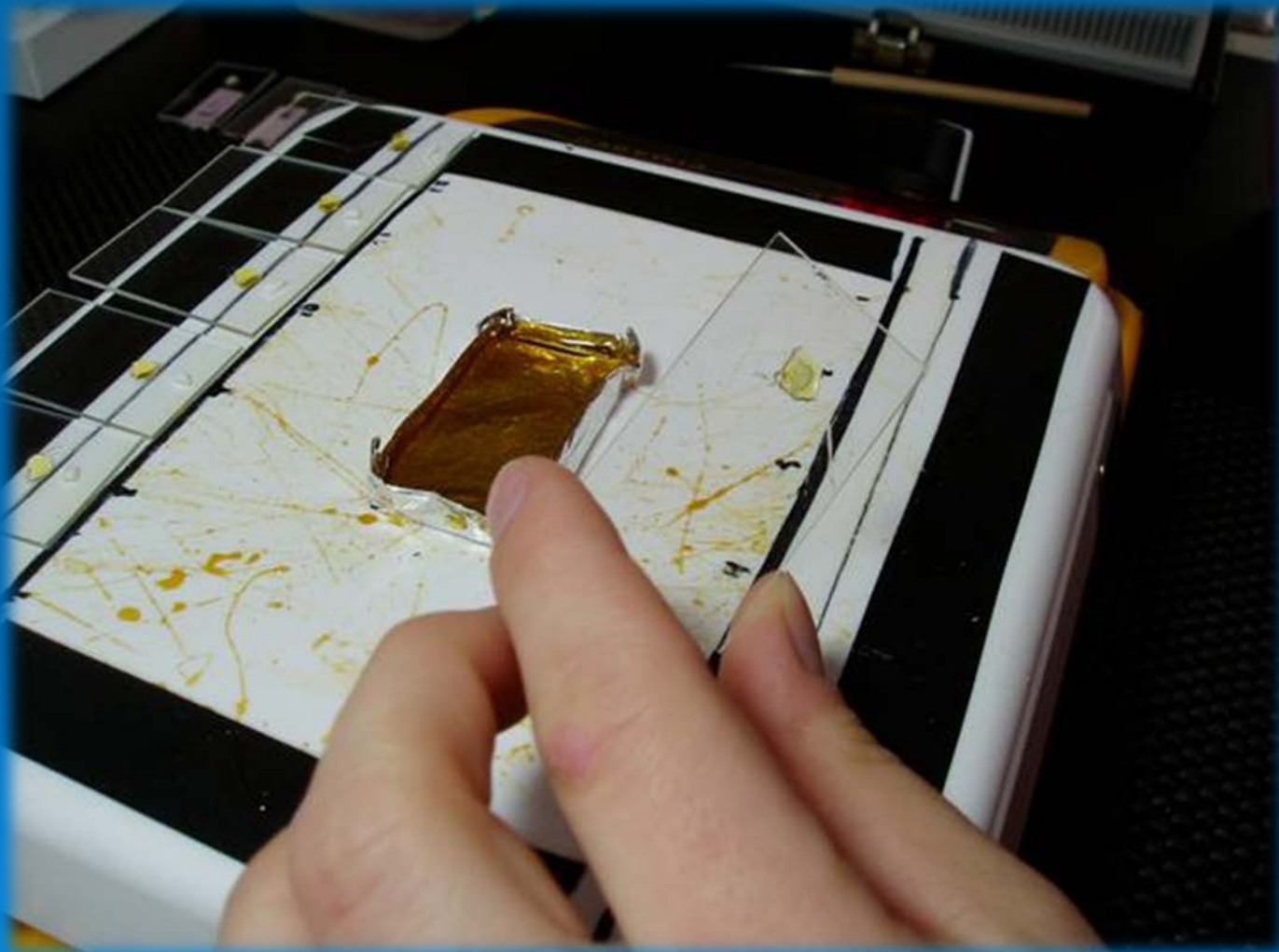




Otolith is placed onto hot resin

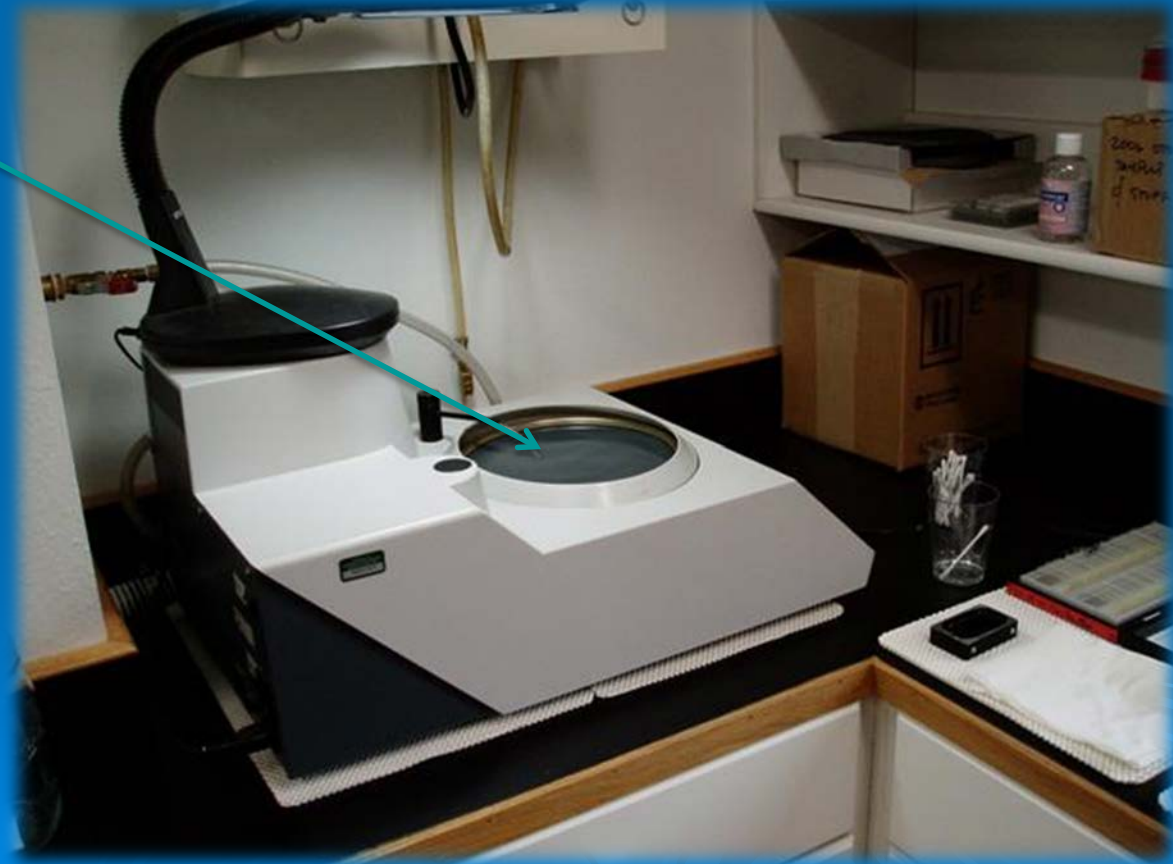


Mounted otolith. Resin cools and secures sample to slide



Next step is to grind down the  
otolith

Sanding disk



Sample is put into special holder





Unit is pressed firmly against  
sanding wheel

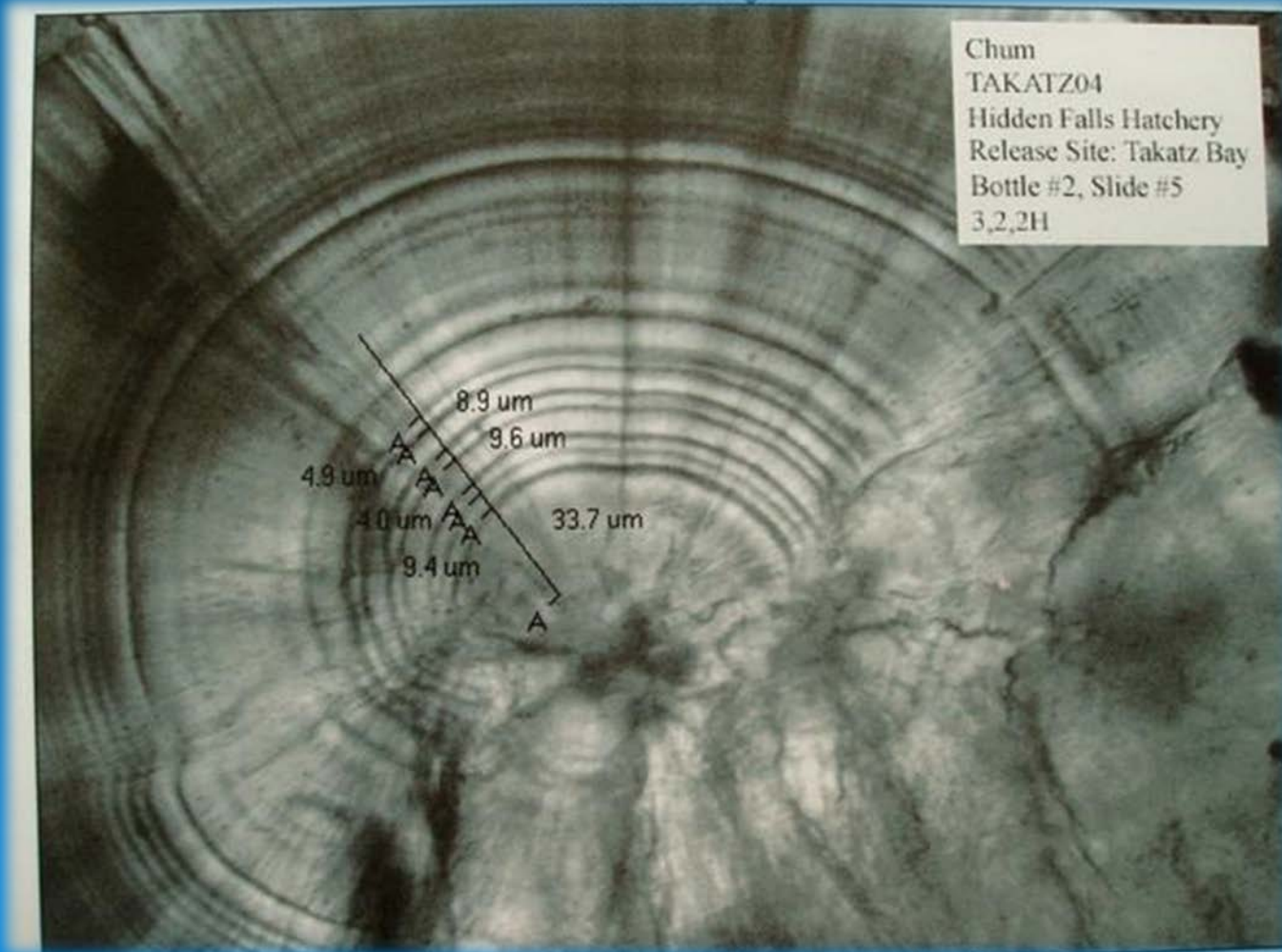




# Reading the sample



# What we see under the scope



# Samples are labeled and stored



# Assignment 8 – otolith videos

- Watch videos re: otolith removal, what they are, how to process them in Course Content/Resources/Videos/Otolith links
- Short summary of each
- Due no later than November 16

