



Activity 10: Managing Salmon by Otoliths

Audience:

Adults and grades 5-12

Time:

30 - 45 minutes.

State Essential Learning Requirements

Science: 2.1, 1.2, 3.2



Resources:

- Scientific Report on marking otoliths to track salmon.
- Otoliths Video News Features: BBC, KOMO and EBC (10 mins. total)

Background:

Otolith marking is an innovative way of marking salmonids without ever having to handle the fish. These markings are induced by adjusting the water temperature at the hatchery that particular fish is coming from. By simply making the water cooler by 8-12 degrees, it causes a "stress" in the environment, which effects the individual's metabolism causing the markings to occur. This process mimics what would happen in nature, which is why it is considered safe to manipulate these markings into a code or pattern. To learn about the history of a particular fish, the otolith is dissected out of the head of the salmonid, sectioned, polished, and examined under a microscope to decode the otolith mark pattern.

Directions:

- Show students otolith video to introduce otoliths and read "Thermal Markings on Otoliths."
- Break students into pairs and give each pair an otolith to examine. Also place an overhead of an otolith on the screen for all students to observe. Ask students to look at the otolith through the magnifier and observe structures. If you have any extra magnifiers, give each pair a magnifier to look closely at their otolith.
- Using the overheads provided describe how scientists mark otoliths of hatchery fish in a special sequence.
- Practice finding the sequence of markings on the otolith student activity sheets provided. Read "How to Read Otolith Markings."

Extensions:

- How do scientists use otolith marking to manage fish?
- What other kinds of research are scientists doing with labeled otoliths?
- What research questions would you ask using labeled otoliths? Explain.

Overview:

Students will read "Thermal Markings on Otoliths" which will show them how to interpret the induced markings on the salmonid otoliths. Once they interpret the code, they will learn about the fish that code pertains to.

Objective:

Students will learn the concept of thermal otolith marking and apply it the way the scientists do once they figure out the pattern. They will learn what kind of information can be found once the "pattern" is discovered. They will determine the otolith code of samples provided.

Critical Questions Addressed:

2. Endangered Salmon
3. Salmon Recovery

Materials:

Available in Activity Packet 10

- Otoliths
- Magnifier
- Overheads
- Copies of overheads.

Thermal Markings on Otoliths



Thermal Markings on Otoliths

Otolith marking is an innovative way of marking salmonids without ever having to handle the fish. These markings are induced by adjusting the water temperature at the hatchery that particular fish is coming from. By simply making the water cooler by 8-12 degrees, it causes a "stress" in the environment, which effects the individual's metabolism, causing the markings to occur. This process mimics what would happen in nature, which is why it is considered safe to manipulate these markings into a code or pattern. Thermal marking can be done through various cooling methods. For example, many hatcheries have two water supplies where one supply is colder than the other. Another way to cool the water is by using a portable chilling system. This system was created by Eric Volk, one of our chief fish scientists at the Washington Department of Fish and Wildlife. To learn about the history of a particular fish, the otolith is dissected out of the head of the salmonid, sectioned, polished, and examined under a microscope to decode the otolith mark pattern.

There are variances in widths between the markings that determine the pattern these markings are going to have. These variances are created by "multiple scheduled cold water events." These events determine when the water temperature will be adjusted, and then the mark will be made. For instance, if the biologists want to create a **narrow** gap between the markings, they will cool the water temperature for 24 hours, (which will create the mark), return to ambient (warm) water for 48 hrs, and then cool the water temperature again so that another mark is created. If they wanted to create a **wide** gap between the

markings, they would cool the water temperature for 24 hours to create a mark, return to ambient (warm) water for 4 days, and then cool the water temperature again to create yet another mark. Waiting 4 days to create another mark as opposed to only waiting 48 hours would create a larger gap between the markings. This method is called the "2 day narrow, 4 day wide method."

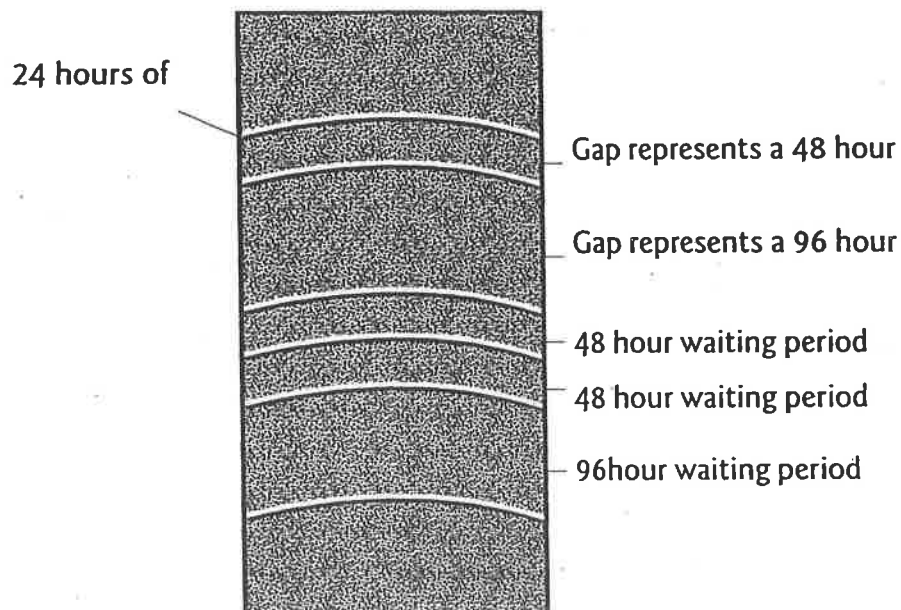
These markings can be placed on the otolith while the salmonid is still in the egg! These are called pre-hatch markings. After they hatch another pattern of markings can be created, these are called post-hatch markings.

Other Ways of Marking Otoliths

Another otolith marking method uses the naturally occurring element, strontium. Strontium is closely related chemically to calcium (an element that is a major component of bones and other calcified tissues). By placing salmon fry into an environment with artificially elevated concentrations of strontium, strontium is then absorbed and incorporated into the bony structures of the fry at a higher rate than normal.

These higher levels of strontium can be recovered from the otoliths of treated individuals by sectioning and polishing the otoliths and examining them using an electron microscope. Each treatment with strontium appears as a white ring in the otolith, just as each thermal treatment appears as a black ring in the otolith.

"2 Day Narrow, 4 Day Wide Method"



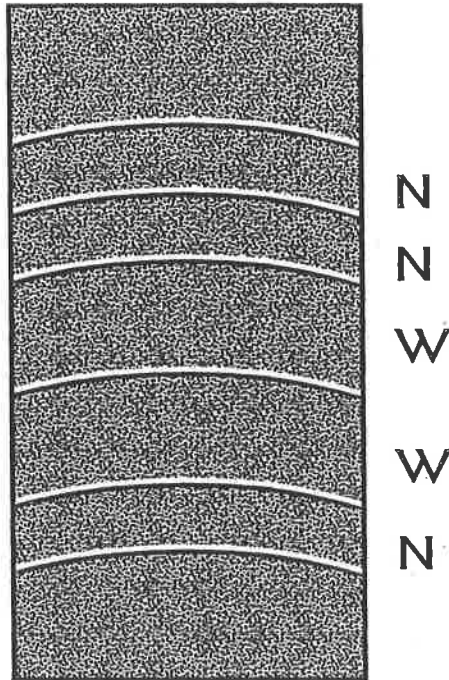


How to Decode the Otolith Markings

How to decode the Otolith Markings:

When looking at the otolith markings you notice that the markings are spread apart in variances. Some spaces are wider than others; The wider spaces are represented as "W" for "wide" and the narrower spaces are represented as "N" for "narrow."

For example:



So the code is: **NWWNN**

So when you observe the pattern of otolith markings you can discover various kinds of information about your fish.

Otolith Pattern Indicator Sheet



Reared in hatchery for approximately 4-6 months.

Transferred to Excelsior side channel held for 1 day then released in **Nooksack River, COHO**

CODE: NWWNN

Reared in hatchery for approximately 6 months.

Transferred to **Deadhorse Unacclimated Pond**-held them for 1 day, then released, **SPRING CHINOOK**

CODE: WWNNN

Reared in hatchery for approximately 6 months.

Transferred to **Deadhorse Acclimation Pond**-held through for 1 month, then released, **FALL CHINOOK**

CODE: WNWNN

Reared in hatchery for approximately 4-6 months.

Transferred to **Kidney Creek**-held for 1 day, then released, **COHO**

CODE: NNWWN

RSI=Remote Site Indicator-otoliths are marked, eggs are put in RSI to hatch and release-late yolk sack stage, **Kendall Creek Hatchery, FALL CHINOOK**

CODE: NWWNW

Yearling Release-reared for 1 year-on site hatching-**Nooksack River, CHINOOK**

CODE: WNNWN

Reared in hatchery for approximately 2-3 months.

Transferred to **Excelsior Glacier** (mainstream)-held for 1 day, then released, **CHUM**

CODE: NWNWN

Zero Release (meaning released before it reached a year old)-reared for 2 months-on site hatching-**Nooksack River, CHUM**

CODE: WNNNW



Teacher Information Answer Sheet

Answers for Activity Sheet #1:

1)—Yearling Release-reared for 1 year-on site hatching-Nooksack River, CHINOOK

CODE: WNNWN

2)—Zero Release-reared for 2 months-on site hatching-Nooksack River, CHUM

CODE: WNNNW

Answers for Activity Sheet #2:

3)—Excelsior side channel- 1 day old-Nooksack River, COHO

CODE: NWWNN

4)—Deadhorse Acclimation Pond-held through for 1 month, FALL CHINOOK

CODE: WNWNN

Answers for Activity Sheet #3:

5)—Deadhorse Unacclimated Pond-held them for 1 day, SPRING CHINOOK

CODE: WWNNN

6)—Excelsior Glacier (mainstream)- 1 day, CHUM

CODE: NWNWN

Answers for Activity Sheet #4:

7)—Kidney Creek- 1 day, COHO

CODE: NNWWN

8)—RSI=Remote Site Indicator-otoliths are marked, eggs are put in RSI to hatch and release-late yolk sack stage, Kendall Creek Hatchery, FALL CHINOOK

CODE: NWNWN



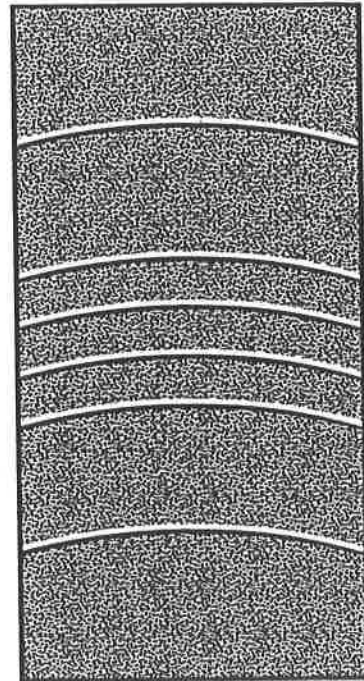
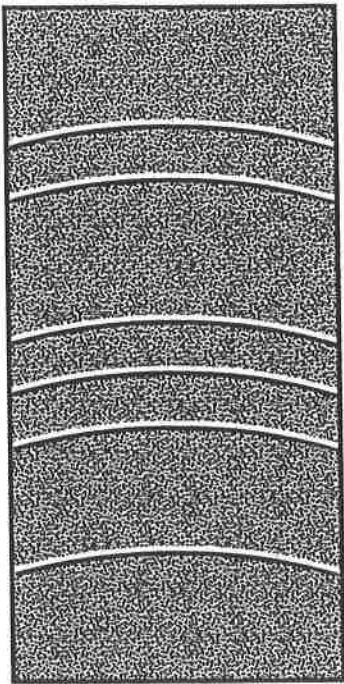
How to Decode the Otolith Markings

Student Activity

Student Activity Sheet Number 1

Name _____ Date _____ Teacher _____

Directions: Find the Pattern in the Otolith Marking that will help you discover the history of your Salmonid! Once you discover the pattern, look it up on the "Otolith Pattern Indicator Sheet."





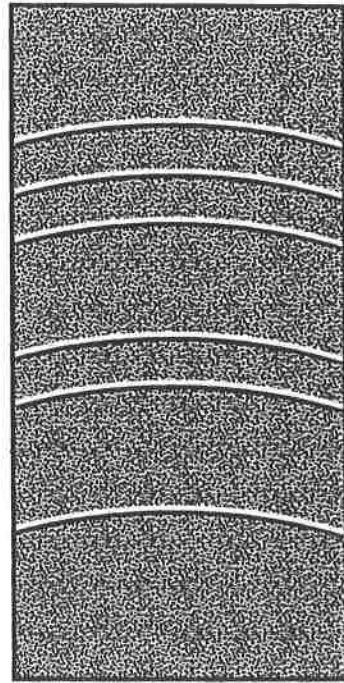
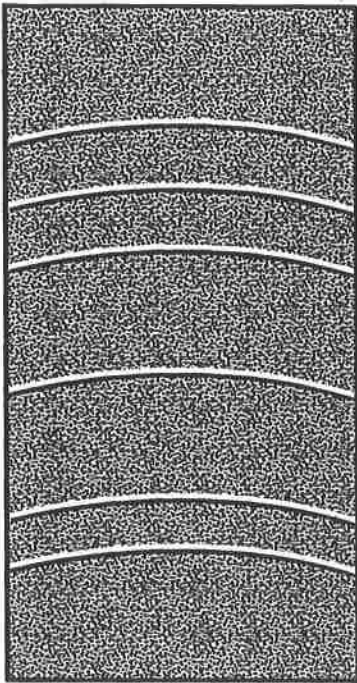
How to Decode the Otolith Markings

Student Activity

Student Activity Sheet Number 2

Name _____ Date _____ Teacher _____

Directions: Find the Pattern in the Otolith Marking that will help you discover the history of your Salmonid! Once you discover the pattern, look it up on the "Otolith Pattern Indicator Sheet."





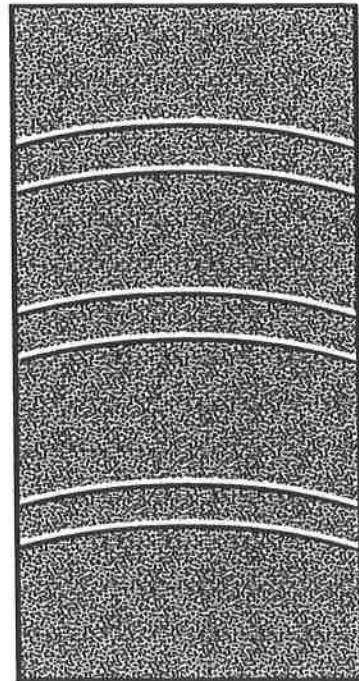
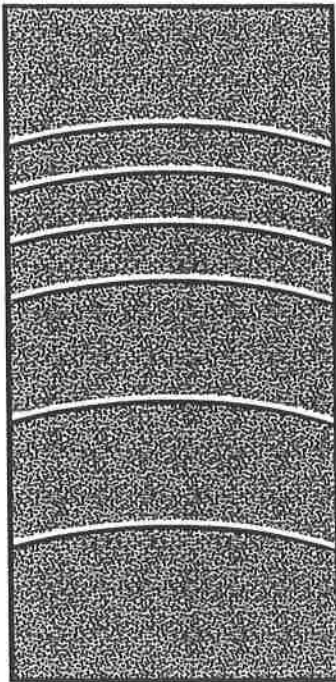
How to Decode the Otolith Markings

Student Activity

Student Activity Sheet Number 3

Name _____ Date _____ Teacher _____

Directions: Find the Pattern in the Otolith Marking that will help you discover the history of your Salmonid! Once you discover the pattern, look it up on the "Otolith Pattern Indicator Sheet."





How to Decode the Otolith Markings

Student Activity

Student Activity Sheet Number 4

Name _____ Date _____ Teacher _____

Directions: Find the Pattern in the Otolith Marking that will help you discover the history of your Salmonid! Once you discover the pattern, look it up on the "Otolith Pattern Indicator Sheet."

