Aging of Fish
by Their Scales
Title: Aging of Fish by Their Scales

Summary:
Fish that have scales can be aged by looking at a scale or a scale imprint under a microscope. Individual scales grow similar to a cross section of a tree trunk and produce what are called annular rings. These rings can be counted to age a fish.

Objectives:
To learn about the various fish and scales that most fish have. To learn to recognize a very important diagnostic tool used by fisheries biologists to age fish.
**Group Size:** 15-20

**Background for Educators:**

The body of most fish are covered with scales, however some fish have very tiny scales, whereas some fish have no scales at all, such as catfish and eels.

**How many types of scales are there?**

There are four main kinds of scales and numerous variations of each kind.

**Placoid** scales - are found in sharks and rays, and can vary greatly in external appearance. They do not increase in size as the fish grows, instead new scales are added. Placoid scales are often referred to as denticles. Although the skin may feel rough to the human touch, the backward orientation of the spines on these scales actually reduces hydrodynamic drag in water. In sharks, placoid scales are modified anteriorly (facing forward) to form replaceable rows of teeth in both jaws.

**Cosmoid** scales - are found in the Lungfishes (family Ceratodidae) and some fossil fishes. Lungfishes are found in Africa and Australia.

**Ganoid** scales - Some of the more primitive bony fishes are covered with hard rhomboid or diamond shaped scales which do not overlap. Ganoid scales are thick and are composed of bone overlaid with an enamel-like substance called ganoin. Many of the primitive fishes also have bony plates on their heads. Fish in the Mississippi River watershed that have this type of scales include: Bowfin, Paddlefish, gars, and sturgeons.

**Cycloid** and **Ctenoid** scales are modifications of the same scale found in the majority of bony fishes (the Teleostei). Each scale is a thin disk of bone covered with thin skin, that overlap each other like shingles. The anterior (front) part of each scale is usually overlapped by the posterior (back) portion of the scale in front. This arrangement of imbricate (overlapping) scales gives the fish greater flexibility than in those species with cosmoid and ganoid scales.

The scale is formed by concentric layers of bone called *circuli* that grows at the edge of the scale as the fish grows. During the winter when growth slows down, the scale also stops growing or is somewhat reabsorbed. When the fish’s
growth resumes in the spring this causes an *annulus* (annular ring) that can be used to determine the age of a fish much like growth rings formed in a tree.

Ridges appearing as lines radiating from the center of the scale are known as *radii*.

- Ridges that appear as lines that radiate from the center of the scale are called *radii*
- Lines that resemble fingerprints around the scale are called *circuli*
- Darker *circuli* are formed each year and are called *annulus* or *annular rings* and can show the age of a fish

The simple smooth scales are known as *cycloid* scales. The word "cycloid" comes from the Greek "cyclo", meaning circle.

*Ctenoid* scales are similar but are differentiated by tiny spines or teeth covering the exposed part of the scale. Ctenoid scales have a variously developed spiny posterior margin (the word "ctenoid" comes from the Greek "cteno", meaning comb, and refers to the comb-like ctenii on the margin of the scale). It is thought that these teeth or spines help to reduce hydrodynamic drag during swimming. If a fish with ctenoid scales is touched from tail to head the scales feel rough rather than smooth.

In the Mississippi watershed the scales that are generally found on scale fish are ganoid, cycloid, or ctenoid. To study and age a fish by its scales it is often necessary to remove a scale for studying the structure under a microscope.

Often fisheries biologists doing population and age studies in a body of water will catch fish by shocking or netting. They quickly work with the fish out of water so that it can be returned to the water as soon as possible to avoid stress and death to the fish. They will record the species of fish, body of water where it was caught, location in the body of water, the fish’s total length, weight, and age. Everything about the fish except for its age can be done in the field. Biologists will remove several scales and place them in a corresponding marked envelope so that the fish can be aged later in the laboratory, using a microscope. By measuring the distance between the annual growth rings, a biologist can determine the rate of growth of a fish from year to year or even from various bodies of water. This may indicate if there is sufficient food for the population of fish in a body of water, if disease or environmental factors
has slowed growth rates, or if certain fish populations are overpopulated and growth is stunted.

**Materials Needed:**

- Both compound and monocular microscopes
- Slides with various scales from various fish species
- Identification charts of fish

**Types of Scales Found on Fresh Water Fish in United States**

*Ganoid fish scales*
Cycloid fish scale
Notice the darker annual rings showing a fish of 4 years old

Ctenoid fish scale
Notice the darker annual rings showing a fish of 4 years old

Procedure:
Explain the various scale types to students and if possible study various live fish in the aquariums at the National Mississippi River Museum & Aquarium.

Look at the various examples of ganoid, cycloid, and ctenoid scales under a microscope. Using the various prepared slides of fish scales have the students try to determine the age of the fish from the scales. After the answers are filled in on the worksheet, check the answer key to see how well you did.

Evaluation:
Visual observation to see if students are learning how to age fish from the annular rings on the scale samples.
Additional resources:
- Local fisheries biologist

Extensions:
- Identify species of fish in the aquariums at the National Mississippi River Museum & Aquarium

Related programs available at the National Mississippi River Museum & Aquarium:
- *Wet and Wild Along the Mississippi River*
- *Water Logged*

Credits:

Mark D. Wagner, Education Director, National Mississippi River Museum & Aquarium.

Iowa Resource Enhancement and Protection (REAP) grant.