# MARKING AND TAGGING

# FIS318

# LECTURE GUIDE

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# MARKING AND TAGGING IN FISHERIES

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## *INTRODUCTION TO MARKING AND TAGGING*

Tagging and marking are important techniques fisheries biologists use to study individual aquatic animals or populations. They will tag or mark aquatic animals to obtain information necessary for research or management. Certain marking techniques allow fish to be tracked giving biologists a better understanding of movement and migration patterns. Other mark and recapture methods provide population estimates, fish growth, and estimates of fish and natural mortality.

When marking fish, it is important for a fish biologist to think about the following reasons for marking

- Is it important to be able to identify an individual fish or a group of fish?
- Will the mark affect the fish's behaviour or increase mortality?
- What are the chances that the tag will be lost or misidentified?

## *FACTORS TO BE CONSIDERED DURING TAGGING AND MARKING STUDY*

A researcher must carefully consider many different factors:

- Fish size
- Tag size and color
- Number of fishes to mark
- Area of the study
- Effects to the fish
- Cost

- Ability to detect by e.g transmitter, x-ray etc
- Retention time of tag/mark
- Ability to differentiate individuals

### *HISTORICAL BACKGROUND*

Historical ledgers of fish tagging dated back to the early 1900's. They primarily focused on the movements of cod, haddock and pollock, but there are also occasional entries of other species such as monkfish and sharks. Since that time scientists have refined their methods and an entire industry of tagging related products has been established. Many of the products available to researchers originated in other industries and were modified to fit the needs of fishery biologists.

### *NECESSARY INFORMATION OBTAINED FROM TAGGING FISH*

- Stock identification
- Migrations
- Behaviour
- Age
- Mortality rates
- Abundance
- Stocking success

### *METHODS AND TYPES OF MARKING AND TAGGING*

Below is a list of various tagging and marking methods with a description of each method. The list is separated into three separate categories: biological, chemical, and physical marks.

## BIOLOGICAL (NATURAL METHODS)

### 1. PARASITIC MARKS

Used to identify stocked fish and determining movement or migration patterns.

Advantages: they have low survey costs , can be used on large bodies of water, and are natural.

Disadvantages: Time to determine if parasite can be a mark, identification of individuals is not always possible, trained personnels are required, and mathematical errors can occur.

## 2. MORPHOLOGICAL MARKS

Used to differentiate stocked fish and for mark recapture studies. Some examples are meristic counts, pigmentation, shape, size, age marks on otoliths or scales.

Advantage: low cost

Disadvantage: markings are subject to environmental conditions.

## 3. GENETIC MARKS

Used to identify fish stock.

Advantage:

I. effectiveness in identifying fish stocks

Disadvantages:

I. Is in preserving blood samples and developing reagents and equipment.

II. The analysis can be costly.

Two examples are electrophoresis and serological methods.

# CHEMICAL METHODS

**Advantages**:- Low cost, decreased handling time, large numbers can be marked, and possible to mark smaller species.

**Disadvantages:** - Individual organisms not being recognized and retention tends to be brief because growth can disperse the marker and differs between species as well as between methods.

## 1. INJECTION

Consideration should be taken with diffusion of the substance, concentration of substance, and location of injection.

## 2. FEEDING

Works well in laboratory and hatchery settings where fish can be monitored and feed on the dyes. Various dyes and chemicals have been used with a varying degree of success.

## 3. IMMERSION

Staining by this technique allows a large number of fish to be marked. Retention of the mark can become a problem depending on age, size, water chemistry, temperature, concentrations of chemical, and duration of immersion.

**Fish submerged in an Oxytetracycline chemical bath.**

### Chemicals used include

- ***Alizarin (ALC)***
  Advantages:

  I. Low mortality rate.

  II. Very effective way to mark fish but more costly than OTC.

  Disadvantage:

  I. Cost of the chemical.

- ***Calcein***
  Disadvantages:

I. Less reliable in producing marks on fish and has a higher mortality rate.

- ***Oxytetracycline (OTC):***
  Advantages:

  I. less costly,

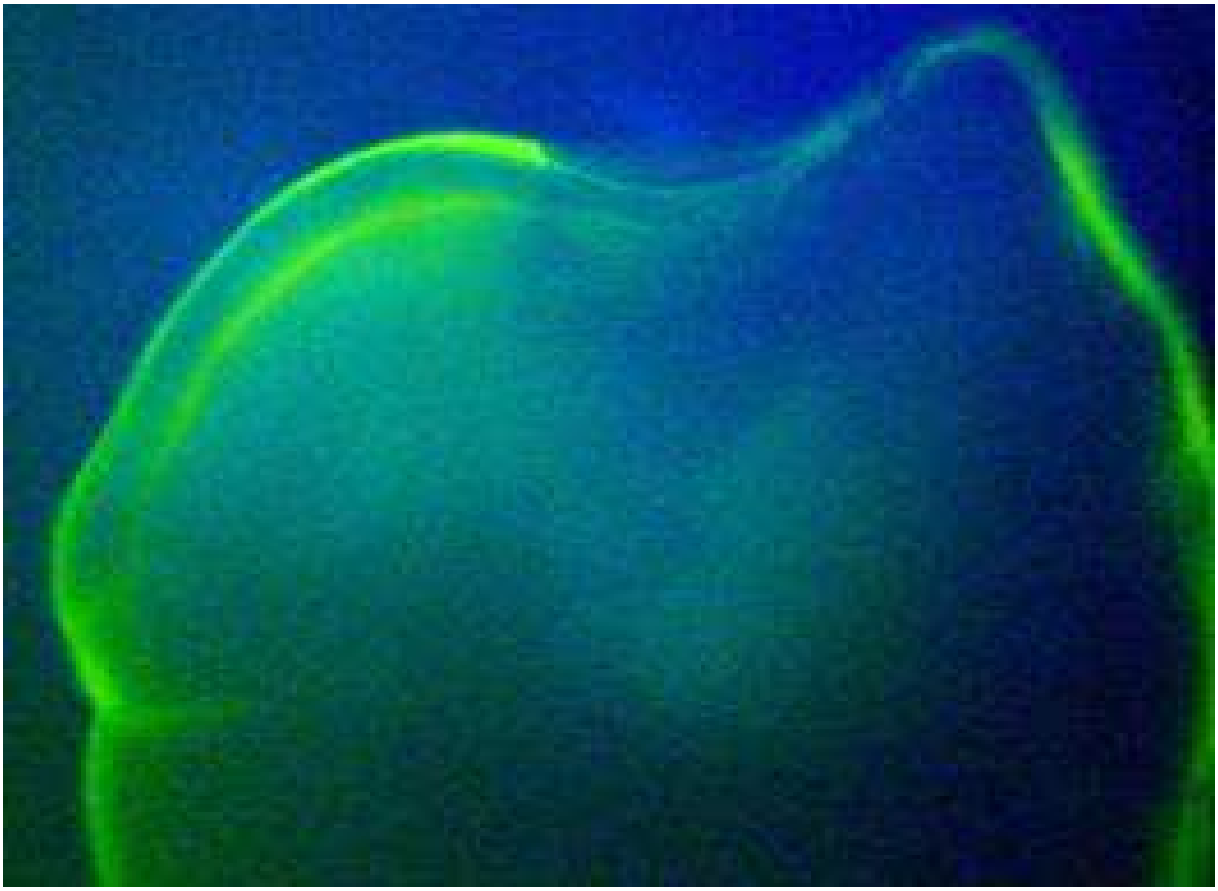
  II. marks are reliably produced

  III. few if any mortalities

  IV. Can be used on salt water fish.

  Disadvantages:

  I. Takes time to produce the mark and the sophisticated equipment needed to identify the mark.



**Otolith with an Oxytetracycline (OTC) mark**

# PHYSICAL (MUTILATION OR TAGS) METHOD

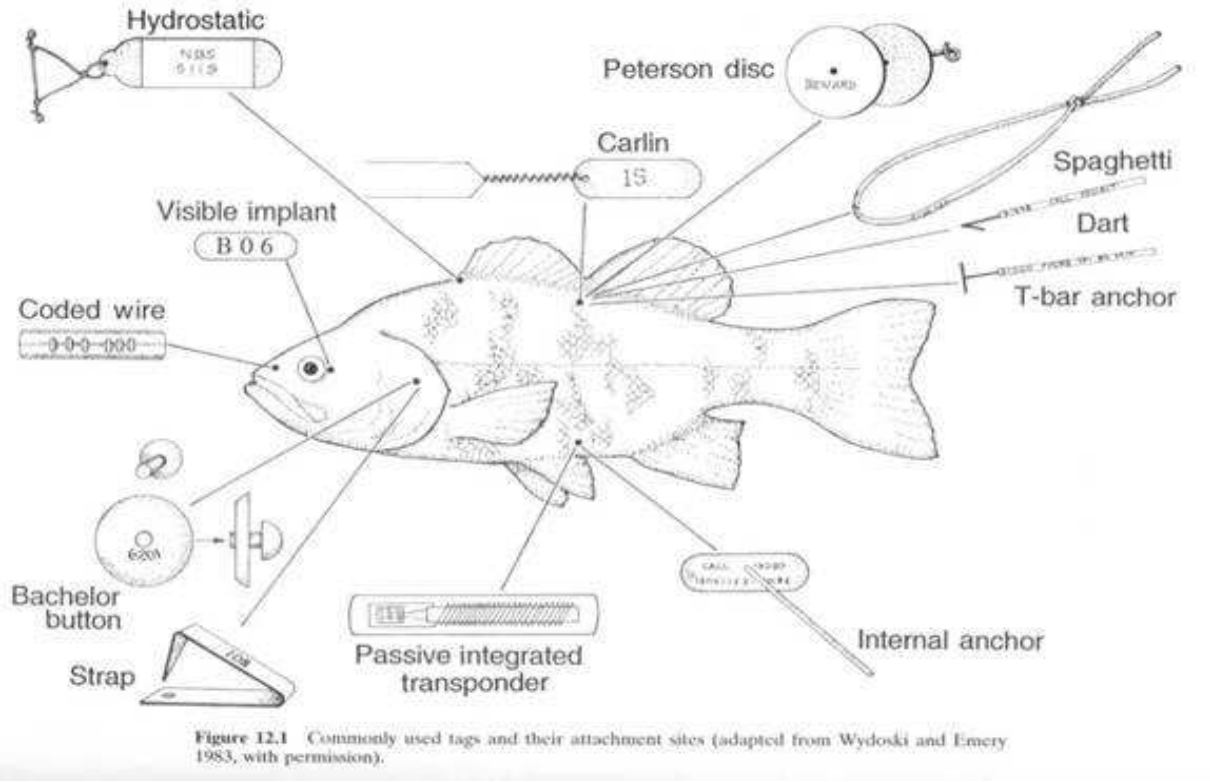



Figure 12.1 Commonly used tags and their attachment sites (adapted from Wydoski and Emery 1983, with permission).

**Commonly used tag types and their attachment sites**

## 1. INTERNAL TAGS

Advantages:

I. They can be inexpensive

II. Non-toxic

III. Put less stress on the fish compared to some other tagging methods.

Disadvantages:

I. Trained personnel are necessary at times

II. Recovery is extremely difficult.

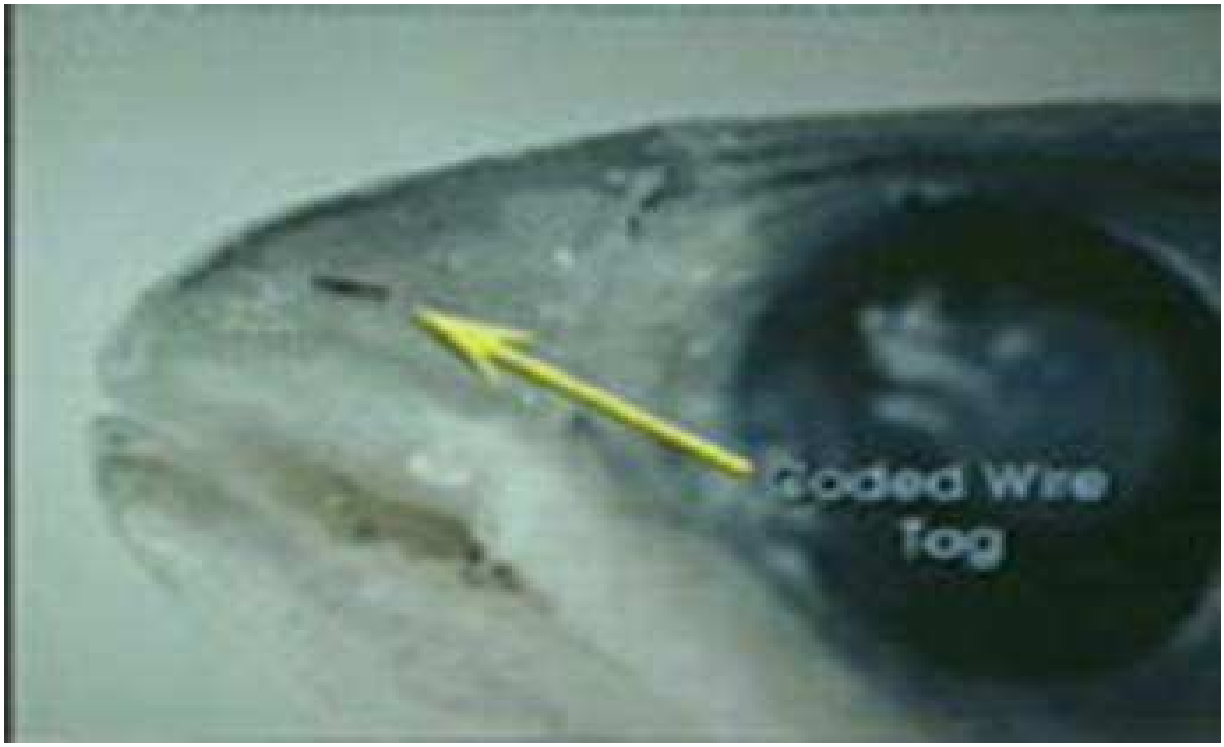
## TYPES

a) **Body Cavity tags:** - First used in flounders during the 1930s, metal anchors were placed in body cavities to later identify.

b) **Subcutaneous tags**: - Inexpensive plastic discs imprinted with serial numbers and legends in order to identify individual fish.

c) **Microtags**: - Originally used to identify explosives, microtags are microscopic plastic chips which contain seven layers of plastic that can be colour coded to identify groups of fish much like coded wire tags.

d) **Coded Wire tags: -** A small piece of wire injected into a fish using small applicators or by hand. They are placed in the snout, necks, caudal fins, and any other muscular area. Tags detected with a sensitive metal detector or an x-ray, which can show colour-coded wires or notches that are used to identify specific groups of fish.




**Coded wire tag in nose of fish.**

e) **Passive Integrated Transponder tags (PIT):** - Many researchers use PIT tags to study migration habits and movement to and from specified areas. A PIT tag is a radio frequency device that transmits a unique individual code to a reader where it is displayed in a numeric or alphanumeric form.

**Two PIT tags next to a penny.**

f) **Thermal marks: -** Thermal marking is an efficient means of marking 100% of the fish at the hatchery. Therefore, we can take fish that have been thermal marked, remove its otoliths or ear bones and tell whether or not it is a hatchery fish

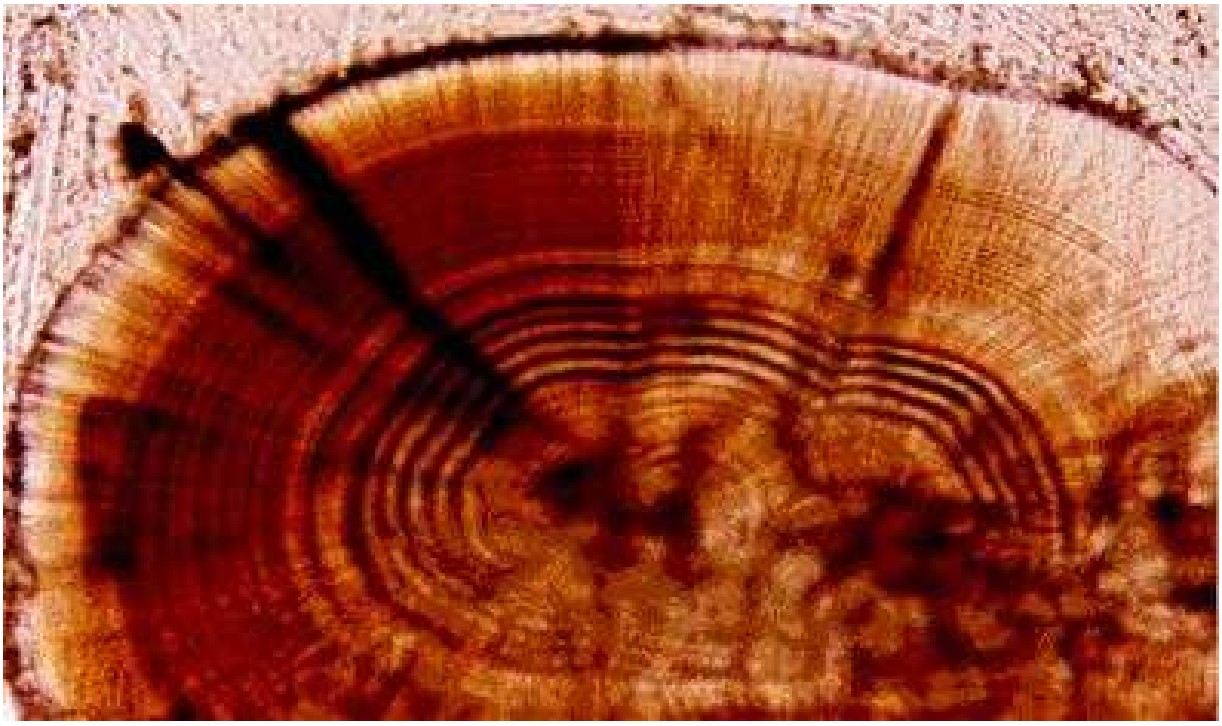


**Image of a thermally marked otolith with a pattern of five dark bands (near center).**

g) **Radio tags: -** tags that transmit radio signals to a receiver.

h) **Surgically implanted radio tag.**

- **Sonar tags:** - hydrostatic tag in which detailed instruction are placed inside a plastic capsule that is attached by a wire to the fish.

- **DST GPS Fish Tag, Fish Positioning Sounder and Simrad GPS Sonar** Data Storage tag (DST) Global Positioning System (GPS) can be attached externally or implanted into fish. DST GPS can receive information about geographic position.

  Advantages

  I. The GPS Fish Positioning System will increase knowledge on fish migratory routes

  II. Provides major contribution to sustainable management of fish resources. Data for improving stock assessment and management, for stock models, accessibility and availability of fish resources, behaviour analysis, migration and distribution, coastal migration.

Disadvantages

I. Requires expensive equipment for locating fish.

II. Time Consuming on insertion of tag internally by surgery.

III. Need skilled personnel for surgical procedure.

IV. Fish need to be fairly big in size and in body cavity for tag to be inserted.

## 2. EXTERNAL TAGGING

Advantages: -

They can be seen without dissection of the fish. Also many external tags allow for individual recognition.

Disadvantages: -

I. Main disadvantage is that they can cause higher mortality by attracting predators,

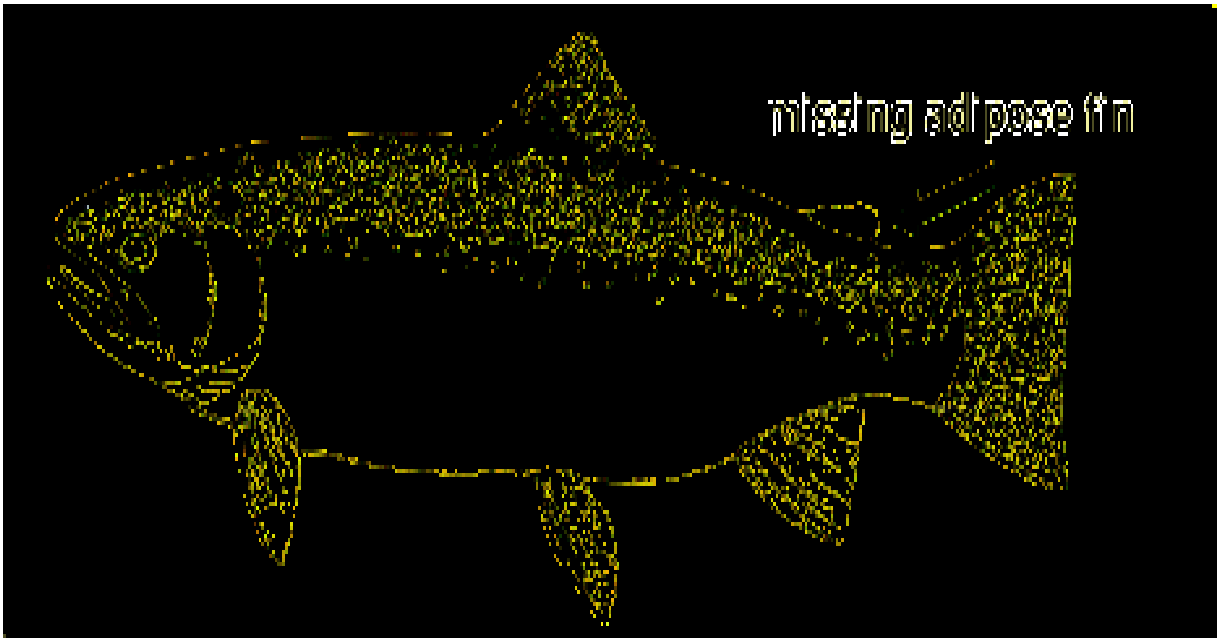
II. interfere with locomotion by protruding

III. Make the organism more susceptible to disease and infection.

### TYPES

- Mutilation
- Branding
- Visible Implant Elastomer (VIE)
- Petersen discs
- Spaghetti tag
- Dart tags
- Anchor tag (Floy tags)
- Dangler tags
- Strap tags
- Paper fasteners
- Carlin tag

a) **Mutilation:** - clipping or punching fins or other body parts are a type of mutilation that can be used to later identify individuals. This is a simple and quick technique that is very inexpensive to use. Although some marks can remain permanent, others like fins can regenerate. Even though fins can regenerate they are often distorted and can be identified as marked. One problem with mutilation is the possibility of negatively affecting the fish's behaviour and ability to survive.




**Example of a mutilation mark (adipose fin clip).**

b) **Branding: -**The uses of hot or cold instruments on the body of a fish in order to produce an identifiable mark for recognition. One advantage of branding is that no changes are made to the body or fins of the fish. The main disadvantage over time is that the mark becomes unrecognizable. When branding it is important to consider the type of scales, age, temperature of the branding tool, total time the branding takes, and the cost of equipment.

**VIE tag implanted behind eye of a coho salmon.**

c) **Visible Implant Elastomer (VIE): -** tags are injected as liquid that soon cure into a pliable, biocompatible solid. They are implanted beneath transparent tissue and remain externally visible.

d) **Paper fasteners:** - Paper fasteners can be used like strap tags for short-term marks. You can purchase these at an Office supply store and paint with fast-drying spray paint for easy detection. Paper fasteners are easy to apply and easy to remove. Paper fasteners work best on fish with bony opercula.

e) **Strap tags:** - strap tags are made of light-weight, noncorrosive metal, come in all different sizes and are serially numbered. Strap tags are easily attached to fish. Straps are attached to different locations of the fish body; opercula, fins, and caudal peduncles. Strap tags are used on a variety of species, are permanent tags on some fish. Best retention results are with fish with bony opercula.

f) **Dangler tags:** - consist of a dangling tag (with information on it) attached by wire to the fish. Dangler tags that are applied close to the body and are streamlined are retained well and can remain on fish for life. Dangler tags are best suited for small studies involving few fish because applying takes a great deal of time.

g) **Petersen discs:** - these tags were used during the first 60 years of tagging. Although tag construction has changed from different types of material to a less expensive in terms application but design of the tag have remained unchanged.

**Peterson disc below the dorsal fin of a warmouth.**

h) **Spaghetti tag:** -is a loop of vinyl tubing that passes through the fish. Information is printed directly on the tubing. Attachment for the tag is by threading tubing through the body of the fish with a hollow needle. Two variations of the tag are lock-on and cinch-up tags, which use special locking devices instead of a knot. The tag is retained well and inexpensive, but application is time-consuming.

i) **Dart tags:** - made of nylon shaft with a barbed end and a vinyl tube that fist over the upper end of the shaft. The barbed end of the shaft holds the tag in the fish and the tube contains the tag information.

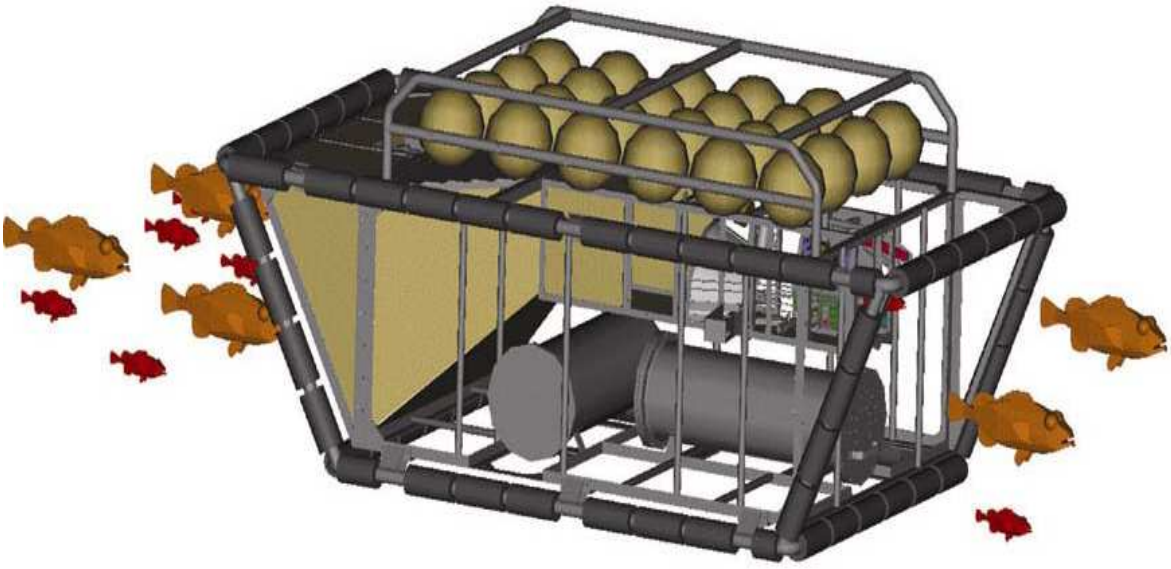
j) **Anchor tag (Floy tags):** - applicable for long-term studies on migration on adult migratory species. This tag is a modified dart tag in which a nylon T-bar replaces the harpoon like head of the dart tag. These tags are exactly like tags used to attach prices to clothing. The tags are inserted with a gun which can be loaded with one or a clip of anchor tags, marking the tagging of individuals or hundreds of organisms quick and easy. Like dart tags it is important that anchor tags penetrate deep enough into the fish that the T-bar interlocks with the skeleton.

k) **Carlin tag:** - the disc carries individual identification of the fish and reporting instructions and can be used for short-term experiments, but is ideal for long-term experiments. Carlin tags are very common in monitoring and research work.

**Carlin darter tag attached to a fish**

## UNDERWATER TAGGING EQUIPMENT (UTE)

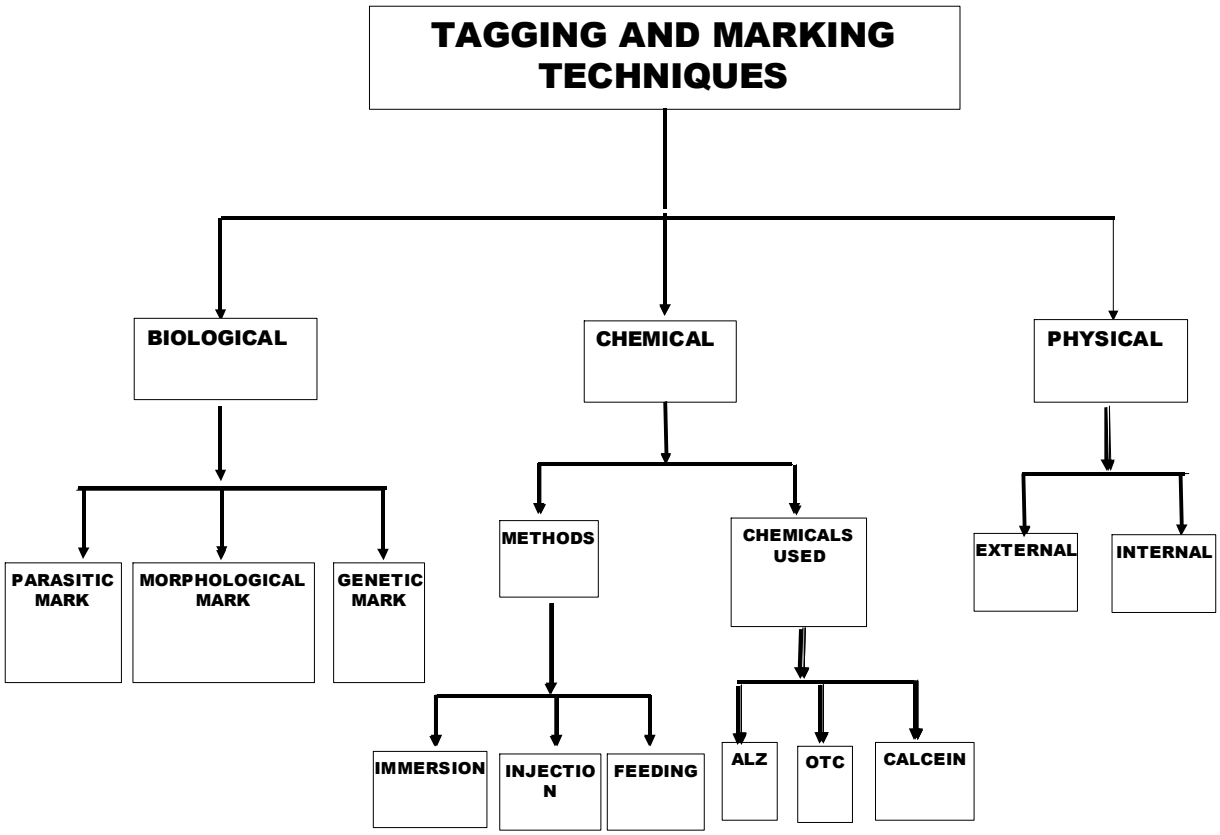
The UTE is located at the end of the belly section of a trawl net (both bottom and pelagic) and performs the whole tagging operation underwater, from the surface down to more than 1000 m. Since UTE prevents the need for hauling the fish to the surface for tagging and release (most deep water species do not survive being brought to the surface), the handling time for each fish is short. By tagging the fish in its natural environment, stress factors such as changes in pressure and temperature can be avoided, reducing tagging mortality.



**The newly developed Underwater Tagging Equipment (UTE) for tagging of fish in situ, by Star-Oddi (http://www.star-oddi.com, Iceland).**

Deep-sea redfish (Sebastes sp.) tagged in situ. A small plastic tube hangs outside the fish to allow its identification (Star-Oddi, http://www.star-oddi.com, Iceland).

## SUMMARY



| Type of mark | $ per Tag<br>Tag Length | Advantages | Disadvantages |
|---|---|---|---|
| Fin clipping/V-notch<br>- fish in a closed system (ex. trout)<br>- lobster  | 0<br>~ 1 in. | - no cost<br>- easy application<br>- fast application | - no animal ID<br>- limited time of mark (regrowth/ molting) |
| Polyethylene ribbon or disc<br>- shellfish  | 0.15 - 0.20<br>1/8 to 3/4 in. | - low cost<br>- unique animal ID<br>- easy application | - need hard surface<br>- life of glue limits tag life |
| Visible implant elastomer (VIE)<br>- turtles<br>- salmon<br>- hatchery releases  | (varies)<br>~ 1/4 in. | - easy detection<br>- easy to tag large #s of fish quickly<br>- inexpensive color | - no animal ID<br>- very expensive injector |
| T-bar anchor tag<br>- most fish<br>- scup, shark...  | 0.45<br>2+ in. | - low cost<br>- unique animal ID<br>- fast application<br>- appropriate for many species | - requires tagging gun<br>- training needed<br>- tags are shed easily |
| Laminated disc<br>- YT flounder<br>- flat fishes  | 0.50<br>3/4+ in. | - low cost<br>- unique animal ID<br>- nearly permanent | - minor injury to animal<br>- some training necessary |
| Internal anchor tag<br>- striped bass<br>- bl. sea bass  | 0.75<br>~3 in. | - longer retention<br>- more secure<br>- unique animal ID | - specific training required<br>- slow application<br>- minor injury to animal |
| Passive integrated transponder (PIT)<br>- turtles<br>- salmon  | 5-10<br>1/2 to 1 in. | - nearly permanent<br>- unique animal ID<br>- electronic tag detection | - not visible<br>- scanner needed to read tag #<br>- cost of scanners and tag injector |
| Archival tag (data storage)<br>- various species<br>- cod<br>-YT flounder  | 200+<br>1 to 2 in. | - temperature and depth records<br>- other options available | - limited battery life<br>- tag must be retrieved to get data |
| Pop-up, satellite tag<br>- tuna<br>- shark<br>- turtles<br>- billfish  | 2,000+<br>2 to 6 in. | - real time data<br>- location recorded<br>- tags do not need to be recovered | - cost<br>- limited battery life<br>- satellite time is additional cost |

**ECHO SOUNDING**

Echo sounding in this context is referred to as hydrostatic 'echo sounder' defined as active sound in water (sonar) used to study fish. Hydrostatic assessments have traditionally employed mobile surveys from boats to evaluate fish biomass and spatial distributions. Conversely, fixed location techniques use stationary transducers to monitor passing fish.

Echo sounding is commonly used for fishing. Variations in elevation often represent places where fish congregate. Most charted oceans depths use an average or standard sound speed. Where greater accuracy is required average and even seasonal standards may be applied to ocean regions. For high accuracy depths, usually restricted to special purpose or scientific surveys, a sensor may be used to observe the factors such as temperature, pressure and salinity used to calculate sound speed and thus determine the actual sound speed in the local water column.

This acoustic technique can be applied to sensing aquatic fish, zooplankton and physical and biological habitat characteristics.

**Basic theory:**

Biomass estimation is a method of detecting and quantifying fish and other aquatic organisms using sonar technology. An acoustic transducer emits a brief, focused pulse of sound into the water. If the sound encounters objects that are of different density than the sounding medium, such as fish, they reflect some sound back toward the source. These echoes provide information on fish size, location, and abundance. The basic component of scientific echo sounder hardware function is to transit the sound, receive, filter and amplify, record, and analyse the echoes. Quantitative analysis requires that measurements be made with calibrated echo sounder equipment, having high signal-to-noise ratios.

**Techniques:**

a. Fish counting

When individual targets are spaced far enough apart that they can be distinguished from one another, it is straight forward to estimate the number of targets. This type of analysis is called echo counting, and was historically the first to be used for biomass estimation.

b. Echo integration

If more than one target is located in the acoustic beam at the same depth, it is not usually possible to resolve them separately. This is often the case with schooling fish or aggregations of zooplankton. In these cases, echo integration is used to estimate biomass. Echo integration assumes that the total acoustic energy scattered by a group of targets is the sum of the energy scattered by each individual target. The total acoustic energy backscattered by the school or aggregation is integrated together, and

this total is divided by the previously determined backscattering coefficient of a single animal, giving an estimate of the total number.

**Instruments:**

. Single-beam echo sounder

. Twin-beam echo sounder

. Split-beam echo sounder

Target strength (TS)

This is a measurement of how well a fish, zooplankton, or other target scatters sound back towards the transducer. In general, larger animals have larger target strengths, though other factors, such as the presence or absence of a gas- filled swim bladder in fishes, may have a much larger effect.

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