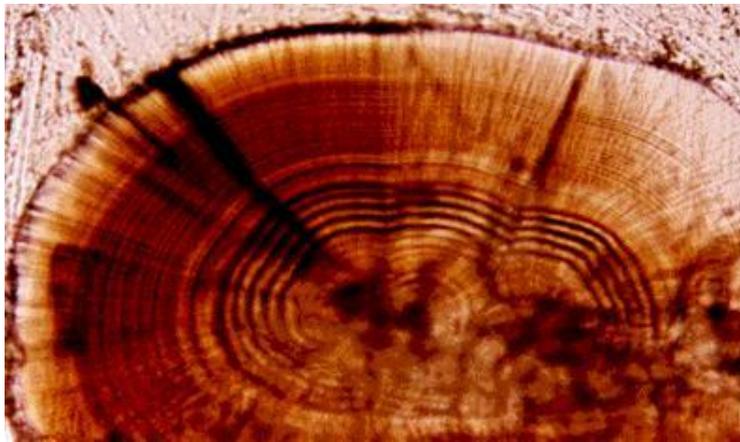


Fish Tagging and Marking Techniques



Why Mark or Tag the fish

- Tagging and marking fish are essential techniques for any fisheries biologist. Marking a fish allows biologists to gather a wide variety of information.
- 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.

Type of Fish marking or tagging

- Biological
- Chemical
- Physical

Biological (Natural Marking)

- **Parasitic Marks**
- **Morphological Marks**
- **Genetic Marks**

- **Parasitic Marks-** Used to identify stocked fish and determining movement or migration patterns.

Advantages are 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 personnel are required, and mathematical errors can occur.

- **Morphological Marks-** Used to differentiate stocked fish and for mark recapture studies.

Advantage is the low cost and one disadvantage is that markings are subject to environmental conditions which can change physical characteristics and overlapping of genotypic characteristics of populations.

Some examples are meristic counts, pigmentation, proportional body parts of body parts; shape, size, age marks of otoliths or scales, and chemical compositions of scales or bony parts, and internal marks on scale.

- **Genetic Marks-** Used to identify fish stock. One advantage is the effectiveness in identifying fish stocks compared to morphological methods while a disadvantage is in preserving blood samples and developing reagents and equipment. Another disadvantage is the analysis can be costly. Two examples are electrophoresis and serological method.

Chemical Marking

- Use of certain chemicals or dye for marking the fish
- 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.

Chemicals

- **Oxytetracycline (OTC)** - Advantages are less costly, marks are reliably produced, few if any mortalities, and can be used on salt water fish. Some disadvantages are the time it takes to produce the mark and the equipment needed to identify the mark.
- **Alizarin (ALC)** - One advantage is the low mortality rate. ALC is an effective way to mark fish however is more costly than OTC. One disadvantage is the cost of the chemical.
- **Calcein**- Two disadvantages are less reliable in producing marks on fish and it also has a higher mortality rate.

Methods of Chemical marking

- **Immersion**
- **Injecting**
- **Feeding**

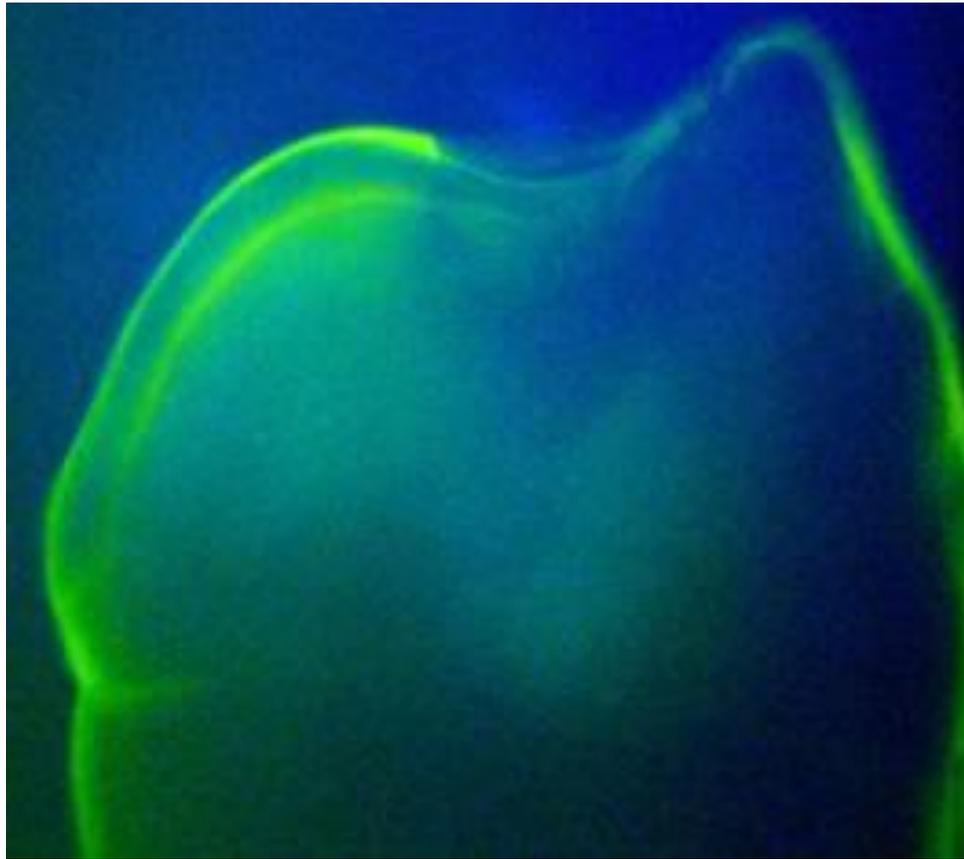
Immersion

- 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. It is also important to look at toxicity of the chemical in certain concentrations as well as any effects marking will have on predation or reduced survival.



Rainbow trout submerged in an oxy-tetracycline chemical bath.

- **Injection**-Consideration should be taken with diffusion of the substance, concentration of substance, and location of injection. Possible problems are injecting into internal organs and time it takes to inject each fish.
- **Feeding**-Works well in laboratory and hatchery settings where fish can be monitored and feed the dyes. Without monitoring the fish problems can occur where some individuals do not feed as much as others and the marker is not as clearly recognized. Various dyes and chemicals have been used with a varying degree of success.



Otolith with an OTC mark

Physical (mutilation or tags)

- Internal Tagging
- External Tagging

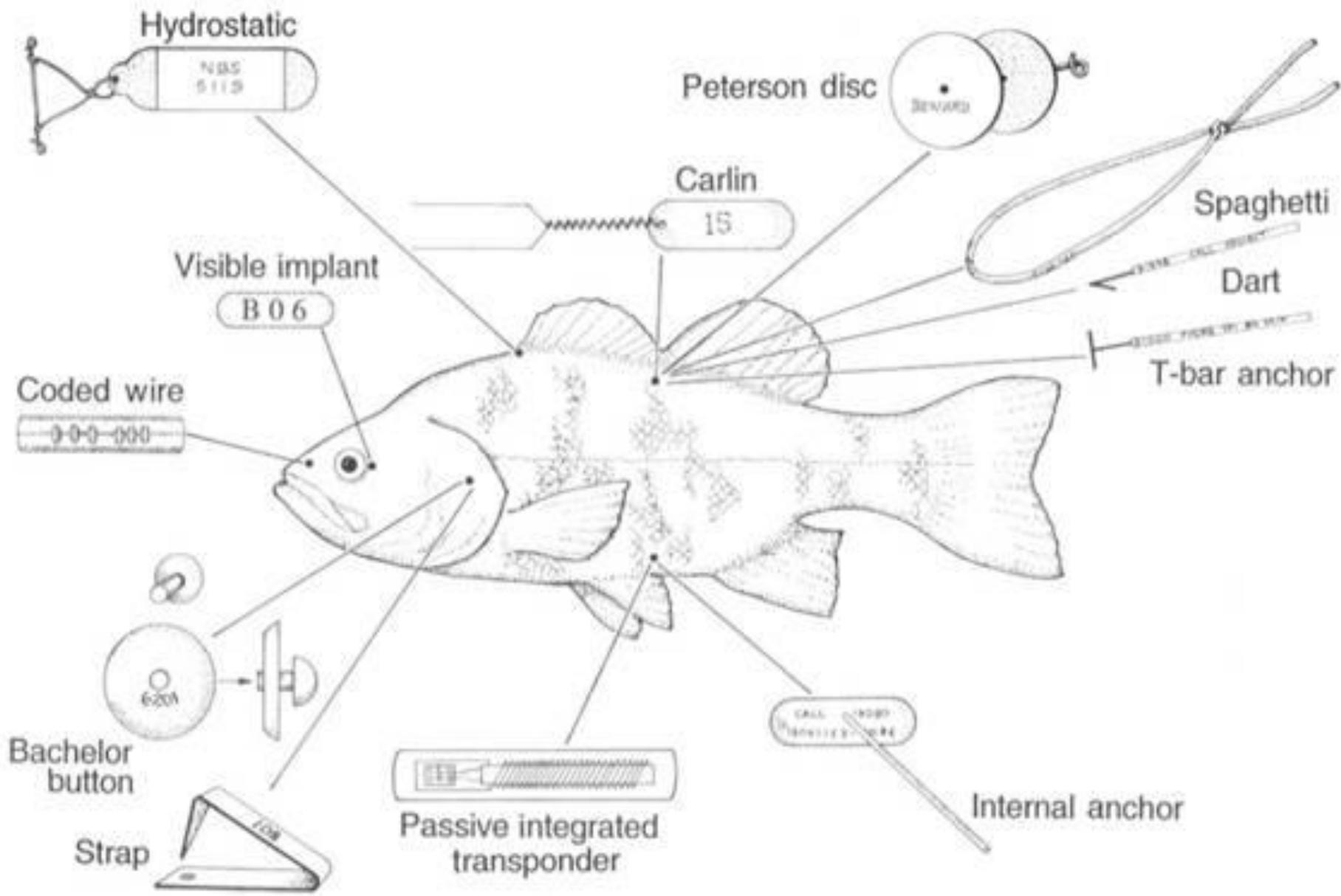


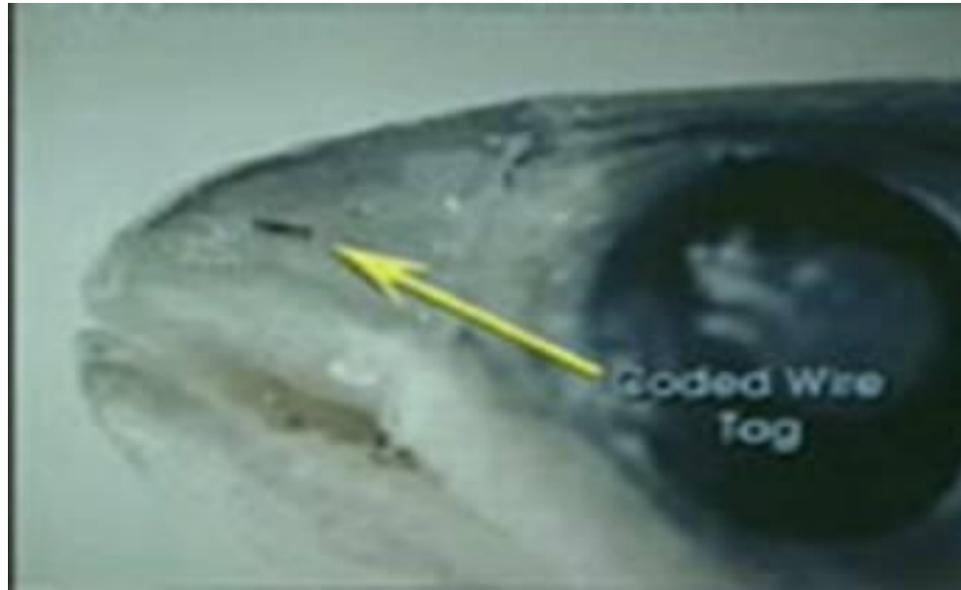
Figure 12.1 Commonly used tags and their attachment sites (adapted from Wydoski and Emery 1983, with permission).

Internal type of tagging

- **Body Cavity tags**
- **Subcutaneous tags**
- **Coded Wire tags**
- **Micro tags**
- **Passive Integrated Transponder tags (PIT)**
- **Radio tags**
- **DST GPS Fish Tag**
- **Fish Positioning Sounder**
- **Simrad GPS Sonar**

- **Body Cavity tags-** First used in flounders during the 1930s, metal anchors were placed in body cavities to later identify. Strong magnets recover the tags; however recovery is difficult. If tags are placed before spawning has occurred fish can expel the tags and machinery can destroy the tags before the magnets can detect them.
- **Subcutaneous tags-** Inexpensive plastic discs imprinted with serial numbers and legends in order to identify individual fish. Discs are planted in between the outer layer of skin and muscles by a small incision. Using this technique normally requires the use of another mark to identify that a subcutaneous tag was inserted inside the fish.

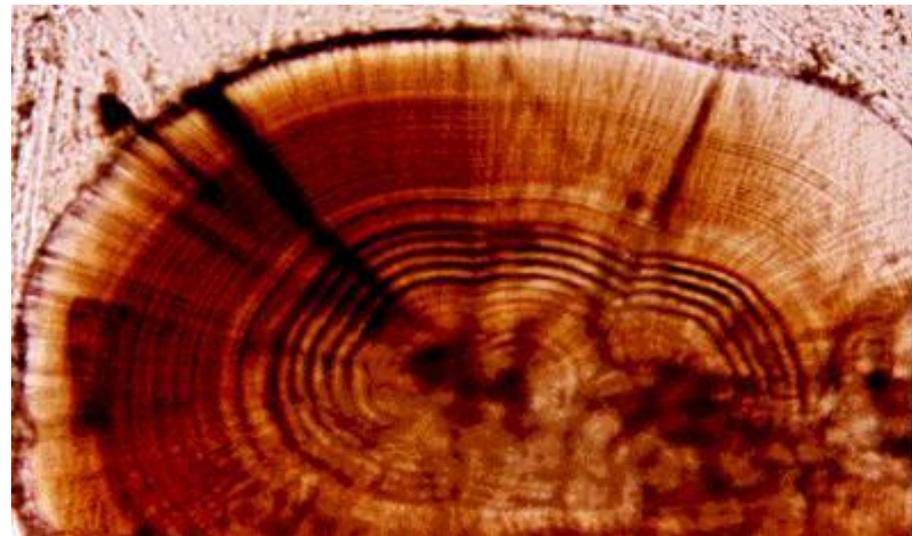
- **Coded Wire tags:** A small piece of wire injected into a fish using small applicators or by hand. These tags can be placed in the snout, necks, caudal fins, and any other muscular area. The tags can be detected with a sensitive metal detector or an x-ray, which can show color-coded wires or notches that are used to identify specific groups of fish. The equipment used to tag and detect the wires are very expensive, however using this technique allow fish to be tagged quickly, easily, and without altering behaviors.



Passive Integrated Transponder tags (PIT) - many researchers use PIT tags and readers 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. The tag has no internal battery, hence the term "passive". The reader powers or excites the tag circuitry by radio frequency induction and receives the code back from the tag. Radio frequency identification does not require line of sight, tags can be read as long as they are within the range of a reader. PIT tags were designed for positive identification; because they are passive they are not capable of long-distance tracking. The implant site is dependent upon the species, size of the animal and the size of the tag.

- **Microtags**-Originally used to identify explosives, microtags are microscopic plastic chips which contain seven layers of plastic that can be color coded to identify groups of fish much like coded wire tags. There are 300 million color combinations that can be used. They can also contain a fluorescent or magnetic layer.

Thermal Tags- 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. The hatchery fish are marked prior to hatch or soon thereafter in incubators. By manipulating the water temperature in the incubators, hatchery technicians can place a series of rings on the otoliths that will identify them by hatchery and brood year. This process forms a type of "bar code" on the otolith that remains with the fish for its lifetime. These patterns of bands can be customized for each hatchery and brood year by varying the number of bands and the width and spatial placement of these bands.



- **Radio tags-** tags that transmit radio signals to a receiver. Radio tags are used most often in shallow, low-conductivity water. Antennas that receive the transmitter signals can be fixed to airplanes, boats, trucks, snowmobiles, and portable towers or can be carried along a stream by hand.



- **Sonar tags-** Hydrostatic tag in which detailed instructions are placed inside a plastic capsule that is attached by a wire to the fish. Identification of the fish or fish group together with reporting instructions.



DST GPS Fish Tag, Fish Positioning Sounder and Simrad GPS Sonar

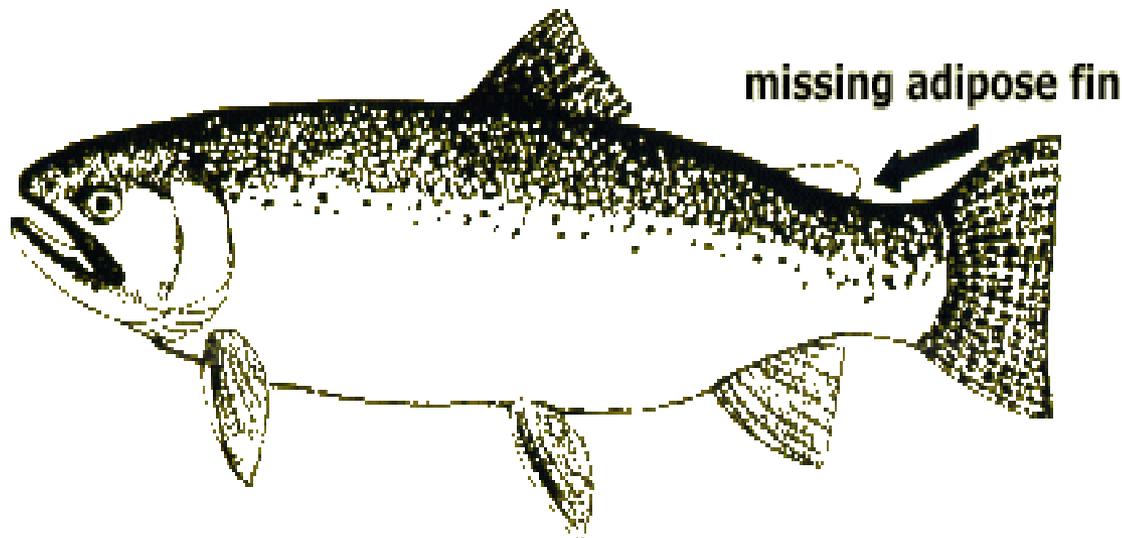
- Data Storage tag (DST) Global Positioning System (GPS) can be attached externally or implanted into fish. DST GPS can receive information about geographic position from satellites via Simrad sonars onboard vessels. The vessel's GPS position is coded and transmitted underwater via the Simrad sonar signal. If a tagged fish is within 4 km range of the GPS sonar, the DST GPS will receive the vessel's geographical position and store the GPS information together with measured temperature, depth and date/time. For use in rivers, lakes and smaller ocean areas, a small and portable acoustic GPS transmitter, named Fish Positioning Sounder (FPS). The DST GPS fits well for medium sized round fish.

External type of tagging

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

External tagging

- **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 often are distorted and can be identified as marked. One problem with mutilation is the possibility of negatively affecting the fish's behavior and ability to survive.



- **Branding-** uses hot or cold instruments against the body of a fish in order to produce an identifiable mark for recognition. One advantage of branding is 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.

- **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.



VIE tag implanted behind eye of a coho salmon

Petersen discs- tag constructed from different types of materials. Round disc can be inserted under the dorsal fin of the fish with a pin. There is various length of use of fish of difference thicknesses. The Peterson disc has also been used on mollusks by gluing to the shells with epoxy cement. Peterson disc remain on the animal for life. Disadvantage of this technique is long application time pre tag.



Peterson disc below the dorsal fin of a warmouth

- **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 opercles.
- **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; opercles, fins, and caudal peduncle. Strap tags are used on a variety of species, are permanent tags on some fish. Best retention results are with fish with bony opercles such as Sturgeon, flounder, and halibut.
- **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 take a great deal of time.

- **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. A smaller version of the tag is the fingerling tag that has been developed to use on small and juvenile fish. Easy to apply and requires few tools. The Carlin tag (Carlin 1955) consists of a plastic disc attached to the fish body with stainless steel wire or polythene thread.



- **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.
- **Dart tags**- made of nylon shaft with a barbed end and a vinyl tube that fits 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.

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.



Orange floy tag below dorsal fin of a sonoran sucker