



Tagging Methods in Fish Stock Assessment: An Overview

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Abstract

This article's objective is to review field data used in the estimation of fish populations. Tags are used in scientific studies to identify methods and techniques that enhance surgical outcomes and to determine the impact of tagging on organisms. Consistently tags are attached to a free-swimming and migratory fishes to collect information on fish behavior, habitat and migration in fresh water, estuaries and oceans, especially as numerous long-term data points can be repeatedly obtained from individual fish. Understanding where fish live and migrate during the day, season, and year is essential for developing effective management strategies.

Keywords: Fish population, Organisms, Marking, Migration

Introduction

The fisheries management requires effective tools and techniques for the assessment of imperiled fish species due to the large population size. Fish marking and tagging methods are vital for the identification of fish as individual or as member of batch. These methods provides reliable information of population size, fish movements, migration patterns and other statistical information such as birth rate, death rate, rate of recruitment and exploitation rate. In this method of stock assessment the fishes are tagged and released back into the environment and allowed to mix thoroughly with the rest of the population (Macaulay *et al.*, 2021). Fish stocks which are commercially important, those are managed sustainably through regulation of fish harvest, fish mortality *etc.* However, various management techniques are in use for fish stock assessment, the major being management through protected areas, ban of fishing for a period of time, the tagging methods are found reliable in providing effective information. The acoustic tags are the conventional method for monitoring fish movement for many decades. In the modern tagging methods the tags size and weight are reduced along with increasing signal strength and life of tag helps in better management of assessment of endangered fish species (Zhang *et al.*, 2007). These days' electronic tagging systems are used for tracking fishes in the

aquatic environment of both fresh water and marine water fish species. The stock assessment is a critical factor due to high migratory patterns of catadromous and anadromous fishes, tagging methods helps in understanding the migratory behaviour and adaptability of different environment by parent and their recruits (Wagner *et al.*, 2007).

Application of Tagging Methods

Tagging of fishes with different markings has wide range of application in assessment of population dynamics of fish stock. The tags are easily detectable and no such special equipments are required for detection. The tags carry individual code, batch code and any other visible instructions for identification. There are widely two methods of tagging.

- External tagging
- Internal tagging

1. External Tags

The external tags are applied on surface of the fish body and easily visible on body. It is marked in the dorsal fin area, jaw area and head regions. These types of tags are identifiable as individual code, a batch code or number. These tags are in the form of threads, wire, straps, ribbon, disc, plate *etc.* The advantageous factors of external tags are inexpensive, simple to use, easy and fast to apply and easy to identify the marked individual fish. On the other hand, the fouling of

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the tags may be a problem due to over growth of barnacles, algae and mussels that make difficulties in tag detection. The high mortality occurs due to attracting predators towards the tags which results in spreading diseases to the tagged fish species (Jepsen et al., 2015).

Types of External Tags

There are various conventional and modern methods of tags used as external tags for the stock assessment:

i) Fin clipping: In this type of method, clipping is used on fins and other body parts of fish. Use of clips on pectoral or pelvic fin is done at base or upper/ lower caudal fin by puncturing with pair of scissors. This method of tagging is found simple, less expensive and quick technique. It is suitable for short term markings and there are very less chances of infection.

ii) Peterson disc: Peterson disc tags are used with wire pinned for the finishes, crustaceans and molluscs. We apply a disc with pin and pliers inside the dorsal fin of fish. This tagging method is also used on molluscs by gulling to the shell and found to be long lasting in the fish body.

iii) Branding tag: There are two types of instruments used in fish branding, *i.e.*, hot branding and cold branding. Hot branding is done by using a heated pencil and electrically heated wire and cold branding done by using a mixture of ethanol, dry ice, acetone, liquid nitrogen and solid CO₂. The main advantage of branding is no changes in their fins or body.

iv) Dangler tag: These tags are applied close to the body and wire is attached to the fins and surface of the body. This type of tag is used for small studies involving few fish as its very time consuming.

v) Strap tag: These tags are used on variety of fish species. The feature of the tags includes light-weight, non-corrosive metal and available in different sizes and serial numbers. Straps are attached on different body part of fish, *i.e.*, fins, operculum and caudal peduncle. These are permanent tags used in bony fishes such as Sturgeons, halibut etc.

vi) Carlin tag: Carlin tags are very common in identification, monitoring and research work. It contains a plastic disc with different colours and attached to the fish body with polythene thread and stainless steel wires. There is an intermediate link between disc and tag. These can be used in short term experiment but mainly suited for long term experiments. Few category of the Carlin tag are used in development stages of juvenile, fingerling and small fishes.

vii) Anchor tag: This is most common type of external tag used in pond management for identification of individual as *Floy*. It is also applied for long lasting studies on migratory fishes. This tag is similar to other type of tags and attached with a piece of cloth. These are made up of small pieces of nylon attached to the back of fish with T like end and inserted with a loaded gun with one clip of anchor tags, hundreds of organisms are instantly tagged quickly at a time.

viii) Transponding acoustic tag: In the transponding tags, these are commonly used to interrogate the behavior of fish. This technology is very helpful in research to obtain data of tagged fish. These tags are introduced in rivers,

lakes, sea, estuaries and tributaries. They transmit acoustic signals when they receive pulses from sonar. They have large diameter 30 kHz tags range more than 1 km and in small 300 kHz has range less than 400 m and its range varies inversely to frequency.

ix) T-Bar tag: These are made up plastic and consists 'T' shaped head. These are most popular on fishes, crustaceans etc. They are less expensive and convenient in some shellfish species and large numbers of fish species may need to be tagged in short time is critical for fish survival. These tags available in various colors in both standard anchor (TBA) and fine anchor (TBF).

x) Stainless steel head dart tag (SSD): These tags are used mainly for marking large marine fishes like billfish and sharks. This tag is made up of stainless steel wire covering the inside of the first 7 cm of the marker and the tag head is generally sharpened. This method of tagging is preferred by researchers as a stainless steel wire core.

2. Internal Tags

Internal tags may be defined as marks not visible from outside. These tags are inserted inside body cavity and bony structures. The inserted material may be identified by X-ray, magnetic and radioactive methods. It is made up of a metal or plastic material with individual coding. It does not require any removal of part of fish body. They can be less expensive and non-toxic to the tagged species (Mackenzie and Abaunza, 1998). This method is preferred at the time of surgery for fixing internal tags. Internal tags can be both natural and artificial in nature.

Types of Internal Tags

i) Subcutaneous tag: This tag are made up of plastic disc like and coded with serial numbers which helps to identify the individuals. Discs are implanted in between outer layer of skin (epidermis) and muscles by a small incision. This technique requires the use of another mark to identify that subcutaneous tag that is inserted inside the body of fish.

ii) Thermal tag: The fish which is thermal marked is made by removing its otoliths or ear bones for identification of hatchery fish. In the thermal tag the 100% marking of the fish is done at hatchery unit. It forms a bar code on the otolith within the fish for life time. A series of ring on the otolith is used to identify the hatchery and brood year of the fish.

iii) Microtags: Microtags are used to identify explosives which look like microscopic plastic clip which have about seven layers of plastic with colour coded bands to identify group of fishes. They also contains fluorescent and magnetic layer along with 300 million colour combination.

iv) Body cavity tag: For identification a metal anchor is placed inside body cavities. Firstly, the body cavity was used in Flounder and since 1930 this type of tagging is used. If tags are placed before spawning, fish can expel the tags and the machinery may destroy the tags before the magnets of the tag can detect them. A magnet recovers the tags but sometimes recovery is difficult.

v) Passive integrated transponder tag (PIT): A PIT tag has a radio frequency device that transmits a unique type of

frequency waves with individual code to the reader where it is decoded in a numerically and alphanumeric form. Many researchers use PIT tags and use in study of movement and migration habitat start from specified area. This tag has no self life and internal battery. These patterns of bands may be varying depending on the number of bands and the width and spatial placement of bands.

vi) Coded Wire tags: The coded wire tags look like a small piece of wire which is injected into a fish by using an applicator or by hand also. These tags can be fixed in snout, caudal fin and other muscular part of fish body. This technique allows fish to be tagged easily and quickly. Tags can be detected by a metal detector or X-ray which can show various colour coded wire that are used to identify a fish and specific group of fishes. These coded wires and equipment use to tag and detect are very expensive.

Conclusion

The fish tagging method has been a proven technology for the stock assessment of a larger section of fish population. The easy methods of inserting, clipping and monitoring have made the methods more popular among researchers. The modern methods like bar coding, use of radio frequencies, use of individual codes have made the study more reliable and accessible for use. When a marked fish is recaptured, the data collected provides population estimates that help in identifying behaviour, migratory pattern, fish biology and other identifiable studies.

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