

Should fin clipping be used as a method for identification of fish?

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Introduction

Individual identification methods are commonly used in fish research, including studies on size of stocks, growth rates, migration patterns, behaviour and genetics. In aquaculture, such methods can be used to calculate growth rates and to aid identification of fish that have escaped.

Fin clipping has often been used in breeding programs, since it is an approved method (Landbruks- og matdepartementet, 2009). Since these programs employ large numbers of fish and are carried out over a long period, it is possible to observe any effects on growth and survival as an effect of fin clipping (Hansen, 1988).

Various types of fin clipping have been the subject of research. Studies on the effects of total or partial removal of different fin types have been conducted on many different species, although the majority have been performed on salmonids.

Criteria for marking methods

A good marking method must meet several requirements:

1. It must be legal
2. It should have minimal effects on the fish
3. It should be easy to read
4. It should last sufficiently long for the duration of the study period
5. It must be suitable for the specific situation.

Most often, a compromise between these requirements is unavoidable when using one single method.

Legal requirements

The Norwegian Animal Welfare Act states (§9):

Medical and surgical treatment shall be carried out taking into account the animal's welfare, and protect the animal's ability to function and its quality of life.

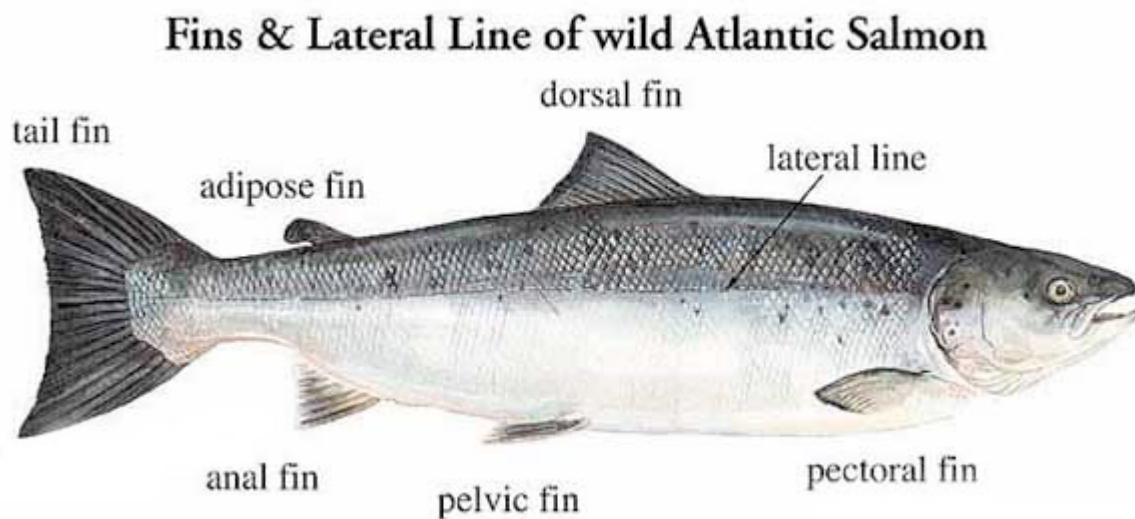
Surgical procedures or removal of body parts must not be carried out unless there is a justifiable reason to do so out of consideration for the animal's health. Marking of animals in holdings is nevertheless permitted. The removal of horns and castration is permitted when it is necessary for animal welfare reasons, or other specific reasons.*

In the case of painful incision, necessary anaesthetic and pain relief shall be used.

*In the original Norwegian version of this sentence, the phrase '**forsvarlig** merking' is used, i.e. marking is only permitted when using techniques that are defensible.

Types of fin clipping

The fins most commonly subjected to clipping are the adipose fin and pelvic fins, but clipping of the tail fin, pectoral fin, dorsal fin and anal fin has also been tested. The method consists essentially of clipping a fin in a standard pattern with scissors, trying to make the same cut/shape in all fish of the same family group.



Fin clipping has been used to recognize individuals within a group and is commonly used in breeding work and animal tracking in the field (Gunnes & Refstie, 1980). In breeding programs, fish are often tagged as soon as they reach sufficient size (5-10 grams), using a characteristic clip for each family. This method is suitable for situations where there are only members of a few different families that need to be identified afterwards.

Advantages and disadvantages of fin clipping

Fin clipping is the most common method for marking groups of fish, but there is still debate in the scientific community as to whether it causes harm. The majority of research studies conclude that fin clipping does not cause reduced survival or growth rate.

Interpretation of these studies is somewhat hampered by the fact that fish have been clipped at different ages under different environmental conditions, and have been collected or recaptured at different time periods after marking. In addition to these variables, one technique may be carried out differently between operators and studies. Other variables include handling stress, anaesthetic methods and the health status of the fish. Some studies evaluate the cost or durability of fin clipping, while others mainly focus on growth and/or survival effects. There are few directly comparable studies, which makes it harder to draw firm conclusions on whether fin clipping is an acceptable method or not.

Advantages

Fin clipping is used extensively because it is cheap and quick compared to other methods (Hammer & Blankenship 2001, Thompson *et al.*, 2005). Hand *et al.* (2010) demonstrated that fin clipping can be automated without having negative effects on fin clip quality and injury rate when performed by experienced markers. Several fins can be clipped, to provide a large number of combinations. In addition, it requires a minimum of equipment. It is thought to cause little or no suffering to the animal due to the short handling time and because few nociceptors are located on the fins.

Disadvantages

One of the disadvantages of this method becomes apparent when fish of a specific group are to be identified over a period of growth. For example, as the fish grows, the shape of the cut can change as the fin regenerates, making identification difficult. Another disadvantage is fish mortality: the cut can produce an open, bleeding wound which does not heal properly, making the fish susceptible to infection by bacteria, viruses and fungi.

Some studies suggest that fin clipping can reduce survival and hinder growth (Saunders & Allen, 1967; Shetter, 1967; Webber & Wahle, 1969; Coble, 1971; Nicola & Cordone, 1973; Mears & Hatch, 1976; O'Grady, 1984; Hansen, 1988). However, a substantial number of reports do not demonstrate deleterious effects on survival or growth (Armstrong, 1947; Radcliffe, 1950; Horak, 1969; Gjerde & Refstie, 1988; Conover & Sheehan, 1999; Pratt & Fox 2002; Thompson *et al.*, 2005; Vander Haegen *et al.*, 2005; Zymonas & McMahon 2006; Dietrich & Cunjak 2006; Zerrenner *et al.*, 2007; Champagne *et al.*, 2008; Bumgarner *et al.*, 2009).

Fin clipping can potentially affect swimming performance, predator avoidance and the ability to find and capture prey. However, Wagner *et al.* (2009) found that fin removal (one or both pectoral and pelvic fins, all paired fins, and a non clipped control) did not compromise foraging behaviours for juvenile muskellunge (*Esox masquinongy*) foraging on moderately evasive prey, and that fish showed immediate behavioural compensation.

In a study by Champagne *et al.* (2008) on Brown Darters (*Etheostoma edwini*), the entire right pectoral fin or rear half of the caudal fin was removed without it affecting swimming performance in an experimental flow chamber. Horak (1969) showed that a range of fin clips

(dorsal fin, both pectoral fins, both pelvic fins, anal fin and adipose fin) did not reduce the swimming ability of rainbow trout in a swim tunnel in a short term study. However, other studies have shown that various types of fin clipping affect swimming or manoeuvring ability for some species. Clipping the upper lobe of the caudal fin of bonytail chub (*Gila elegans*) and humpback chub (*Gila cypha*) decreased swimming ability in laboratory tests, and may influence the ability of fish to maneuver or maintain position in swift flowing streams (Ward, 2003). Clipping one or both pelvic fins, however, had little effect on swimming ability.

Removing the pectoral fins of pike fishes (*Esocidae*) is probably more harmful than removing the pelvic fins, since the pectoral fins are especially important to these species (McNiel & Crossman, 1979). These studies on swimming ability illustrates the importance of adapting the fin clipping technique to different species, since swimming ability affects both survival and growth.

Handling and severing fins is known to be stressful to fish (Sharpe *et al.*, 1998; Barton *et al.*, 2002) and can be a potential vector for bacterial infection (Elliot & Pascho 2001; Vander Haegen *et al.*, 2005). Decreased survival of fish can result when physiological stress responses remain elevated and become debilitating, leaving fish vulnerable to predation or swimming challenges (Barton, 2002; Portz, 2007).

Another important issue when using fin clipping as a marking method is the regeneration time of the different fins. Several studies show that the adipose fin is most suitable for long term studies (Armstrong, 1947; Stauffer & Hansen, 1969; Weber & Wale, 1969; Johnsen & Ugedal, 1988), since it shows least regeneration, followed by the pelvic fins. Pectoral fins and the anal fin regenerate more quickly and are not suitable for studies lasting over one year. Most of the studies which reported no effects on growth and survival clipped the adipose fin and pelvic fins.

Clipping more than one fin led to reduced survival for salmonids compared to clipping only one fin (Mears & Hatch, 1976; Johnson & Ugedal, 1988). Even though the adipose fin clip has the advantage of slow regeneration and low effect on survival, it can present a problem for male spawning success (Næsje *et al.*, 1988). The male's adipose fin grows faster than the female's fin prior to spawning, suggesting it plays a role in rivalry and/or pair formation. Studies that investigated return rates of salmon suggest that the pelvic fin may be a better alternative, whereas in studies where salmon are held in cages or tanks the adipose fin may be better. More research is needed to conclude with certainty which fin to clip for each species. Fin clipping methods must also be adapted to fish age, life stage and environmental conditions. In addition, protocols should be developed to minimize the induced stress on fish.

The differences in findings between studies may be due to a number of reasons, including water quality and other environmental conditions and the duration of the observation period. Common to most studies showing negative effect on survival and/or growth is that they were performed under natural environmental conditions. Factors such as predation and competition may increase differences between marked and unmarked fish.

Alternatives to fin clipping

Due to the problem with infections, reduced growth and survival associated with fin clipping, other methods are now being developed. The electronic Passive Integrated Transponder (PIT) tag is a chip which is inserted in the abdomen of the fish. It is also known as a Coded-Wire Tag (CWT) and has been used by the Michigan Department of Natural Resources Fisheries Division since the 1980's (DNR, 2011). An electronic scanner is used to detect the chip, which contains a unique individual code. There are several advantages to this method compared with fin clipping:

1. Very few errors (of special relevance when fish need to be identified several times as they grow).
2. Fish are anaesthetised when the tag is inserted.
3. The tag does not appear to affect the survival and growth in fish.
4. The fish are not subjected to a mutilation.
5. The method does not result in a skin wound that may act as an entry site for bacteria, viruses and fungi.
6. There are online databases where fish breeders can publish their tagging lists, so that individuals from other farms can be identified.

The disadvantages of this method are:

1. The fish must be captured and anaesthetised to insert the chip.
2. The fish must be caught to identify them.
3. Special equipment (scanner and software) is needed to register the fish and identify individuals.

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