# Passive Integrated Transponder Tag Retention Study

Trout Unlimited Canada Technical Report
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**Prepared by:**

Silvia D'Amelio, Ontario Provincial Biologist
Trout Unlimited Canada

Tamara Lang, Research Assistant
Trout Unlimited Canada

Vince D'Elia, Project Ecologist
Toronto Region Conservation Authority

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## Background

Passive Integrated Transponder (PIT) technology is a common tool used to identify fish in the field as well as in lab or aquaculture settings (e.g. Mahapatra et al 2001). Relatively small tags allow for the identification of fish as small as 60cm with a 12 mm tag (Horton et al 2007). Slightly larger tags facilitate the monitoring of fish movement at a variety of scales (e.g. Ledgerwood et al 2004, Smith et al 2002, McCutcheon et al 1994). In addition to size, other benefits include the rapid tagging (80-100 per hour) and the longevity of the tags because they do not require a battery (Gries and Letcher 2002, Buzby and Deegan 1999). This technology has even been utilized in the assessment of survivorship through man-made facilities, diurnal habitat preferences, growth and survival rates, as well as predator prey dynamics (e.g. Peterson 2003, Beckman 2003, Ryan et al 2003, Burns et al 2007). All these studies and the results they produce rely on the PIT tags being retained by the fish for the duration of the study. As a result, many researchers have investigated and tested many techniques on the implantation of these tags and their effect on retention in an effort to increase retention and therefore the applicability of PIT tags.

Tag loss depends greatly on the type of tag implanted. While external tags can be rubbed off by the fish in some cases, internal tags can be expelled by the fishes body. External tags are easily lost at a rate of 40-80% in a two year period (Hartman and Janney 2006, Van Dan Aryle and Wallin 2001, Kincaid and Calkin 1992). Alternatively, internal tags display a much lower 7% instantaneous loss versus 14.9% with anchor tags (Buzby and Deegan 1999). Welch et al (2007) tested the retention of acoustic tags and PIT tags in the same fish and found that tag loss was related to body size, but that acoustic tags had a rate of loss of about 13% versus 0% for PIT tags. Longer term, PIT tags have been shown to display rates of 85%-100% retention over years and survival rates of over 94%, with high potential for retention for the duration of the fish’s life span (Dare 2003, Gries and Letcher 2002, Baras et al 2000, Buzby and Deegan 1999, Prentice et al 1990, Ombredane et al 1998).

While retention rates for PIT tags are very high, variability does exist and typically depends upon the size of the fish tagged and the method used to implant the tag. Two basic methods are utilitzed for the implantation of PIT tags. Smaller tags are often injected into the cheek or body cavity at a tag to weight ratio of <3.4% (Acolas et al 2007). Tag retention has been noted as lower in studies utilizing injection methods for tag insertion (Acolas et al 2007, Baras et al 2000). The rate of loss is even higher in smaller fish (57-63mm) where rates of up to 20% loss has been observed using injection methods (Acolas et al 2007, Navarro et al 2006, Dare 2003, Baras et al 2000). With surgical implantation of the same size tages, healing is faster and retention is 100% after 28 days (Baras et al 2000). It has also been noted that healing is increased with the use of sutures and decreased water temperatures (Baras et al 2000, Prentice 1990).

To derive a level of confidence in our tagging technique and to understand the rate of potential tag loss within our monitoring studies, we decided to initiate a tag retention experiment. This experiment allows us to understand the reliability of our technique and consequently the movement data being collected in our monitoring studies. We tested two tag locations, controlled for handling and for stock. The goal was to determine if our technique would result in reasonable tag retention over a short duration.

## Methods

Brown trout were obtained from the Ontario Ministry of Natural Resources provincial fish hatchery on November 16, 2006. They were transported in bags filled with oxygen to the Islington Sportsman's Club where they were to be processed and held for the duration of the experiment. The fish obtained ranged from 120mm to 172mm in length and 19.2g to 62.8g in weight.

A total of 120 brown trout were utilized and randomly separated into four groups. Group A fish were tagged on the left side below the pectoral fin. Group A' fish were also tagged, but on the right side below the pectoral fin. Group B fish were processed but not tagged and group C fish (control) were not processed in any way.

The fish from groups A and A' were tagged using 23mm Passive Integrated Transponder (PIT) tags (Texas Instruments, USA). Each fish was first anesthetised using clove oil diluted 0.1% solution. Once the fish was sedated, it was removed from the solution and its weight (g) and total length (mm) were recorded. Using a scalpel, a small incision was made below the pectoral fin providing access to the body cavity. The PIT tag was then inserted and directed to the rear of the fish, lining the tag up horizontally in the body cavity. The tag ID number and condition of the fish were recorded for each individual.

Once the tag was inserted and positioned, the wound was sealed using vet bond. The fish was placed in a tank of fresh water to facilitate recovery and once alert it was transferred to its respective holding tank.

The fish in group B were placed in the clove oil solution and, when sedated, they were weighed (g) and measured (total length in mm). Upon reviving, they were replaced in tank A.

All fish remained in holding tanks and observed for 12 days. Daily observations included evidence of dropped tags, changes in behaviour, evidence of illus, infection or injury and water temperature. The fish were fed by an automatic feeder on a 12-hour cycle and all unconsumed food was removed.

Following the 12 day holding period, all fish were removed from the tanks, inspected for injury or infection and scanned for PIT tags. Fish were then transported via a 75 gallon aerated holding tank to the Humber River in Palgrave, Ontario and released below the Palgrave Mill Dam.

## Data and Results

Of the 120 fish utilized in this study, 60 were successfully tagged, revived and released into holding tanks. Four of the tagged fish bled a significant amount and were recorded as potential significant injuries. Tagged individuals ranged from 124mm to 172mm with an average of 144m and an average weight of 43g. Ranges in length were reasonable similar among groups (Figure 1) and a paired T-test revealed no significant differences in length between tagged and untagged fish.

Daily observations of the holding tanks revealed no noticeable changes of fish behaviour and no observable infections, illness or injury. No expelled tags were observed in the tanks. Water temperature remained at approximately 7.5ºC for the duration of the observation period.

Following 12 days of observation all individuals were noted as healthy and energetic. All tagged fish were noted as having uninfected, healing incisions with no obvious signs of internal or external injury (Figure 2). Each fish was scanned and all tags accounted for. This resulted in an observed 0% tag loss rate for all tagged fish.

There was no difference in survival or general observed behaviour among fish based on tag location (groups A' and A). In addition, there were no observed differences in survivorship among all groups.

# Summary Plots

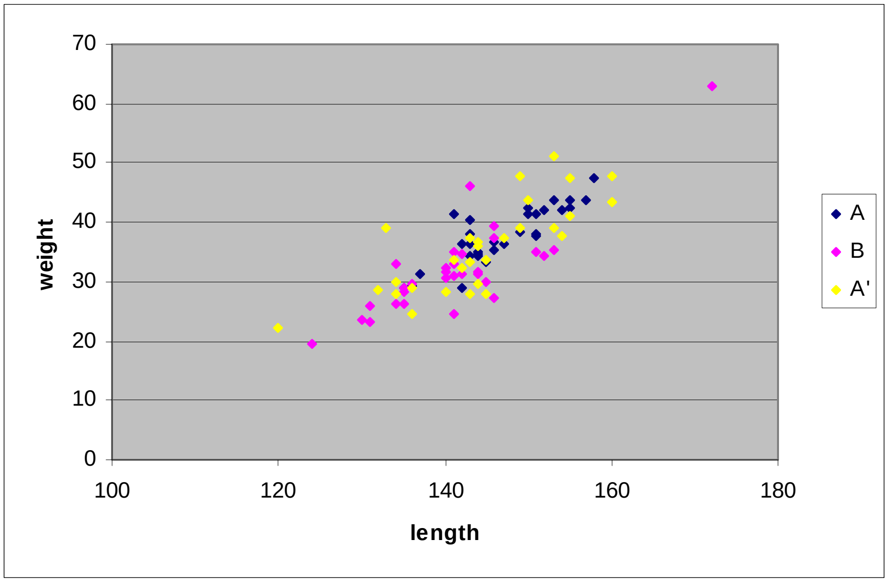


**Figure 1: The measured weights (g) of the 90 fish that were processed during the study.**

**Figure 2: Typical incision wound following 12 days in holding at 7.5ºC.**

## Implications

This study confirmed the findings of previous studies that surgically implanted PIT tags are rarely expunged by small fish. The highest potential for loss has been noted within two days of tagging (Dare 2003). The 100% retention rate combined with the 100% survival rate within this study provides confidence in this tagging procedure for monitoring of brown trout movements.

Healing of wounds seemed slow and may be due to the sustained low water temperatures within the holding facility. Temperature has been known to effect healing rates in fish, usually increasing with decreasing temperature (Baras et al 2000, Parkinson et al 1999, Moore et al 1990). Repeating this study within a natural water body would clarify the effect of temperature on the healing rate of brown trout following surgery. In addition, this will also allow for the investigation of the potential effects of temperature on tag loss.

To further investigate the usefulness of this technique, it would be prudent to extend the holding period to determine long-term retention rates. Additional species would aid in the understanding of the variability of the effects of these different factors among species. Lastly a comparison of retention of sutured versus non sutured incisions would help to refine methods.

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