



## Benign data recovery using coded wire tags.

Application Note APC02

Coded wire tags are detected in live or dead fish using one of a range of magnetic detection devices. These range from a hand-held “wand” detector which is highly portable, through to tunnel detectors for locating tagged fish amongst large catches which can be passed through the detector by gravity or using a conveyer belt. Scanning catches may be made much simpler and quicker by adopting a widespread protocol in salmonid projects of removing the adipose fin at the time of tagging to indicate the presence of a cwt. However, the tag must be recovered from the fish to read the coded data. Most often this is done by dissecting the tag from a dead fish after it has been caught by an angler or commercial fisherman. The tag is then “read” under a low-power microscope (10-20 x magnification).

However, with salmon stocks under increasing pressure and threat there is a growing need for a tagging system that does not require the fish to be sacrificed for tagging information to be recovered. The disadvantages of external tags are well known. Some researchers are turning to PIT tags, internal tags whose code can be “read” from outside the fish. The main limitation of that system is the high price of each tag, making large-scale deployment prohibitive.

However, it is often overlooked that there is some scope for data recovery from live fish using coded wire tags. There are basically four approaches.

### 1) Tagged or untagged.

Simply knowing the fish is tagged may be sufficient for some purposes.

### 2) Tag location, without tag recovery.

In larger fish, detection of tags in different body locations may provide a simple batch coding system, exploiting the limited detection range of the wand detector. This device can resolve tag location to about 20 mm, and in large fish it is likely that several, perhaps many, suitable, differentiable sites could be found (e.g. cheek muscles, bases of fins). In small fish the tags can be put into suitable locations which may not be differentiable at the time, but will become so when the fish grows.

There are several published accounts of the use of this approach, and much information is available from cwt studies on non-salmonid species where the nasal cartilage is often not the best tagging site. Fletcher et al (1987) obtained 100% tag retention in the cheek musculature of largemouth bass (*Micropterus salmoides*, Centrarchidae). Heidinger and Cook observed 92-100% tag retention in the nasal area, nape and cheek of channel catfish (*Ictalurus punctatus*, Ictaluridae), golden shiner (*Notemigonus crysoleucas*, Cyprinidae), bluegill (*Lepomis macrochirus*, Centrarchidae) and walleye (*Stizostedion vitreum*, Percidae). Tipping and Heinricher (1993) used three sites on tiger muskellunge (*Esox masquinongy x Esox lucius*, Esocidae) to

differentiate between groups. Tag retention rates were 88.3% between the rays of the dorsal fin, 99.4% in the cheek, and 99% in the anal fin. Oven and Blankenship (1993) observed tag retention rates of 96% in post-ocular tissue, 99% in adipose fins, and 97% in dorsal fins in rainbow trout. Klar and Parker used four tag locations in striped bass (*Morone saxatilis*, Percichthyidae). Retention in the musculature below the dorsal fin and in the adductor mandibularis muscle was virtually 100%, whereas two locations in the snout gave retention rates ranging from 51-64% - a clear example where the nasal area is not the optimal target site! Bergstedt et al examined two tagging sites in larval sea lampreys (*Petromyzon marinus*, Petromyzontidae); retention was 99% in the dorsal musculature, and 82% for a sub-cutaneous location on the ventral surface.

Schram *et al* (1999) double-tagged hatchery-produced lake sturgeon (*Acipenser fulvescens*, Acipenseridae) with two coded wire tags, one in the snout and one beneath one of the dorsal scutes to indicate the year of release. They reported on the fate of the 1991 release, tagged beneath the sixth dorsal scute. Tag loss was estimated to be less than 1%.

A very useful study of the application of the approach to salmonids is reported by Hale and Gray (1998). Using both brown and rainbow trout they examined the tag retention in seven body locations. Mean retention rates observed were; snout (98.5%); cheek (97%); base of pectoral fin (95.7%); muscle below the dorsal fin (98.4%); base of pelvic fin (97.3%); muscle below the adipose fin (99.5%); and musculature immediately anterior to the caudal fin (96.8%). The snout tags were injected using species-specific headmoulds and a moving needle; tags in all other locations were inserted using a fixed needle and needle support tube. Both Mk IV and multishot injectors were used. The tagged fish ranged from 80 to 314 mm in length. Two inexperienced fish samplers were trained for one hour regarding detection of coded wire tags and were completely successful at detecting tagged fish. Some problems arose with correctly identifying the body locations, however, with the two samplers achieving 91% and 98% correct diagnoses. Difficulty in resolving between caudal and adipose, and dorsal and adipose, were the chief sources of error. This was attributed to the short distance between these locations in the small fish being used, and it was concluded that this problem would not occur in larger fish.

Thus for marking juvenile Atlantic salmon for example, which are likely to be in excess of 50 cm in length upon return when batch identification would be required, a considerable number of body locations are available. These include the snout, left and right cheeks (or post-ocular area), left and right pectoral fin bases, left and right pelvic fin bases, and around the bases of or in the dorsal fin, the anal fin, the adipose fin and the caudal fin (11 in all). In many studies it will be desirable to clip the adipose fin as a secondary mark so that tagged fish would be immediately recognised; checking all body locations with a wand detector would take many seconds and tags are likely to be missed if tagged fish are not visually identifiable and represent only a limited fraction of a run of fish being sampled. However, care should be used not to confound any local or regional protocols which may have reserved the adipose clip for use to indicate that a fish is snout tagged with a CWT. In such situations consideration might be given to double tagging, with a snout tag and a second tag in another body location. In this way returns would be expected from high-seas fisheries such as that in Greenland, from intercoastal fisheries such as that in Ireland, and from experimental samples of post smolts such as those being taken by Norwegian and Scottish scientists to the north of Scotland. The catch scanning programmes in these fisheries are unlikely to find tags elsewhere than in the snout.

### **3) Benign recovery of tags.**

By placing the tag in shallow tissue (e.g. post-ocular tissue or between fin rays), a detected tag may be excised and recovered without significant damage to the fish. A useful description of this technique is given by Oven

and Blankenship (1993); they used a magnetised scalpel to recover tags from between fin rays, and a modified syringe to extract tags from the adipose fin and from post-ocular tissue. They also found a 2mm biopsy punch effective at removing tags from the adipose fin. An important feature of this method is that the tag should be visible once it has been magnetically detected; “blind” recovery may be more difficult or may involve more trauma to the fish. The rainbow trout used by Oven and Blankenship (above) more than doubled in size during the experiment and all tags remained visible, but the effectiveness of this approach for recovery of tags from adult salmon that were tagged as parr or smolts would need careful evaluation. If it is desired to have the fish identifiable on subsequent recapture after the tag had been recovered, it would be necessary to re-tag them.

#### 4) “Slaughter and read”

Although this approach does not involve benign data recovery as such, it does overcome a major problem in salmon ranching and farming projects, where crossing of parents of known origin is required, and where reading the coded wire tag in the fish is the only way to determine its provenance. Unfertilised eggs and milt will remain viable, with care, for at least 24 hours after being removed from the adult. Tagged fish can be stripped, killed and have their tag removed and read within a matter of minutes, leaving many hours for appropriate mates to be found and identified. Appropriate crosses can then be made using the gametes from selected parents. This is the approach used on the highly-successful Delphi ranching project in Ireland.

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