



Could the coded wire tag affect the navigation and homing of salmonids?

Application Note APC01

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New users of the coded wire tag (CWT) system are sometimes concerned that placing a magnetised object such as a CWT into a migratory salmonid might interfere with its' ability to navigate and home. This is a reasonable concern given that salmon are believed to use the earths' magnetic field for oceanic navigation. Fortunately, there is ample evidence from the hundreds of projects involving a total of more than a billion tagged salmon that there is no measurable effect of the tag on behaviour, growth or survival.

Along the west coast of the United States approximately 50 million juvenile salmonids are Coded Wire Tagged annually by Federal, State, Tribal, and Local governments (Johnson and Longwill, 1987-2000). It is widely accepted as a tag that virtually has no affect on survival or straying in salmonids. Each year hundreds of research and management decisions are based upon this assumption.

The evidence comes from three types of study:-

- a) Laboratory studies observing orientation to magnetic fields;
- b) Field studies showing a level of return to the home river as high as or higher than those observed with any other marking system;
- c) Field studies showing very low rates of straying, comparable with those obtained by other methods.

These are now examined in turn, along with one study where an impact on straying has been suggested.

Laboratory studies.

Only one such study has been published of which we are aware. Quinn and Groot (1983) studied the preferred compass orientation of groups of chum salmon fry (*Oncorhynchus keta*) in experimental tanks; they appeared to adopt an orientation appropriate to migration through local coastal waters. Placing coded wire tags in the fish had virtually no effect, whether magnetised or not. It is worthy of note that chum salmon migrate to sea as fry and the fish used in this experiment were small, averaging 51mm in length; thus the magnetic field is large relative to the fish. Standard length (1.1mm) coded wire tags were used.

Field studies showing high levels of returns.

Many studies using coded wire tags have shown levels of return to the river or site of release that are as high or higher than those obtained with any other marking system, and are consistent with survival estimates from other sources. Such observations have been made with several species of Pacific salmon, Atlantic salmon and migratory trout (*Salmo trutta*). For example, Isaksson and Bergman (1978) observed returns of CWT fish to a

ranching facility to be on average 1.6 times greater than those of equivalent Carlin tagged fish. While such results show that many fish are able to return and generally give re-assurance that there is little or no effect of tagging, they fall short of proof that some straying is not induced by the tags. It is known that a certain level of straying does occur naturally (straying here being defined as fish originating from one river occurring in the non-tidal reaches of another river) but the level observed is as dependent upon the organisation of recording of returns as on the true dispersion of fish. To put it simply, a return to the native river of (say) 10% of fish tagged says little about straying unless there are appropriate checks for marked fish in other rivers.

One study (presently unpublished but being written up for publication) goes some way further is described below by Dan Thompson:-

Study Title: Effects of Coded Wire Tags on the Survival of Spring Chinook Salmon. H.L. Blankenship, D.A. Thompson, E. Volk, G. Vander Haegen.

”This study analysed the effects of handling, anaesthesia , CWT and adipose fin clipping on numbers of adult chinook salmon returning to three hatcheries. At first glance it may seem that comparing survival would not answer the question of straying. However, if there was a significant stray rate, there would have been a significant difference in survival back to the hatchery, which there was none.

Our hypothesis was that adult spring chinook that were coded wire tagged and adipose fin clipped as juveniles would return at the same rate as fish that were not tagged or fin clipped as juveniles. The entire production of spring chinook at 3 hatcheries over 3 consecutive brood years was otolith marked using thermal marking. The otolith mark served as the control mark which would allow any strays returning to the hatchery to be discounted. Each year one third of the population were coded wire tagged and adipose fin clipped and the other two thirds were hand counted to determine exact numbers at release. There were approximately 15 million juveniles released in the study of which 5 million were coded wire tagged. There were approximately 17,000 returning adults analysed. We found no significant difference in return rates or growth for tagged or untagged adults.”

Field studies directly demonstrating a low rate of straying.

Another experiment in Washington State is relevant here. Again the results are still being written up for publication and the following details are supplied by Dan Thompson:-

Study Title: Survival and Stray Rates of Coho Salmon tagged with 1.1 and 2.2 mm Coded Wire Tags. H.L. Blankenship and D.A. Thompson.

“Our hypothesis was that coho salmon that were tagged with 1.1 and 2.2 mm CWT's as juveniles would return as adults in the same proportion as they were released. Two groups of coho salmon were released from the George Adams hatchery. The first group used 1.1 mm CWT's from tag wire with low magnetic properties. The second group used 2.2 mm CWT's from tag wire with the highest magnetic properties available. The 2.2 mm CWT's had a magnetic moment approximately 300% higher than the 1.1 mm group. We assumed that if the magnetic properties of CWT's caused straying, increasing the magnetic properties by 300% would increase the stray rate. We analysed the returning adults and found 802 fish from the group with 1.1 mm CWT's and 801 fish from the group using 2.2 mm CWT's. We

found no significant difference between the two groups. We then searched the Coast wide CWT data base to determine if CWT's from either group were recovered from another hatchery or nearby streams which would indicate straying. There were no such recoveries from either group.”

As already mentioned, a problem with establishing straying by CWT fish is that one needs appropriate monitoring facilities in other rivers to check for strays. A project with Atlantic salmon and sea trout where this condition was satisfied took place in several rivers on the English N E Coast (Potter and Russell, 1994). Coded wire tagged hatchery parr and smolts were released into five rivers (Coquet, Tyne, Wear Tees and Esk) which have their estuaries along a stretch of the north Sea Coast of about 200 km. In addition, wild smolts of salmon and sea trout were tagged in the Coquet and Wear. While recoveries from the coastal nets were made mainly by sampling landings, returns from the rivers were made by asking anglers to return the heads of any adipose clipped fish that they caught. Thus a similar sampling regime was employed on each of the five rivers.

Of the 182 CWT wild adults caught within the five rivers, 178 (97.8%) were in the river in which they were originally tagged as smolts. Of the 204 CWT hatchery origin fish caught within the five rivers, 198 (97.1%) were in the river in which they were released. One wild and one hatchery origin CWT fish were reported from other more distant rivers; all angling licences carry a notice requesting anglers throughout England and Wales to look for and to report adipose clipped fish. Any extensive straying would have been indicated by this mechanism.

These apparent rates of straying are consistent with, and indeed rather lower than, rates observed from studies elsewhere involving fish marked with external tags. Hvidsten et al (1983) Carlin tagged hatchery smolts released to two adjacent rivers in Norway, the Gaula and the Orkla. Of 231 tagged adults caught and reported by anglers, 192 (83.1%) were in the river of release. In a study involving tagging of wild salmon smolts in three adjacent rivers in England and Wales (Usk, Wye and Severn), 106 fish were caught and reported by anglers. Of these, 97 (91.5%) were in the native river (Solomon 1973, Swain 1975). In this project the tags used were darkened silver or plastic (cellulose nitrate) smolt tags attached in front of the dorsal fin (Anon, 1953).

Field evidence of an effect of CWT on homing and straying.

Habicht et al (1998) examined the tag placement of CWT pink salmon that had successfully homed and those that had strayed to streams up to 40 km from their native stream or hatchery. In one year they found a correlation between tag location with respect to critical elements of the olfactory system and tendency to stray; in another year they did not. Somewhat unsatisfactorily the authors did not present the actual numbers of fish with “critically-placed” tags in the homing and straying samples. However, if the conclusion that poorly-placed tags were contributing to the rate of straying is correct the following points should be considered:-

- The fish involved were extremely small at tagging - mean weight 0.2g, and half length CWT were used. The “target” for tag placement in such small fish is very small and is surrounded by components of the olfactory system.
- Correct tag placement was associated with minimal straying
- The authors suggested that any interference with homing was associated with damage to the olfactory system, not through any magnetic influence.

Conclusion

In none of the many hundreds of investigations involving CWT in migratory salmonids has any evidence of interference with magnetic orientation due to the presence of the tag been indicated. The studies discussed above, and many, many others like them, have all demonstrated a homing ability in CWT fish that is comparable to unmarked fish and to fish marked with other types of tag.

References.

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