Retention Rate of Numbered TYVEK Tags Attached to the Operculum of Adult Spring Chinook Salmon at Dworshak National Fish Hatchery

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INTRODUCTION

Tagging adult spring chinook salmon (*Oncorhynchus tshawytscha*) with individually numbered tags when they return to the hatchery can provide useful information on run timing in addition to providing opportunities for brood stock management initiatives such as selective breeding. Moreover, individual fish tag numbers can help to facilitate hatchery operations by tracking fish inventories as well as individual fish dispositions and disease samples. Female spring chinook salmon at Dworshak National Fish Hatchery (NFH) and Kooskia NFH are routinely tested for bacterial kidney disease. By having each fish tagged with a unique number, the hatchery manager has the ability to cull eggs from a highly infectious female or can segregate various lots of eggs, or fish, according to potential infection levels (Pascho et al. 1991). Another reason to tag adults is to differentiate between stocks. Chinook salmon returning to Kooskia NFH are transferred to Dworshak NFH for holding and spawning. Since these two stocks are spawned separately, tagging individual fish facilitates stock identification and separation.

Adult spring chinook salmon returning to Dworshak and Kooskia NFH's may require several months to become sexual mature (i.e., ripe), therefore, tags have to be durable, have a high retention rate, and have little or no detrimental effects on the health of the fish. Because of the latter reason, tags requiring insertion into the body through the skin, such as dart tags, anchor tags, disc tags, etc., were not considered. Other specifications for the tag include time and ease of application and tag readability. Tags have to be quick and easy to apply and require no specialized training. Numbers on the tags have to be clearly visible during spawning and fish handling activities. Over the past four years, several different types of tags have been tested and evaluated at Dworshak NFH.

In 1993, an elastic spaghetti tag material was attached to the caudal peduncle of adult spring chinook salmon. The tag was looped around the caudal peduncle and the two loose ends were threaded through a soft lead binder which was crimped flat after the ends were pulled tight. Tags were lost at a very high rate; tags that remained on fish cut severely into the skin. Later that year, aluminum and stainless steel strap tags were attached to the operculum and ventral fins of steelhead (*O. mykiss*). Tag loss was unacceptably high for both types of the strap tag.

In 1994, the spaghetti tag material used in 1993 was attached to the operculum of adult spring chinook salmon at Kooskia NFH by tying a loop through a hole punched in the operculum. These tags damaged the gill filaments of some fish but did not increase the pre-spawning mortality rate. However, tag loss was still unacceptable. That same year, visual implant tags were tested in steelhead but were discounted because of the time required for application and the difficulty in reading the tag.

In 1995, small plastic tags were attached to the operculum of spring chinook using two stainless steel staples. Initially, this tag performed well, but tag loss increased as the spawning season progressed. The primary reason for the tag loss was due to the rigidity (i.e., stiffness) of the plastic tags. Fish handling and processing at Dworshak NFH is very mechanical and tags were easily snagged and ripped off during the crowding and handling operations. A contributing factor to the tag loss was the flattening (crimping) of the staples with pliers. Staples were

crimped to reduce potential gill filament erosion, but this action inadvertently weakened the operculum tissue and contributed to the tag loss. Although tag loss was unacceptable, we were hesitant to abandon this type of tag because it was easy to apply, very visible, and caused minor damage to the gill filaments.

In 1996, we discovered a material called TYVEK that was very flexible, yet extremely durable. We decided that the difficulties encountered in 1995 with the plastic tags might be eliminated or significantly reduced by using tags manufactured from TYVEK and not crimping the staples. This study was designed to evaluate the utility and durability of numbered TYVEK tags for managing spring chinook salmon broodstock at Dworshak NFH.

METHODS

Adult spring chinook salmon return to Dworshak and Kooskia NFHs from June through September. The fish enter an initial holding pond and are inventoried weekly where each fish is measured for length (cm, fork length), sexed, operculum punched, tagged with a numbered TYVEK tag, and transfered to one of several adult holding ponds. Sex could not always be determined for each fish with complete accuracy at the time they were initially inventoried, especially during the early part of the run. For those fish, sex was determined when the fish was spawned, except when the fish lost its tag before it was spawned. The sex of the fish was determined but could not be associated with the original data at the time the fish was tagged.

Dworshak stock fish had the tags attached to the right operculum; Kooskia stock fish had the tags attached to the left operculum. Tags were attached using two 3/8" stainless steel staples applied with a hand-held staple gun. The opposite operculum was punched with a hand-held paper punch to ensure identification of tagged fish if tags were lost.

Tags were purchased from Chicago Tag and Label, Inc. IL (800-826-8260). Tags were constructed of #1085 TYVEK, 22 mm in diameter, white, and numbered with black waterproof ink. Letter codes on the tags identified the fish stock. The number of tags for Dworshak NFH was insufficient for the number of fish that returned, so additional tags were cut from sheets of #1085 TYVEK and were numbered using a black “Sharpie” permanent marker. Staples and staple guns were purchased from Inland Fastening Systems Inc. WA (509-535-5770).

The total number of chinook that lost tags was determined by adding the number of pre-spawning mortalities that lost tags to the number of spawned fish that lost tags. Once spawning was started, all fish in the holding ponds were examined once or twice weekly for ripeness. Tag loss was not recorded for fish that had lost their tag but were returned to the holding ponds to ripen. Tag retention rates were calculated by sex and by age group. Age was determined by hatchery length criteria.

RESULTS

Operculum punches were effective marks for stock identification, even on fish where the wound had regenerated. Regenerated operculum punches were characterized by dark discoloration on the wound. For fish that lost tags, this mark was 100% effective for identifying the stock.

A total of 1,108 adult spring chinook salmon were tagged using TYVEK tags (Table 1). Six hundred and sixty-one males were tagged, primarily I- and II-Ocean fish. Four hundred and forteen females were tagged, almost all were II-Ocean fish. Only thirty-three of the tagged fish could not be definitively sexed because of loosing the tag before the fish was spawned. At the end of spawning, a total of 1,105 of the tagged fish were accounted for and were used in the analyses. Three tagged fish were never recovered or accounted for and were not included in the analyses. Sex was not determined for 1 pre-spawning mortality that lost its tag.

A total of 973 fish retained their tags for an overall tag retention rate of 88.1%. A total of 132 fish lost their tags. Tag loss was minimal until we started handling fish regularly for spawning which began on August 20.

Tag Loss Prior to August 20

On July 29, all chinook salmon on station (914) were injected with Erythromycin as a preventative measure against bacterial kidney disease. Tag retention on July 29 was 100%, although several fish had loose tags which were replaced. A total of 920 chinook had been tagged by August 20. Twenty-five pre-spawning mortalities were recovered during this time period; only 1 fish out of 920 (0.1%) had lost its tag by August 20. .

Tag Loss Post August 20 (During Spawning)

Spawning started on August 20 and was conducted every 3 or 4 days. The last spawning take was on September 24, 1996. Males were not re-ponded after spawning (i.e., they were spawned only once). Tag loss was separated into two categories: pre-spawn mortality tag loss and spawning tag loss.

Pre-spawn Mortality Tag Loss

A total of 131 fish lost tags after August 20. Of these fish, 61 were pre-spawn mortalities (Table 2). Although the overall rate of tag loss for pre-spawn mortalities during this time period was 36.3%, very few missing tags were observed until Spawning Take Number 8 (9/17). Even more interesting is the fact that most of the mortalities that had missing tags were males, 58 out of 62 or 94% (Table 3). Forty-three of those males were I-Ocean (74.1%). Only 3 female pre-spawn mortalities were recovered without an operculum tag.

Spawning Tag Loss

Seventy adults that were spawned had missing operculum tags (Table 4). The overall tag loss rate for spawned fish during this time period was 7.6%, and again, large numbers of missing tags

did not begin showing up until Spawning Take Number 7 (9/12). Similar to the pre-spawn mortality record, most of the tag loss on chinook that were spawned occurred on males, 63 out 70 or 90% (Table 5). Out of 70 fish that lost tags, only 7 (10%) were females. Of the 63 males that lost their operculum tags, 41 (65%) were I-Ocean fish.

DISCUSSION

TYVEK operculum tags worked better than previous types of external tags evaluated to date at Dworshak NFH. The tag's attributes include minimal damage to the fish, ease of application, speed of application, low cost, and tag readability. Tag retention was excellent until the fish were handled frequently during spawning operations. Protocol for spawning called for every fish to be examined for ripeness during each spawning take. Since spawning takes were only 3 or 4 days apart, fish were handled continually over a one month time period. The I-Ocean male component of the run appeared to be the most susceptible to tag loss. Sixty-three percent of the total tag loss was attributed to I-Ocean males. Higher tag loss for the smaller fish is not unexpected since the operculum is thinner on smaller fish.

In addition to tag loss, other problems associated with the tag included algae growth on the tag and the edges of the tag tended to roll up and obscure the number. These two factors could potentially slow fish handling activities since additional time would be required to read the tag.

Table 1. Ocean age class and sex of returning adult spring chinook salmon that were tagged with operculum tags Dworshak National Fish Hatchery, 1996.

	I-ocean	II-ocean	III-ocean	Total
Males	338	303	20	661
Females	3	408	3	414
Unknown	4	28	1	33
Total	345	739	24	1108

Table 2. Number of adult spring chinook salmon at Dworshak National Fish Hatchery in 1996 that were recovered as mortalities from the adult holding ponds and the number that were missing operculum tags for each spawning take.

Spawning Take	Dates	Mortalities	Missing Tags
Pre-Spawning	6/1 to 8/19	25	1
Take 1	8/20 to 8/25	10	0
Take 2	8/26 to 8/28	4	1
Take 3	8/29 to 9/2	1	0
Take 4	9/3 to 9/5	13	1
Take 5	9/6 to 9/8	5	1
Take 6	9/9 to 9/11	4	1
Take 7	9/12 to 9/16	2	0
Take 8	9/17 to 9/23	80	39
Take 9	9/24	52[1]	18
Total		196	62

[1] Includes three fish that were not tagged.

Table 3. Ocean age class and sex of tagged adult spring chinook salmon that lost their operculum tag and were recovered as mortalities at Dworshak National Fish Hatchery.

	I-ocean	II-ocean	III-ocean	Unknown	Total
Males	43	15	0	0	58
Females	0	3	0	0	3
Unknown	0	0	0	1	1
Total	43	18	0	1	62

Table 4. Number of tagged adult spring chinook salmon that were spawned at Dworshak NFH in 1996 and the number that were missing operculum tags for each spawning take.

Spawning Take	Date	Number of Tagged Fish Spawned	Number of Fish Missing Tags
Take 1	8/20	34	0
Take 2	8/26	46	2
Take 3	8/29	91	3
Take 4	9/3	259	9
Take 5	9/6	123	5
Take 6	9/9	65	3
Take 7	9/12	73	10
Take 8	9/17	84	11
Take 9	9/24	137	27
Total		912	70

Table 5. Ocean age class and sex of tagged adult spring chinook salmon that had lost their operculum tag by the time of spawning at Dworshak National Fish Hatchery.

	I-ocean	II-ocean	III-ocean	Unknown	Total
Males	41	20	2	0	63
Females	0	6	1	0	7
Unknown	0	0	0	0	0
Total	41	26	3	0	70

Literature Cited

Pascho, R.J., D.G. Elliott, and J.M. Streufert. 1991. Brood stock segregation of spring chinook salmon *Oncorhynchus tshawytscha* by use of the enzyme-linked immunosorbent assay (ELISA) and the fluorescent antibody technique (FAT) affects the prevalence and levels of *Renibacterium salmoninarum* infection in progeny. Dis. Aquatic Org. 12:25-40.