Comparison Of Mortality Rates Between PIT Tagged And Non-PIT Tagged Groups Of Spring Chinook Salmon And Summer Steelhead At Dworshak And Kooskia National Fish Hatcheries in Idaho

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INTRODUCTION

Monitoring the post-release performance of spring chinook salmon (*Oncorhynchus tshawytscha*) and summer steelhead (*O. mykiss*) smolts after their release from Dworshak and Kooskia National Fish Hatcheries (NFH) is an integral part of the production evaluation program at the Dworshak Fisheries Complex. Representative samples of fish from experimental treatment groups and regular production lots are marked with Passive Integrated Transponder (PIT) tags to monitor their downstream migration time and survival to several lower Snake River smolt collection facilities after they are released. Data collected from PIT-tagged smolts are used to make inferences about the post-release performance of the population released. Results from evaluations are then used to recommend changes in rearing and release strategies to improve smolt quality and adult returns. One of the important assumptions that has to be made when using PIT tags is that tagged fish have similar mortality rates as non-tagged fish.

Previous research demonstrated little or no effect of PIT tags on the growth or survival of chinook salmon, sockeye salmon (*O. nerka*), or steelhead (Prentice et al., 1984, 1985, 1986, 1987, 1990a, and 1990b). However, Prentice et al. (1993) concluded that the results needed to be viewed with caution because their experimental design did not allow them to distinguish between container and treatment effects. Peterson et al. (1994) compared the over-winter growth and survival of wild juvenile coho salmon (*O. kitsutch*) marked with sequential coded-wire tags with those marked with PIT-tags over a two year period and found no significant differences between the two tag groups for either year. However, comparisons were not made with non-tagged fish. The purpose of this paper is to compare mortality rates between PIT tagged and non-PIT tagged groups of steelhead and spring chinook salmon at Dworshak and Kooskia NFHs prior to their release.

METHODS

Ninety-nine individual raceways or Burrows ponds containing representatve groups of PIT-tagged spring chinook salmon or summer steelhead at Dworshak and Kooskia NFHs from 1993 to 1996 were selected for analysis. These rearing units represented twenty-five different experimental or regular production groups. Mortalities from all rearing units were collected daily from the day the fish were PIT tagged until the fish were released. All the mortalities were examined for the presence of PIT tags by scanning them with either a Destron portable PIT-tag scanner or a Biomark Mark X PIT-tag scanner (prototype).

The pair-wise T-Test (Wilkinson 1990) was used to detect significant differences in mean mortality rates between tagged and non-tagged fish for each experimental and production group. First, mortalities for PIT tagged and non-PIT tagged fish in each rearing unit were expressed as percentages. The percentages were then normalized using the square-root arcsine transformation (Snedecor and Cochran 1978). The pair-wise T-Test was then performed on the transformed data.

RESULTS

Differences in mean percent mortality between PIT tagged and non-PIT tagged fish for the majority of the groups examined were not significant. However, significant differences ($P \leq 0.05$) were observed in 10 of the 25 groups (Table 1). In all of these cases, the PIT tagged fish had lower mortality than the non-PIT tagged fish. PIT tagged fish had higher mortality than non-PIT tagged fish in only seven of the 25 groups examined although none of these differences were significant. In five of those cases, the difference in mean percent mortality between PIT tagged and non-PIT tagged fish was 0.05 or less.

DISCUSSION

The fact that it was the PIT tagged fish that had significantly lower mortality than the non-PIT tagged fish was unexpected. Logic would ordinarily suggest that PIT-tagging would result in higher rates of mortality because of the additional stress and injury associated with tagging process. After examining the results in 1993, where four of the five groups tested resulted significant results, we concluded that the taggers were selecting the healthiest, most fit individuals for tagging; weaker, smaller, less healthy fish were being consciously rejected. Because PIT tags are relatively expensive, taggers were hesitant to "waste" tags on fish that were at high risk of mortality. This introduced an obvious bias into the tagging program since tagged fish were not selected randomly from the population. We have since made it official policy to discuss tagging protocol with taggers to insure that fish are marked randomly.

In any kind of tagging program, some injury and mortality is to be expected and PIT tagging is no exception. Every care needs to be taken to insure that the tagging process does not introduce a bias into the experiment where excessive handling or high rates of tagging injury lead to differences in survival between the tagged group and the rest of the population they represent. However, as our results indicate, steps need to be taken to insure that excessive care and consideration of tagged fish does not bias the experiment in the opposite way.

Table 1. Mortality data for the PIT tagged and non-PIT tagged spring chinook salmon and steelhead in various production groups at Dworshak and Kooskia NFHs for 1993 to 1996.

		Rearing	Non-Tagged			Tagged		
Year	Group	Unit	Number	Mort	%	Number	Morts	%
1993	Rel 1	A1	15437	798	5.17	250	0	0
		A2	16020	566	3.53	250	0	0
		A3	15861	151	0.95	250	0	0
		A4	16827	376	2.23	250	0	0
		B16	16383	18	0.11	250	0	0
		B19	16845	287	1.7	250	2	0.8
				Mean =	2.3			0.13
					P=0.01			
	Rel 2	A10	15686	1919	12.23	250	0	0
		A11	15973	166	1.04	250	0	0
		A12	15986	257	1.61	250	1	0.4
		A13	16157	127	0.79	250	0	0
		A15	18063	1206	6.68	250	0	0
		B25	16119	49	0.3	250	1	0.4
				Mean =	3.8			0.13
					P=0.05			
	Rel 3	A5	15959	564	3.53	250	0	0
		A6	16014	815	5.09	250	0	0
		A7	15855	528	3.33	250	1	0.4
		A8	15851	798	5.03	250	1	0.4
		B20	15856	74	0.47	250	0	0
		B23	15833	53	0.33	250	0	0
				Mean =	3.0			0.13
					P=0.00			
	ADClin	R2	28388	40	0.14	200	1	0.5
		R3	30527	33	0.11	200	0	0
		R11	28562	33	0.12	200	0	0
				Mean =	0.12			0.17
					P=0.66			
	LVClin	R6	28624	78	0.27	200	0	0
		R7	28215	32	0.11	200	0	0
		R10	28290	169	0.6	197	0	0
				Mean =	0.33			0.0
					P=0.05			
1994	Rel 1	A1	22656	2	0.01	2000	3	0.15
		A2	20657	9	0.04	2000	1	0.05
		A3	20580	14	0.07	2000	3	0.15

				Mean =	0.04			0.12
					P=0.20			

Table 1. Continued.

Year	Group	Rearing Unit	Non-Tagged			Tagged		
			Number	Mort	%	Number	Morts	%
	Rel 2	A4	23521	20	0.09	2000	2	0.1
		A5	30538	8	0.03	2000	2	0.1
		A6	24986	7	0.03	2000	2	0.1
				Mean =	0.05			0.1
					P=0.19			
	Rel 3	A7	23216	11	0.05	2000	0	0
		A8	21284	12	0.06	2000	1	0.05
		A9	24276	11	0.05	2000	3	0.15
				Mean =	0.05			0.07
					P=0.83			
	Gali	B23	31174	10	0.03	150	0	0
		B24	31123	10	0.03	150	0	0
		B25	31784	13	0.04	150	0	0
		B26	31777	19	0.06	148	0	0
				Mean =	0.04			0.0
					P=0.00			
	Aqua	B27	30693	18	0.06	150	0	0
		B28	31566	23	0.07	150	0	0
		B29	30892	18	0.06	150	0	0
		B30	30836	13	0.04	150	0	0
				Mean =	0.06			0.0
					P=0.00			
	28Day Fed	C3	29660	21	0.07	150	0	0
		C4	29491	38	0.13	150	0	0
		C5	29504	60	0.2	150	1	0.67
		C6	29542	49	0.17	150	0	0
				Mean =	0.14			0.17
					P=0.43			
	21Day Fed	C7	29505	42	0.14	150	0	0
		C8	29641	30	0.1	150	0	0
		C9	29575	162	0.55	150	0	0
		C10	29170	172	0.59	150	1	0.67
				Mean =	0.35			0.17
					P=0.12			
	Sys 1	BP5	30224	349	1.15	250	0	0
		BP17	32297	271	0.84	249	1	0.4
		BP35	28812	413	1.43	250	0	0
				Mean =	1.14			0.13

					P=0.10			

Table 1. Continued.

Year	Group	Rearing Unit	Non-Tagged Number	Non-Tagged Mort	Non-Tagged %	Tagged Number	Tagged Morts	Tagged %
	Sys 3	BP56	26264	1398	5.32	250	4	1.6
		BP57	29643	360	1.21	230	2	0.87
		BP64	30364	1696	5.59	239	4	1.67
				Mean =	4.04			1.4
					P=0.13			
	2Feedings	R3	29587	131	0.44	100	0	0
		R5	29465	126	0.43	100	0	0
		R6	30398	47	0.15	100	0	0
				Mean =	0.34			0.0
					P=0.03			
	3Feedings	R9	29731	133	0.45	100	0	0
		R10	29974	47	0.16	100	0	0
		R12	30203	51	0.17	100	0	0
				Mean =	0.26			0.0
					P=0.03			
1995	28Day S/F	A1	35708	44	0.12	200	1	0.5
		A2	32678	23	0.07	200	0	0
		B16	32645	20	0.06	200	0	0
		B17	33825	31	0.09	200	1	0.5
				Mean =	0.09			0.25
					P=0.75			
	28Day S/S	A7	37068	65	0.18	200	0	0
		A8	35866	72	0.2	200	0	0
		B22	35496	34	0.1	200	0	0
		B23	35664	66	0.19	200	0	0
				Mean =	0.16			0.0
					P=0.00			
	21Day S/F	A3	32134	59	0.18	200	0	0
		A4	32674	41	0.13	200	0	0
		B18	32936	35	0.11	200	1	0.5
		B19	32788	200	0.61	200	0	0
				Mean =	0.26			0.13
					P=0.31			
	21Day S/S	A9	34730	26	0.07	200	1	0.5
		A10	40779	47	0.12	200	3	1.5
		B24	34549	43	0.12	200	0	0
		B25	40277	44	0.11	200	1	0.5
				Mean =	0.11			0.63
					P=0.28			

Table 1. Continued.

Year	Group	Rearing Unit	Non-Tagged Number	Non-Tagged Mort	Non-Tagged %	Tagged Number	Tagged Morts	Tagged %
	Control	A5	34079	54	0.16	200	0	0
		A6	34697	100	0.29	200	1	0.5
		B20	34635	37	0.11	200	1	0.5
		B21	34322	211	0.61	200	0	0
				Mean =	0.29			0.25
					P=0.59			
	1Feeding	R3	29644	110	0.37	249	0	0
		R4	29741	118	0.44	200	1	0.5
		R5	29683	121	0.41	202	0	0
				Mean =	0.39			0.17
					P=0.21			
	2Feeding	R6	29755	122	0.41	200	0	0
		R7	29837	141	0.47	200	1	0.5
		R8	29739	130	0.44	200	1	0.5
				Mean =	0.44			0.33
					P=0.44			
1996	DNFH	A1	16556	62	0.37	200	0	0
		A2	17060	142	0.83	200	1	0.5
		A3	17802	93	0.52	201	0	0
		A4	17641	72	0.41	201	0	0
		A5	17539	43	0.25	201	0	0
				Mean =	0.48			0.1
					P=0.00			
	KNFH	R5	34133	80	0.23	209	0	0
		R6	34146	82	0.24	200	0	0
		R7	34540	77	0.22	200	1	0.5
		R8	34546	73	0.21	199	0	0
		R9	34736	47	0.14	200	1	0.5
		R11	34581	70	0.2	200	0	0
		R12	34538	100	0.29	199	1	0.5
				Mean =	0.22			0.21
					P=0.31			

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