FISH PASSAGE CENTER

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MEMORANDUM

TO: Joe Bumgarner

FROM: Michele DeHart

DATE: January 8, 2010

RE: Tucannon River Steelhead Straying Behavior

In response to your request the FPC staff analyzed the Tucannon River origin steelhead groups from 2004-2008. We summarized observations and recaptures for PIT tagged wild and hatchery steelhead to describe the extent and location of straying. Also, as per your request, we separated adults into two groups for comparison: those that out migrated in-river and those that were transported. Our results were:

1) Transported hatchery steelhead strayed into the middle Columbia River sub-basins (Deschutes, John Day, Umatilla, and Walla Wall Rivers) while in-river steelhead did not.
2) Transported and in-river hatchery steelhead strayed into the upper Columbia River sub-basin at the same rates.
3) In-river hatchery adults had a higher success rate from BON to the TUC than for adults that were transported as smolts.
4) In-river hatchery fish have a higher stray rate to above Lower Granite Dam than for those transported.
5) Straying and success rates for wild Tucannon fish were similar for the in-river and transported groups.
6) The Tucannon Endemic Hatchery stock had a higher straying rate and lower success rate than The Lyon's Ferry hatchery stock in migration year 2007.

Data Description

We utilized information from all PIT tagged steelhead released into the Tucannon River (2004-2008). The number of PIT tagged fish used for this analysis is shown in Table 1. We aggregated all passive detections and recaptures (passive and actual recaptures) for these groups of fish throughout the Columbia and Snake River basins. We defined strays as any fish first detected at Bonneville Dam (BON) at least one calendar year after their release and then detected outside of the assumed migration corridor during the return adult migration. This included all individuals detected at sites other than BON, McNary Dam (MCN), Ice Harbor Dam (ICH), or the lower Tucannon River (TUC).

Hatchery steelhead that originated from two different stocks were released into the Tucannon River. Stocks of Lyon's Ferry origin and a Tucannon Endemic Stock were released in the Tucannon River (Table 1). Small numbers of hatchery origin fish were tagged in the Tucannon River from a separate upstream release of Tucannon endemics hatchery fish as part of a short-term study; these are labeled "Tucannon River tagged" in tables 1 and 2. This group was included in hatchery rates of straying and success shown in Figures 1 and 2 Ostensibly wild Tucannon steelhead were also tagged in each year (Table 1).

Table 1. The total number of PIT-tagged hatchery and wild steelhead released into the Tucannon River from 2004-2008. The coordinator ID on all releases was MLS.

Stock (if known)	2004	2005	2006	2007	2008
			HATCHERY STEELHEAD		
Lyon's Ferry Stock	0	0	8997	5000	3500
Tucannon Endemic	9970	9965	8953	8500	11500
Tucannon River tagged	508	18	2	300	0
			WILD STEELHEAD		
Tucannon River Wild	1984	1835	1417	301	1087

Observations of straying

Table 2. Summary of last detection area for adult strays and adults last detected in the Tucannon River. All individuals were detected at Bonneville Dam during the return adult migration and subsequently detected upriver of Bonneville. Individuals are grouped by stock and whether they were transported as a juvenile or not.

Outmigration history	Stock (if known)	Middle Columbia	Upper Columbia	Tucannon River	LGR or above
		HATCHERY	**STEELHEAD**		
In-river	Lyon's Ferry		8	83	203
	Tucannon Endemic		5	27	162
	Tucannon R. tagged			1	5
Transported	Lyon's Ferry	5	3	26	24
	Tucannon Endemic	12	6	30	44
	Tucannon R. tagged			1	
		WILD	**STEELHEAD**		
In-river	Wild		2	6	30
Transported	Wild	1		7	8

Middle Columbia River sub-basin detections

A variety of relatively new PIT tag detectors are now available in the middle Columbia River sub-basin. SHERFT (Sherar's Falls on the Deschutes River) and JD1 (John Day River flat plates) came online in 2007. Within the Umatilla River, FDD (Feed Diversion Dam) and TMF (Three Mile Falls Dam) came online in 2008 and 2006, respectively. The Oasis Road Bridge detector (ORB) in the Walla Walla River has been online since 2005. One interesting record in particular was from the MINP recap site (Minthorn Acclimation Pond in the Umatilla River). There was only a single PIT tag entry in PTAGIS for this site and the recap remarks for this individual were "Spawned at Minthorn Springs Hatchery 4-15-09."

Included in Table 2 are the fish that were last detected in the middle Columbia River sub-basin. It is worth noting that several of these PIT tag detectors have only been in operation over a portion of the return years that coincide with the 2004-2008 out-migrations. All of the strays detected in middle Columbia River tributaries were transported as smolts. The detections suggest an overwintering or straying behavior into the middle Columbia tributaries and that transportation of Tucannon smolts can influence this behavior.

Upper Columbia River sub-basin detections

PIT tag arrays for adult detection have been in place longer within the upper Columbia River sub-basin than in the middle Columbia River tributaries. Detection at PRA (Priest Rapids), RIA (Rock Island Adult), RRF (Rocky Reach Fishway), and WEA (Well's Dam Adult) has been in place since 2002, 2003, 2006, and 2002 respectively. Strays were also detected in the Methow Rivers (MRB; online since 2004). These upper Columbia strays originated from both in-river and transported groups (Table 2.).

Detections above LGR

Detection of adults at LGR (Lower Granite Dam) has been in place since 1988. Additional detectors above LGR that detected Tucannon steelhead include ASOTIC (Asotic Creek), LAPC (Lapwai Creek), SWEETC (Sweetwater Creek), and DWOR (Dworshak hatchery) and have been in place since 2005, 2008, 2008, and 1995 respectively. These Snake River strays originated from both in-river and transported groups (Table 2).

Detections within the Tucannon River

There were 181 hatchery and wild adults that were last detected in the Tucannon River. These include those adults previously detected in the adult ladder at LGR but later returned to and were detected in the Tucannon River. These LGR and subsequent Tucannon River detects included adults from both the in-river and transported groups and amounted to about one third (59) of the total adults that were last detected in the Tucannon River. This suggests that overwintering behavior above LGR is common for Tucannon steelhead.

Comparing rates of adult success and straying between in-river and transport groups

We calculated straying and success rates for transported and in-river steelhead from the Tucannon River. A success was defined as an adult detected at BON and last detected within the Tucannon River. The adult success rate reflects a combination of fishing and other mortality and straying between BON and the Tucannon River. We defined a stray as any adult fish detected at BON and last detected outside the assumed migration corridor as an adult. The stray or success rate was the number of strays or successes divided by the numbers of adults detected at BOA for a particular group of interest. We used a non-parametric bootstrap approach (e.g. resampling with replacement) to calculate 90% confidence intervals for straying and success rates. The 90% confidence interval around these statistics were used to determine if there was a significant difference between in-river and transported groups in each year. At best, the point estimates of straying or success rates are minimal conservative estimates because detection efficiency is less than 100% in most cases (detection efficiencies at newer detectors have not been established), many detection sites were not available across the Columbia Basin for all years, and there are likely potential straying sites without PIT-tag detection. In one case, the PIT tag detector in the lower Tucannon River was inoperable from January through August of 2008. However, both transported and in-river groups should express these biases equally and therefore a comparison between these two groups should be valid.

All strays to the middle Columbia River sub-basins (Deschutes, John Day, Umatilla, and Walla Wall Rivers) were transported as smolts. In 2006 and 2007 the stray rate for transported Tucannon hatchery steelhead into middle Columbia River subbasins was significantly different from zero (Figure 1). Straying into the upper Columbia River was less prevalent across years and there was no significant difference between in-river and transported groups (Figure 1). Straying above LGR was significantly different from zero for both groups across most years. The in-river group had a significantly higher rate than transported fish in most years. The point estimates for straying rates above LGR were much higher than for the other areas (Figure 1 & 2). However, these estimates are not directly comparable and caution should be used in interpreting these disparate point estimates. The detection efficiency in the adult ladder of Lower Granite Dam is near 100% whereas detectors within the middle and upper Columbia Rivers do not include all possible straying areas and most detection site likely has less than 100% efficiency. Also, the 2008 migration year stray rates are incomplete and interpreting these results may be premature; the 2008 migration year stray rates may include individuals that overwintered during the 2009 calendar year but may still return to the Tucannon River in 2010.

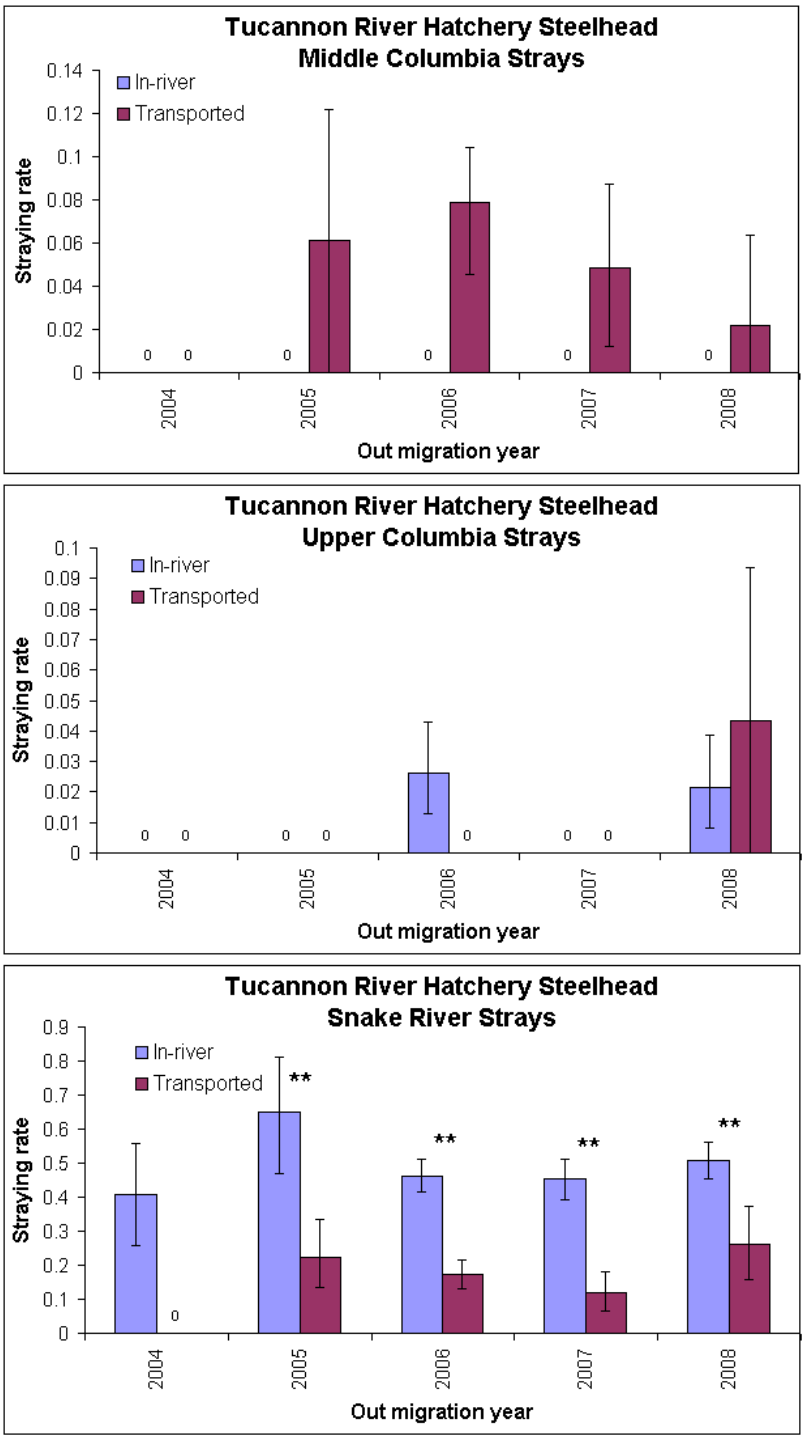

Figure 1. Straying rates are displayed for Tucannon River hatchery steelhead to the middle and upper Columbia River, and the Snake River in the top, middle, and bottom panels respectively. Non parametric 90% bootstrap confidence intervals are shown for each non-zero estimate. The double asterisk (**) denotes a significant difference between adults that outmigrated via transport and in-river routes.

We were able to detect a difference between the success rate for transported and in-river smolts to the Tucannon River in 2006. During this year, the in-river group migrated from BON to the Tucannon River at a greater rate than transported smolts (Figure 2). Across years, these successful adults included some returning fish that strayed above LGR and then returned to the Tucannon River from 4to 283 days later. We compared the success rate for in-river & transported individuals that were detected in the LGR adult ladder and then returned to the Tucannon River to ascertain if there was any difference in homing ability. Across years, success rates from this subset of LGR adult detects followed a similar pattern as the overall success rates from the BON adult ladder but with wider confidence intervals. We could not detect a statistical difference in the return rate to the Tucannon River for adults that were detected in the LGR adult ladder (Figure2). Also, the 2008 migration year success rates are incomplete and interpreting these results may be premature; the 2008 migration year success may include individuals that overwintered during the 2009 calendar year but may still return to the Tucannon River in 2010.

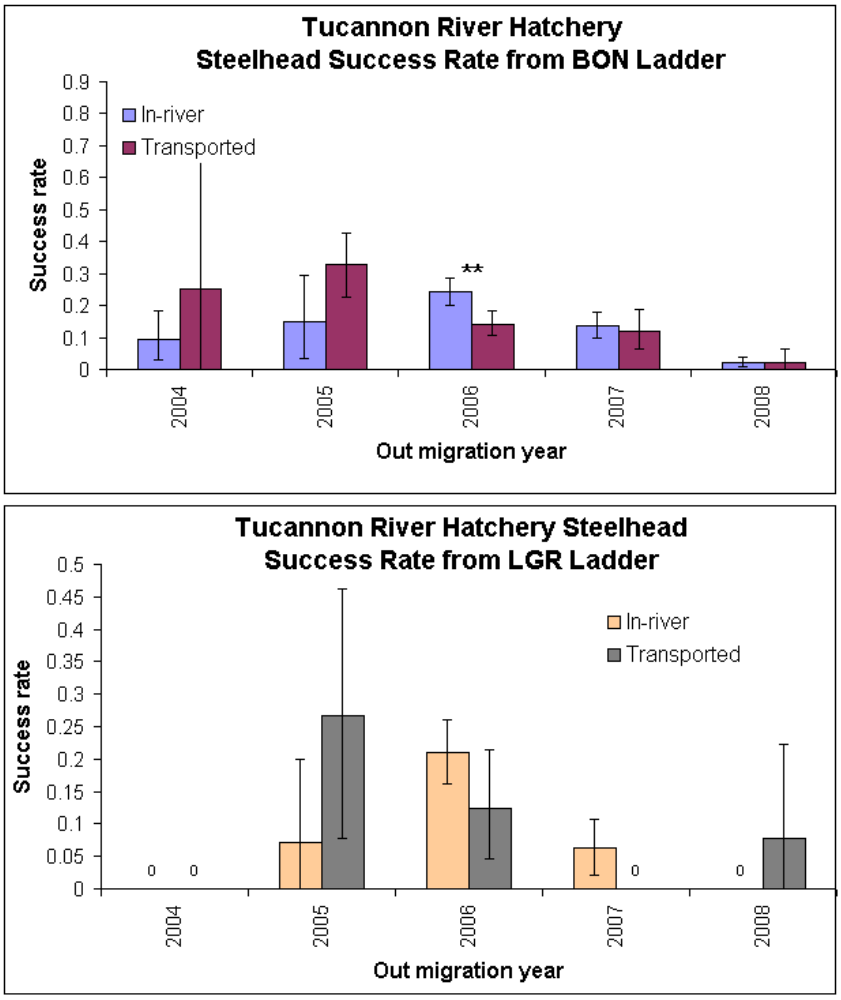

Figure 2. The success rate for Tucannon River hatchery steelhead is shown in the top panel. The success rates for adults that temporarily migrated above LGR but did not stray is shown in the bottom panel. Non parametric 90% bootstrap confidence intervals are shown for each non-zero estimate. The double asterisk (**) denotes a significant difference between adults that outmigrated via transport and in-river routes.

There were far fewer ostensibly wild Tucannon River steelhead marked than hatchery fish and with the subsequent wide confidence intervals in straying and success rates no significant difference was detectable between in-river and transported groups. During 2007, only 301 individuals were able to be marked and no adults were detected returning to the Tucannon River, albeit the detection efficiency here is likely less than 100%. As stated above for hatchery steelhead, the 2008 migration year stray and success rates are incomplete, and interpreting these results for wild stocks may be premature.

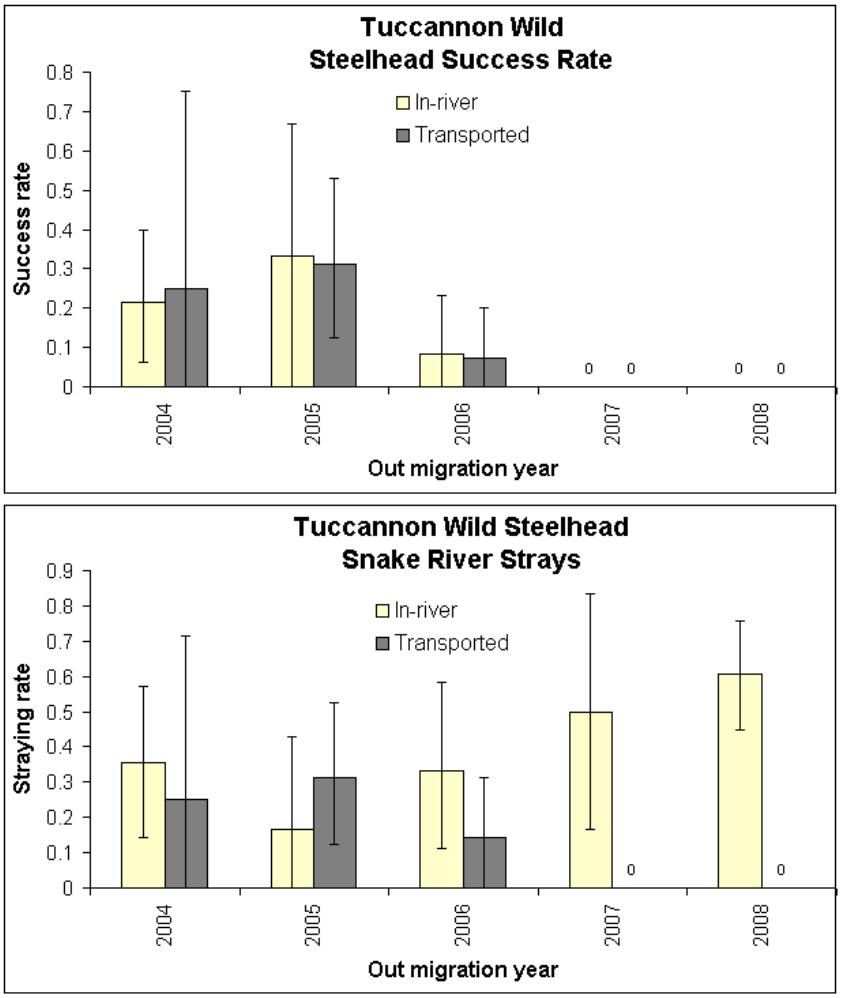

Figure 3. The overall success rates and straying rate (to all regions) for Tucannon wild steelhead are shown in the top panel. The bottom panel shows the overall straying rate. Non parametric 90% bootstrap confidence intervals are shown for each non-zero estimate. The double asterisk (**) denotes a significant difference between adults that outmigrated via transport and in-river routes.

Comparing two stocks of hatchery steelhead

We compared both the Tucannon endemic hatchery steelhead and Lyons Ferry Hatchery steelhead stocks released in the Tucannon River in a similar manner. The Tucannon endemic hatchery stock had a higher straying rate and lower success rate than the Lyons Ferry hatchery stock in migration year 2007. Again, the 2008 migration year stray and success rates are incomplete and interpreting these results may be premature.

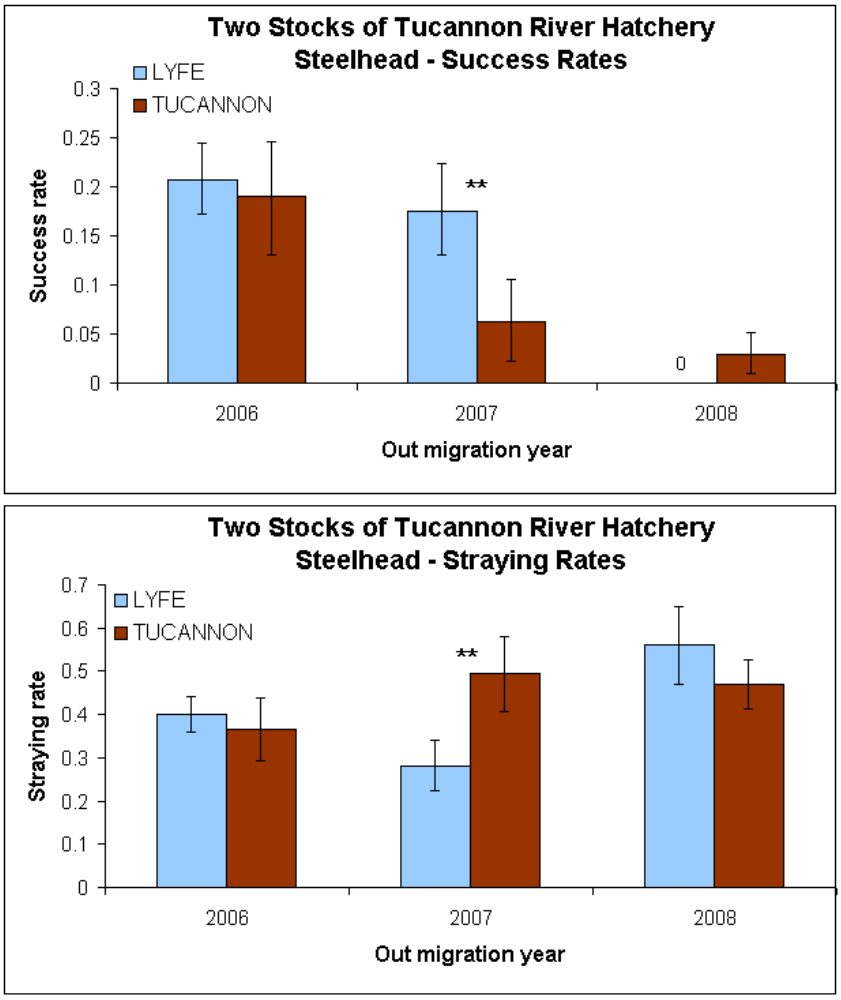

Figure 4. The overall success and straying rates (to all regions) for hatchery steelhead released in the Tucannon River during years where both Lyon's Ferry (LYFE) and Tucannon endemic hatchery (TUCH) origin fish were released (2006-2008). Non parametric 90% bootstrap confidence intervals are shown for each non-zero estimate. The double asterisk (**) denotes a significant difference between adults that outmigrated via transport and in-river routes.