IDAHO COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT
COLLEGE OF NATURAL RESOURCES
UNIVERSITY OF IDAHO
P.O. BOX 441141
MOSCOW, ID 83844-1141

(208) 885-2750
Fax (208) 885-9080

24 January 2006

To: David Clugston and Marvin Shutters (USACE)

From: Matt Keefer and Chris Peery (University of Idaho)

Re: Summary of 2004 straying rates for known-origin adult Chinook salmon and steelhead in the Columbia/Snake Hydrosystem; Letter Report

Introduction: An understanding of adult salmon and steelhead inter-basin straying rates is necessary to reliably evaluate Biological Opinion survival goals for ESA-listed populations in the Columbia River basin. Since 2000, we have used adult radiotelemetry, combined with data from juvenile PIT tagging projects, to document average, annual, and stock-specific straying rates for steelhead and spring–summer and fall Chinook salmon. Straying rates from the 2000-2003 study years were summarized in a Technical Report (Keefer et al. 2005) and were 2.2% (annual range 1.6-4.5%) for spring–summer Chinook salmon, 6.8% for steelhead (range 6.1-9.1%) and 4.2% for fall Chinook salmon; rates varied for specific stocks. This letter report includes stray estimates for the 2004 migration year.

Methods: Adults were collected opportunistically at the Adult Fish Facility (AFF) at Bonneville Dam (Figure 1). An automated PIT-tag detection system in the AFF identified PIT-tagged fish available for study use. When identified, these fish were diverted for radio tagging. Chinook salmon were tagged throughout the spring–summer run (April-July) and during the peak fall run (mid-August to early October) runs and steelhead were tagged from June-September. All fish were released ~10 km downstream from Bonneville Dam (both sides of the river).

Fish fates were identified from the combination of telemetry records at dams and in tributaries, PIT-tag interrogation records at dams, and recapture data from fisheries, hatcheries and weirs. Permanent straying status was designated for those fish with final records (telemetry or recapture) in river basins outside their natal basins, as identified by juvenile PIT-tag location. Because monitoring of small tributaries was limited, we only considered straying at the large-river scale. For example, we did not examine straying within or between Snake River tributaries, but instead considered the Snake River basin as a whole. Errors in identifying straying fish should have been relatively small given broad telemetry coverage and data provided by PIT-tag interrogators at dams. For example, the latter could identify fish that lost radio transmitters during migration.

Stray rate calculations: Basic stray rates were calculated by dividing the number of permanently straying fish (N_S) by the number of radio-tagged fish released from that population (N_R) (Equation 1). These rates included fish harvested in non-natal basins,

although some may have been temporary strays had harvest not occurred. We calculated a second stray rate that treated fish harvested in non-natal rivers (N_H) as non-strays, providing estimates that should be considered minimums (Equation 2). Combined, these two estimates provide the potential range of the percentages of fish that strayed, with the full samples at Bonneville Dam as the denominator baseline. We note, however, that values may be underestimates because some fish were harvested in mainstem fisheries and did not have the opportunity to stray. This bias should decrease as fish progress upstream past the tributaries where most straying occurred. We addressed this question in Keefer et al. 2005, and found that bias related to mainstem harvest was relatively minor.

Equation 1, basic stray rate: N_S / N_R

Equation 2, basic stray rate with tributary harvest excluded: $(N_S - N_H) / N_R$

Results: Our overall tagging effort was somewhat reduced in 2004, and samples of known-origin fish were smaller than in previous years. We tagged a total of 135 known-origin spring–summer Chinook salmon (Table 1). The basic stray rate for this group was 1.5% ($n = 2$). Both fish were reported harvested in the non-natal basins and treating these fish as non strays resulted in a rate of 0.0%. More than half of the known-origin spring–summer Chinook salmon were from the Snake River and the basic stray rate for this group was also 1.5%. The other stray was from Warm Springs Hatchery in the Deschutes River basin. Harvest of the Snake River stray was in the Wind River, while the Deschutes River fish was harvested in the Little White Salmon River.

Table 1. Numbers and percentages of known-source spring–summer[1] Chinook salmon groups that were last recorded straying into non-natal tributaries, 2004. Basic stray rate includes fish harvested in non-natal tributaries. Tributary harvest excluded stray rate treats fish harvested in non-natal tributaries as non-strays and is therefore a conservative estimate. Table only includes stocks or aggregates with ≥10 fish, except Deschutes River stock, which had straying fish.

Stock	n	Basic stray rate % (n)	Tributary harvest excluded stray rate % (n)
All spring–summer Chinook	135	1.5% (2)	0.0% (0)
All Snake R.	67	1.5% (1)	0.0% (0)
Known Snake R. transport	12	0.0% (0)	0.0% (0)
No known Snake R. transport	55	1.8% (1)	0.0% (0)
Rapid River Hatchery	36	2.8% (1)	0.0% (0)
All Upper Columbia R.	39	0.0% (0)	0.0% (0)
Leavenworth Hatchery	30	0.0% (0)	0.0% (0)
Yakima R.	16	0.0% (0)	0.0% (0)
Deschutes R.	*3*	*33.3% (1)*	*0.0% (0)*

[1] some upper Columbia stocks are considered summer–fall Chinook salmon

A total of 27 known-origin fall Chinook salmon were radio tagged in 2004. None of these fish strayed into non-natal rivers. Eleven fall Chinook salmon were from Priest Rapids Dam Hatchery, 13 were from Lyons Ferry Hatchery (released upstream from Lower Granite Dam), and 3 were from other sites upstream from Lower Granite Dam.

We radio tagged a total of 75 known-origin steelhead in 2004 (Table 2). The basic stray rate for all steelhead was 6.7%; the harvest excluded rate was 4.0%. Basic stray rates were 8.6% for all Snake River fish, 10.0% for Ringold Hatchery fish, and 5.3% for all upper Columbia fish. The five steelhead strays were last recorded in the Deschutes River (n = 1) or the Little White Salmon (n = 4, with two reported harvested).

Table 2. Numbers and proportions of known-source steelhead groups that were last recorded straying into non-natal tributaries, 2004. Basic stray rate includes fish harvested in non-natal tributaries. Tributary harvest excluded stray rate treats fish harvested in non-natal tributaries as non-strays and is therefore a conservative estimate. Table only includes stocks or aggregates with ≥10 fish, except Deschutes River stock, which had straying fish.

Stock	n	Basic stray rate % (n)	Tributary harvest excluded stray rate % (n)
All steelhead	75	6.7% (5)	4.0% (3)
All Snake R.	35	8.6% (3)	5.7% (2)
Known Snake R. transport	18	11.1% (2)	5.6% (1)
No known Snake R. transport	17	5.9% (1)	5.9% (1)
All Upper Columbia R.	19	5.3% (1)	5.3% (1)
Ringold Hatchery	10	10.0% (1)	0.0% (0)

Discussion: Although samples sizes were small in 2004, estimates of stray rates were quite consistent with those from 2000-2003 when samples were considerably larger (e.g., 1,588 spring–summer Chinook salmon, 166 fall Chinook salmon, and 1,414 steelhead). The 2004 stray rate for fall Chinook salmon (n = 27, 0.0%) was lower than for the earlier studies, but given the sample size was well within the range of stray rates for this group. Spring–summer Chinook salmon and steelhead harvest rates in non-natal rivers were also similar to the previous years' and stray locations were generally similar as well.

The results presented here are based on extensive radiotelemetry coverage. Caution should be taken when applying these basic stray rates to years without radiotelemetry studies, and would be most appropriate for the known-source groups we studied. The rates could be applied, for example, to counts of Snake River or upper Columbia stocks detected at Bonneville Dam PIT-tag interrogators.

References: Keefer, M.L., C.A. Peery, J. Firehammer, and M.L. Moser. 2005. Straying rates of known-origin adult Chinook salmon and steelhead within the Columbia River basin, 2000-2003. Technical Report 2005-5 of Idaho Cooperative Fish and Wildlife Research Unit, Moscow, ID for U.S. Army Corps of Engineers, Portland and Walla Walla Districts. (http://www.uidaho.edu/cnr/ferl/publications)