18 January 2006

To: David Clugston (USACE) and Ron Boyce (Oregon)
From: Matt Keefer and Chris Peery

Re: Preliminary summary of adult spring–summer Chinook escapement upstream from Lower Granite Dam

We used the adult radiotelemetry databases from 2000-2003 to estimate escapement of spring–summer Chinook salmon upstream from Lower Granite Dam. The estimates below are based on reported harvest (from the transmitter reward program), agency collections at hatcheries and weirs, mobile radio-tracking in tributaries, spawning ground surveys, and especially records of fish at fixed antennas. Antenna locations were in the Snake at the upstream end of Lower Granite Dam, at the mouths of the Clearwater, Grande Ronde, and Imnaha rivers, in the Salmon River at Riggins and near the NF Salmon confluence, and at four secondary tributaries (Table 1).

Table 1. Locations and numbers of fixed radiotelemetry sites upstream from Lower Granite Dam during the study years. All sites except those between Asotin and the Salmon River mouth were in operation in all years.

River basin	Fixed telemetry sites
Snake R.	Asotin (1,); Between Asotin and Salmon R. mouth (3, 2000-2001)
Clearwater R.	Mouth (1); SF Clearwater mouth (1); Lochsa mouth (1)
Grande Ronde R.	Mouth (1)
Salmon	Riggins (1); SF Salmon mouth (1); MF Salmon mouth (1); Upper salmon at NF confluence (1)
Imnaha R.	Mouth (1)

Studies used to collect these data were developed to evaluate different aspects of passage in and through the hydrosystem. This meant that the amount of effort to monitor fish upstream from the hydrosystem (upstream from Lower Granite reservoir in this instance) was not exhaustive. Consequently, escapement estimates in Tables 2-5 are not estimates of spawning success or necessarily estimates to spawning grounds. Rather, the data presented are estimates of escapement to major tributaries and possible spawning areas, as well as estimates of harvest.

A total of 1,383 spring–summer Chinook salmon were monitored in the four years. Two qualifications regarding the sampling effort are necessary. First, the radio-tagged fish were not a random sample of the fish passing Lower Granite Dam. In all years we selected at Bonneville Dam for fish with PIT tags from juvenile tagging efforts. Overall, 40% (n = 560) of the sample had been PIT-tagged as juveniles. Most PIT tagged fish (341, 61%) were from the mixed-stock tagging efforts at Lower Granite Dam, with the remainder (219, 39%) from a wide variety of sub-basins, hatcheries, and traps. Combined, these groups were probably a reasonable sample of the runs, but they were not truly random. Second, we attempted to radio tag fish at Bonneville Dam in proportion to the overall runs, but this was not always possible due to run timing surprises and competing research objectives.

There were also some limitations and uncertainty regarding harvest. All transmitter returns from tribal and sport fisheries were voluntary. Despite rewards for returns, it is likely that some fish were harvested and their tags were not returned. This does not mean that unreported harvests were illegally caught fish (but it is possible). People returning tags were encouraged to report the location and type of recapture, but some forms were incomplete and we could not verify all details. For example, we may not have been able to differentiate in some cases whether transmitters were found (i.e. in carcasses or along river corridors) or were removed during harvest. Unreported harvest would tend to reduce the escapement estimates and increase the true harvest estimates. Found transmitters returned as 'harvest' would have the opposite effect and these two factors may be partially offsetting.

In our opinion, the areas of greatest uncertainty for the Chinook salmon escapement estimates are for those fish last recorded at the Clearwater River mouth and at the Riggins site on the lower Salmon River. Most spring–summer Chinook salmon spawning sites are upstream from these locations, but we did not systematically survey all spawning sites. It is likely that many—but almost certainly not all—of the fish recorded at these antennas were successful migrants, and we have tried to capture the range of potential escapements in the four equations in Tables 2-5. We have also provided the final recorded locations and fates for each fish so that the numbers can be further manipulated if necessary.

Table 3 provides a comparison of escapements for fin-clipped and unclipped fish. Note that fish with clips were less likely to escape in almost all cases, especially when harvest was treated as migration failure. This is due at least in part to greater harvest effort for hatchery fish, but may also reflect reduced homing abilities for these fish.

Table 2. Estimated fates and final locations of **all** radio-tagged spring–summer Chinook salmon that passed Lower Granite Dam. Equations are for a variety of potential escapement estimates, with differing criteria for success. Many additional alternatives are possible, including estimates where harvested fish are censored.

	All salmon			
	2000	2001	2002	2003
a) Snake unknown	5	10	4	12
b) Snake harvest	1	5		
c) Tributary harvest	48	101	84	54
d) Hatchery/weir	91	69	75	42
e) Secondary tributaries	58	194	112	133
f) GRR/IMR mainstem	13	43	25	20
g) CWR: mouth to S Fork	8	15	16	8
h) CWR: above S Fork	3	4	5	1
i) SAL: Riggins to N Fork	1	34	22	25
j) SAL: above N Fork	5	15	8	14
T) Total	233	490	351	309
(T-a)/T	0.979	0.980	0.989	0.961
(T-a-b-c)/T	0.768	0.763	0.749	0.786
(T-a-b-c-g)/T	0.734	0.733	0.704	0.761
(T-a-b-c-g-i)/T	0.730	0.663	0.641	0.680

Table 3. Estimated fates and final locations of radio-tagged spring–summer Chinook salmon, **with and without fin clips**, that passed Lower Granite Dam.

	2000	2000	2001	2001	2002	2002	2003	2003
	clip	no clip	clip	no clip	clip	no clip	clip	no clip
a) Snake unknown	3	2	8	2	3	1	7	5
b) Snake harvest	1		5					
c) Tributary harvest	44	4	94	7	76	8	39	15
d) Hatchery/weir	75	16	47	22	48	27	34	8
e) Secondary tributaries	28	30	68	126	36	76	36	97
f) GRR/IMR mainstem	1	12	5	38	5	20	5	15
g) CWR: mouth to SF	8		10	5	10	6	6	2
h) CWR: above SF	2	1	4		3	2	1	
i) SAL: Riggins to NF	1	0	25	9	21	1	19	6
j) SAL: above NF		5		15		8	1	13
T) Total	163	70	266	224	202	149	148	161
(T-a)/T	0.982	0.971	0.970	0.991	0.985	0.993	0.953	0.969
(T-a-b-c)/T	0.706	0.914	0.598	0.960	0.609	0.940	0.689	0.876
(T-a-b-c-g)/T	0.656	0.914	0.560	0.938	0.559	0.899	0.649	0.863
(T-a-b-c-g-i)/T	0.650	0.914	0.466	0.897	0.455	0.893	0.520	0.826

Tables 4 and 5 are summaries of unclipped and fin-clipped fish that either did or did not fall back at Columbia or Snake River dams during migration. We included these comparisons because of the reasonably well established link between fallback and reduced Hydrosystem escapement and the concern that some effects of Hydrosystem passage carry over to the migrations upstream from Lower Granite Dam. In general, both unclipped and fin-clipped fish that fell back during migration had lower escapement estimates upstream from Lower Granite Dam than their counterparts that did not fall back (Tables 4 and 5). Note that sample sizes for fallback fish were small (*n* = 14-23) for the unclipped groups, and that conclusions should be tempered by this restriction. We also note that fallback likely occurs for a variety of reasons, including operations at dams, poor individual fish fitness, juvenile experiences (i.e. we have seen much higher fallback by transported fish), and other factors. Fallback may be a symptom rather than a cause of lowered escapement for the study groups. To better understand the escapement patterns presented here, we recommend that follow up analyses consider migration timing, passage times in the Hydrosystem, and both temperature and flow exposure histories.

Table 4. Estimated fates and final locations of **unclipped** radio-tagged spring–summer Chinook salmon that passed Lower Granite Dam and **did or did not fall back (FB)** during migration through the hydrosystem.

	Unclipped spring-summer Chinook salmon							
	2000	2000	2001	2001	2002	2002	2003	2003
	FB	no FB	FB	no FB	FB	no FB	FB	no FB
a) Snake unknown	1	1		2		1	2	3
b) Snake harvest								
c) Tributary harvest	2	2	1	6	2	6	1	14
d) Hatchery/weir	5	11		22	3	24	2	6
e) Secondary tributaries	4	26	14	112	13	63	11	86
f) GRR/IMR mainstem	2	10	3	35	3	17	2	13
g) CWR: mouth to SF				5	2	4		2
h) CWR: above SF		1				2		
i) SAL: Riggins to NF				9		1	1	5
j) SAL: above NF		5		15		8	1	12
T) Total	14	56	18	206	23	126	20	141
(T-a)/T	0.929	0.982	1.000	0.990	1.000	0.992	0.900	0.979
(T-a-b-c)/T	0.786	0.946	0.944	0.961	0.913	0.944	0.850	0.879
(T-a-b-c-g)/T	0.786	0.946	0.944	0.937	0.826	0.913	0.850	0.865
(T-a-b-c-g-i)/T	0.786	0.946	0.944	0.893	0.826	0.905	0.800	0.830

Table 5. Estimated fates and final locations of **fin-clipped** radio-tagged spring–summer Chinook salmon that passed Lower Granite Dam and **did or did not fall back (FB)** during migration through the hydrosystem.

	Fin-clipped spring-summer Chinook salmon							
	2000	2000	2001	2001	2002	2002	2003	2003
	FB	no FB	FB	no FB	FB	no FB	FB	no FB
a) Snake unknown	2	1	3	5	1	2	3	4
b) Snake harvest		1		5				
c) Tributary harvest	16	28	13	81	17	59	8	31
d) Hatchery/weir	23	52	6	41	11	37	6	28
e) Secondary tributaries	11	17	8	60	8	28	10	26
f) GRR/IMR mainstem	1			5	1	4		5
g) CWR: mouth to SF	5	3	4	6	6	4		6
h) CWR: above SF	1	1	1	3	1	2		1
i) SAL: Riggins to NF		1	3	22	7	14	6	13
j) SAL: above NF							1	
T) Total	59	104	38	228	52	150	34	114
(T-a)/T	0.966	0.990	0.921	0.978	0.981	0.987	0.912	0.965
(T-a-b-c)/T	0.695	0.712	0.579	0.601	0.654	0.593	0.676	0.693
(T-a-b-c-g)/T	0.610	0.683	0.474	0.575	0.538	0.567	0.676	0.640
(T-a-b-c-g-i)/T	0.610	0.673	0.395	0.478	0.404	0.473	0.500	0.526

Particular interest has been raised regarding harvest of unclipped salmon, as these are the focus fish for the Snake River ESUs. Table 6 summarizes the numbers and percentages of unclipped fish that were reported harvested as well as the distribution of harvest among sites. We wish to reiterate that the samples were not completely random and some tagging bias may have occurred. Any bias appears to be small, however, as 59% (*n* = 20 of 34) of the harvested unclipped fish were randomly-collected (no juvenile PIT tag) and another 29% (10) were from mixed stock juvenile tagging at Lower Granite Dam; 1 (3%) was PIT-tagged at Lower Monumental Dam and only 3 harvested fish were PIT tagged as juveniles in upper basin tributaries (1 each in the Clearwater, SF Salmon, and mainstem Salmon).

Table 6. Harvest summary for **unclipped** radio-tagged spring–summer Chinook salmon that passed Lower Granite Dam.

	2000	2001	2002	2003	Total
Total *n*	70	224	149	161	604
Sport	1 (1.4%)	4 (1.8%)	5 (3.4%)	8 (5.0%)	18 (3.0%)
Tribal	3 (4.3%)	3 (1.3%)	2 (1.3%)	5 (3.1%)	13 (2.2%)
Unknown harvest type			1 (0.7%)	2 (1.2%)	3 (0.5%)
Total	4 (5.7%)	7 (3.1%)	8 (5.4%)	15 (9.3%)	34 (5.6%)
SF Salmon	3 (4.3%)	2 (0.9%)	4 (2.7%)	5 (3.1%)	14 (2.3%)
Little Salmon/Rapid		4 (1.8%)	3 (2.0%)	7 (4.3%)	14 (2.3%)
SF Clearwater	1 (1.4%)		1 (0.7%)	1 (0.6%)	3 (0.5%)
Other		1 (0.4%)		2 (1.2%)	3 (0.5%)