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 September 2007

To: David Clugston, USACE
From: Matt Keefer and Chris Peery (University of Idaho)

Re: Estimates of pinniped predation at Bonneville Dam on specific Chinook salmon stocks

Introduction: Increasing pinniped abundance and predation on salmonids in the Bonneville tailrace has elevated concern about impacts on ESA-listed stocks. Estimated take for all salmonids between 1 January and 31 May have been 0.3% (2002), 1.1% (2003), 2.0% (2004), and 4.1% (2007) (Stansell 2004; Stansell et al. 2007). Pinnipeds also take other species in good numbers at times, such as adult lamprey and sub-adult sturgeon. During late winter and early spring, steelhead are the most available salmonid prey, but spring Chinook salmon are most abundant by early to mid-April. Spring Chinook salmon make up 90-99% of the salmonids counted at the dam from mid-April through late May.

Pinnipeds tend to be present in low but relatively constant numbers through late March, after which numbers rapidly increase coincident with the spring Chinook run. Estimating impacts on listed spring Chinook salmon (upper Columbia River spring, Snake River spring–summer) is difficult for several reasons: 1) listed and unlisted stocks are well mixed at Bonneville Dam, 2) both pinniped and available Chinook numbers change daily, 3) daily predation rate estimates are imprecise, 4) it is unknown how many non-Chinook salmonids (primarily steelhead) are available in the tailrace, and 4) it is usually impossible to identify species of salmonid being consumed.

In this summary, we make some very general comments on the potential for different predation impacts on the various spring Chinook salmon stocks. We use preliminary pinniped data from 2007 that were reported in Stansell et al. (2007) and provided by USACE. The specific metrics we use are the minimum daily estimates of pinniped abundance and daily salmonid predation estimates (Figures 1 and 2 in Stansell et al. 2007). Estimates of spring Chinook stock composition and migration timing are from the adult salmon radiotelemetry project from the 1996-2001 study years. These data have been reported in greater detail in Keefer et al. (2004).

Methods, Results, and Discussion: The 2007 spring Chinook salmon run was somewhat later than average, but followed a fairly typical distribution pattern (Figure 1). As in other years, pinniped numbers observed at the dam (considered a minimum number since some pinnipeds could have been missed during surveys) tracked the spring Chinook dam count reasonably closely; no pinnipeds were observed in the tailrace after 25 May.

Three metrics we considered useful for evaluating predation were 1) the number of Chinook counted per pinniped number, 2) the number of salmonids caught per the pinniped number, and 3) the number of salmonids caught per salmonids counted each day (Figure 1). The first metric is an approximation of the number of Chinook salmon available to pinnipeds each day. In 2007, there were very few Chinook salmon per pinniped early in the migration and the ratio steadily increased as the season progressed, though with a dip at the highest pinniped abundance in early May. The second metric

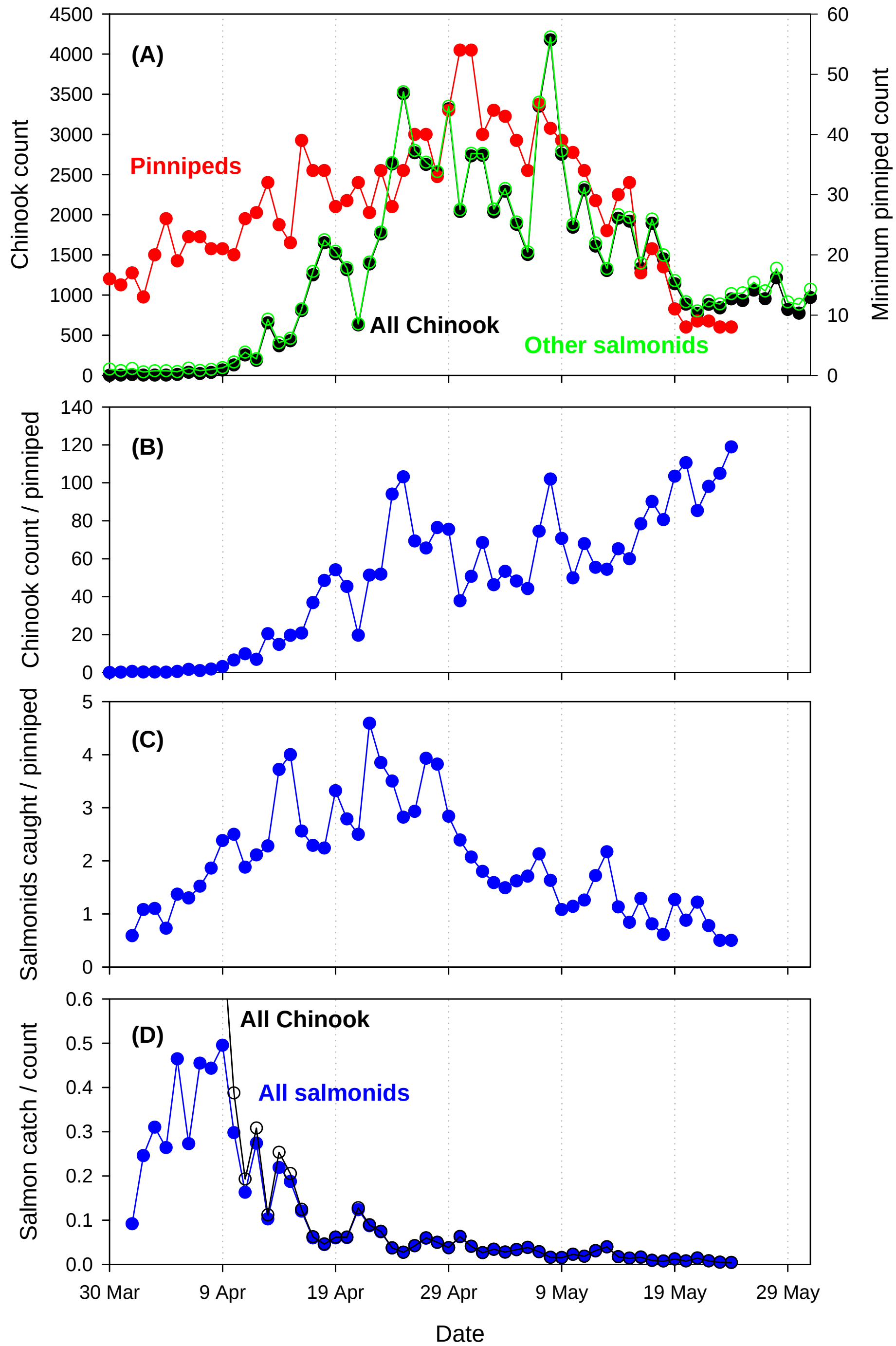

Figure 1. (A) Daily Chinook and total salmonid counts at Bonneville Dam fish ladders and daily minimum estimates of pinniped abundance in the tailrace in 2007. Pinniped data are from Stansell et al. (2007). (B) Daily ratio of the numbers of Chinook salmon counted to the minimum number of pinnipeds present. (C) Daily ratio of the number of salmonids caught per pinniped present. (D) Ratios of the number of salmonids caught to the total salmonid count and total Chinook count.

gives an indication of predation efficiency, though this depends on the accuracy of the pinniped catch estimates. In 2007, the highest predation efficiency appeared to be in mid- to late April before the peak in pinniped numbers (Figure 1). Somewhat surprisingly, predation efficiency declined as the ratio of Chinook count:pinnipeds increased through May. It is not clear whether this reflected unmeasured predation, reduced pinniped effort (i.e., due to saturation feeding), pinniped competition for feeding sites, or some other factor.

The third metric shows the relative predation impact on all salmonids (or Chinook only). Several potentially important patterns emerged with this measure. First, the ratios for all salmonids and for Chinook only are nearly identical from about 10 April through the end of May (Figure 1). This suggests that pinnipeds likely switch prey from steelhead to Chinook salmon during this period. Second, the impact is highest in early April -- in fact, about five times higher than during most of the rest of April and May. Average estimates were 0.332 for the first half of April, 0.063 for the second half of April, 0.027 for the first half of May, and 0.009 for the second half of May. Third, the impact appears to gradually decline throughout the latter half of the migration. Finally, the greatest variability in this metric is also early in April. This is not surprising given the relatively low numbers of both salmonids and pinnipeds during this time, but also raises some questions about reliability.

The ratios derived from the pinniped, predation, and count data suggest that the largest predation risk is likely for the earliest migrants. Although spring Chinook salmon stocks are well mixed, the earliest migrants in the telemetry studies (on average) were from the Salmon (Little Salmon), Clearwater (South Fork, Lolo Creek, Lochsa) and Icicle River drainages (Keefer et al. 2004). When lumped by major river basin, Salmon and Clearwater fish were the most abundant in the first week of April in the 1996-2001 data (Figure 2); lower Columbia stocks (Wind, Little White Salmon, Deschutes, John Day) were most abundant in early April in 1996-2000. The 1996-2000 years had fewer fish from upstream populations than 2001 or several more recent years, but were also more random samples. We did not detect strong seasonal patterns in hatchery:wild ratios in the telemetry study (i.e., unclipped fish were not disproportionately abundant early in the migration), though there were many unclipped hatchery fish in those study years. (Note: adult PIT tag detections at Bonneville in 2007 supported the general patterns described for the telemetry data. Namely, the earliest migrants were primarily from the Snake River [e.g., Dworshak and Rapid River hatcheries and some wild groups] and Carson Hatchery on the Wind River. There were also a few fish from the Leavenworth and Entiat hatcheries. Importantly, the PIT data represent only a few populations.)

It is probably reasonable to conclude that the earliest spring Chinook are at the greatest individual risk of predation. However, we were also interested in whether the relatively high early risk had a detectable influence on overall estimates given that the majority of the run passes when impacts are relatively low. We calculated a unit-less impact estimate by multiplying mean weekly predation ratios (from D on Figure 1) by weekly stock-specific percentages from the 1996-2001 telemetry data (these show the abundance of each stock through time, independent of other stocks). These were summed for each population separately and then standardized: a value less than 1.00 indicates lower than average predation impact and a value greater than 1.00 indicates above average impact. The results of this exercise were consistent with our general sense of run timing and the predation patterns: stocks with earlier than average timing likely experienced more predation than later-timed stocks (Table 1). The highest estimates were for South Fork Clearwater (1.48), Little Salmon (1.47) and Lochsa (1.37) groups. The lowest were for South Fork Salmon (0.22), Klickitat (0.64) and Imnaha (0.65) stocks -- each of which has relatively large late-timed groups.

Conclusion: Although based on the best available information, we caution that these results are very qualitative. We used only one year of pinniped information (2007) and the average of a different set of years for stock timing information. We would expect that the general patterns described are likely valid in individual years, but variability among years is potentially large. The largest unknown, from our point of view, is the dependability of our predation estimates and ratios. Both pinniped abundance and their predation rates almost certainly differ from year to year in response to run size and environmental conditions. A more thorough analysis, including pinniped abundance and catch data from previous years would certainly help refine the results. Such a summary may be possible if these data are available. Stansell et al. may also have more appropriate metrics for evaluating predation estimates, and we suggest follow-up analyses should be in close consultation with him or someone closely involved with that research effort.

In summary, it does appear that there is the potential for differential pinniped predation among spring Chinook salmon stocks in the tailrace of Bonneville Dam. Early-timed stocks, like those returning to some Clearwater and Salmon River drainages in Idaho, are likely at higher risk than those returning later in the run. Over time, it is conceivable that relatively high early season predation will have population-level impacts on some stocks.

Keefer, M.L., Peery, C.A., Jepson, M.A., Tolotti, K.R., and Stuehrenberg, L.C. 2004. Stock-specific migration timing of adult spring-summer Chinook salmon in the Columbia River basin. N. Am. J. Fish. Manag. **24**:1145-1162.

Stansell, R.J. 2004. Evaluation of pinniped predation on adult salmonids and other fish in the Bonneville Dam tailrace, 2002-2004. Technical Report. US Army Corps of Engineers.

Stansell, R.J., Tackley, S., and Gibbons, K. 2007. Status report – pinniped predation and hazing at Bonneville Dam in 2007. Preliminary Report.

Table 1. Estimated (unit-less) impacts of pinniped predation on spring Chinook salmon stocks.

Stock	Impact	Stock	Impact
Wind	0.96	All Clearwater	1.16
Little White Salmon	0.81	SF Clearwater	1.48
White Salmon	0.93	Lochsa	1.37
Klickitat	0.64	Grande Ronde	1.09
Deschutes	1.11	All Salmon	1.05
John Day	1.10	Little Salmon	1.47
Yakima	0.86	SF Salmon	0.22
Upper Columbia	1.07	Imnaha	0.65

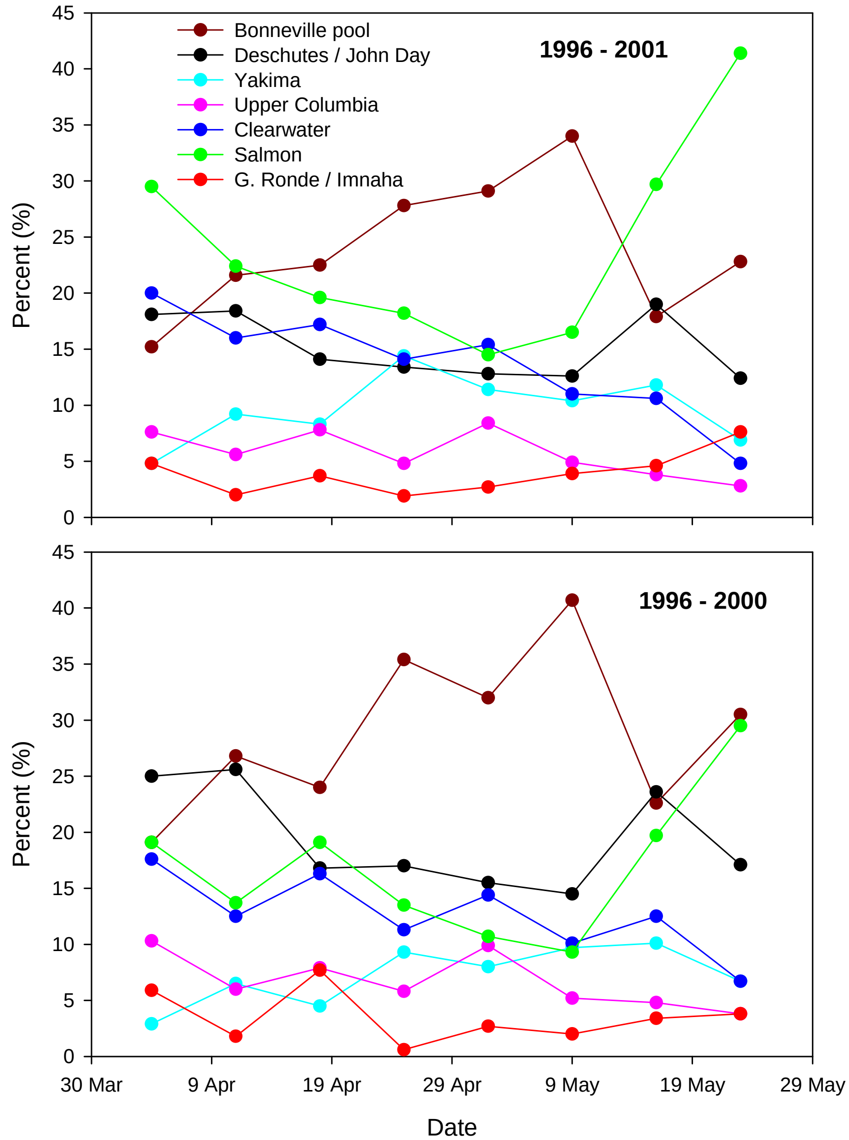

Figure 2. Weekly stock composition estimates at Bonneville Dam, lumped by major sub-basin and averaged across years. Estimates are based on successful migrants from the radiotelemetry studies. Samples were nearly random (i.e., no known-origin fish) in 1996-1998 and 2000; the 2001 sample included known-origin fish, which were principally from upper basin populations.