# APPENDIX 1

## Steelhead Abundance in Lapwai Watershed

The importance of the Lapwai watershed steelhead population to the Clearwater-Lower Mainstem (CRLMA) depends on several population parameters. Measurement or estimation of the population abundance and growth rate of Lapwai watershed steelhead relative to those of other sub-basins in the CRLMA is required to assess the overall importance of Lapwai watershed to the CRLMA (McElhany et al. 2000). Unfortunately, there is very little historical data describing steelhead abundance and population growth in the watershed (Lohn, 2006). Some anecdotal evidence suggests that the streams in Lapwai watershed were historically important producers of anadromous steelhead. Until about 30 years ago the Nez Perce Tribe operated a steelhead snag fishery in Mission Creek. The number of fish removed from this operation suggests that large numbers of adult steelhead were returning to Mission Creek to spawn (Johnson and Stangl 2000). In another anecdotal report, the Lewiston Morning Tribune documented numerous steelhead killed in a flash flood in late April, 1986. While these reports suggest that steelhead were historically present and perhaps abundant in Lapwai watershed, they do not offer the kind of information required to develop even a rough estimate of historic steelhead abundances or population growth rates. To overcome this dearth of historical data, later in this paper we present a model which considers realistically-bound sub-basin-specific estimates of population growth rate to estimate the importance of Lapwai watershed to the CRLMA.

More recent studies allow us to make more direct estimates of the current total abundance of steelhead in Lapwai watershed. Chandler and Parot (2003) and Chandler (2004) conducted a spatially extensive study of the abundance of steelhead throughout the watershed. They conducted electrofishing passes on every stream kilometer along Lapwai, Mission, Sweetwater, and Webb Creeks. The methods used (single pass electrofishing and no block nets) offered only a relative estimate of abundance in these streams. But we combined the data from Chandler and Parot (2003) and Chandler (2004) with unpublished data collected in 2008 by one of us (Hartson) to produce an estimate of absolute steelhead abundance for all areas of the watershed reachable by anadromous fishes. The estimates of absolute abundance were determined by three pass electrofishing depletion curves on 100 meter stretches of representative stream.

We used 80 point estimates of relative steelhead abundance from Chandler and Parot (2003) and Chandler (2004) and 6 point estimates of absolute abundance from Hartson's data in our analysis. The data from both of these studies were collected in late July and early August. We chose the 6 estimates of relative abundance that were closest in spatial proximity to each of the 6 estimates of absolute abundance and then correlated each pair of measures. We were then able to extrapolate these correlations to the remaining relative abundances to obtain 80 estimates of absolute abundance. We grouped the relative estimates by attempting to maximize spatial proximity to associated absolute measures and minimize differences in the magnitude of the age structured relative and absolute abundance measures. The result was to split the basin into 6 units, each correlated to an absolute abundance measure and grouped to maximize the similarity between the absolute measure and each relative measure in the group. For example, Lapwai Creek had 2 absolute point estimates on it, and we assigned each of the 32 relative measures on Lapwai Creek to one of these two absolute measures based on proximity to the absolute measure as well as similarity in the age structured abundance estimate to the absolute measure. Thus, we had one unit on lower Lapwai that was characterized by low overall steelhead abundances and a second unit on upper Lapwai that was characterized by high steelhead abundances. Both units had age structures similar to the watershed-wide average. The two absolute abundance measures had age structures generally similar to their respective relative measures and the abundances from the first pass of the absolute measures were generally 2 to 4 times higher than the single-pass relative measures, which we might expect since the relative measures did not use block nets. This discrepancy in abundance between the first pass of the absolute measure and the relative measure is also likely reflecting some inter-annual variation. Nevertheless, it appears that for Lapwai Creek the absolute abundance measures from 2008 correspond nicely with the relative measures from 2003. The same can be said of the absolute and relative abundance measures in Mission Creek. Here the relative measures have higher proportions of yearling fish than the basin-wide average, but this is expressed in the absolute measure as well. In Webb Creek, the absolute and relative estimates don't agree as nicely as in Mission and Lapwai Creeks. Here, the absolute abundance from Hartson's data seems to be rather higher than the relative abundances from Chandler (2004). Thus, it is possible our method has misestimated the steelhead population in Webb Creek due to larger inter-annual variations in Webb Creek; however, since this creek supplies only 15% of the total population, a misestimate by a factor of two (which we feel to be on the high side) would increase our watershed-wide abundance estimate by about 8%. In Sweetwater Creek, the overall abundances match the relative abundances as in Lapwai and Mission Creeks, but the age structures differ. The relative abundances indicate a larger subyearling population than the absolute abundances, suggesting that we may have overestimated the yearling abundance in Sweetwater Creek. As discussed below, this could have an effect on our estimate of the number of smolts successfully returning to spawn; however, because the abundances in Sweetwater Creek account for less than 2% of the watershed-wide abundance, this discrepancy has little ability to impact the overall adult return rate. Overall, the estimate we have developed seems to measure abundance accurately, with potential minor exceptions in Webb and Sweetwater Creeks, which we have argued will not affect our basin-wide abundance appreciably.

If we make some simple assumptions about the proportion of anadromy and the survival of smolts to adulthood in Lapwai watershed, we can create a rough estimate of the input of Lapwai watershed steelhead to the entire CRLMA population. We will assume that the Lapwai watershed steelhead population is largely dominated by anadromous individuals. The high relative abundance of subyearling fish and near zero abundance of fish aged 2 years or older (Hartson, unpublished data; Chandler and Parot, 2003) supports this assumption. Based on historic measures of the age structure of smoltifying steelhead in the Clearwater basin (Whitt, 1954), we assume the proportion of each age class smoltifying is 15%, 75%, and 90% for subyearlings, yearlings, and fish aged 2 years or older respectively and we estimate survival of smolts to spawning age as 0.02, 0.04, and 0.08 for subyearlings, yearlings, and fish aged 2 years or older respectively. Under these population parameters, we expect the Lapwai watershed as a whole to return 1191 spawning adults (table 1). When we compare this number to our estimate from the previous section that adult returns to the CRLMA over the last 10 years have averaged 3320 individuals, we estimate that the Lapwai watershed produces around 36% of the total CRLMA returning adult steelhead population. We conclude that, despite its relatively small size, Lapwai watershed appears to be a very important source of anadromous steelhead and that failure of this fishery could potentially produce a noticeable effect on the steelhead population in the CRLMA.