Susitna-Watana Hydroelectric Project
(FERC No. 14241)

River Productivity Study
(Study 9.8)

Fish Diet Sample Size Sufficiency Analysis Technical Memorandum

Prepared for

Alaska Energy Authority

Prepared by

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LIST OF ACRONYMS AND SCIENTIFIC LABELS

Abbreviation	Definition
AEA	Alaska Energy Authority
FA	Focus Area
ISR	Initial Study Report
RSP	Revised Study Plan
TM	Technical Memorandum

1. BACKGROUND

The River Productivity Study Revised Study Plan (RSP) (AEA 2012) proposed to conduct a trophic analysis to describe the food web relationships within the current riverine community within the Susitna River. To achieve this objective, the RSP proposed to sample the stomach contents of juvenile Chinook salmon, juvenile coho salmon, and two size classes of rainbow trout. The RSP established a target sample size (*n*) of eight fish per species and size class, within each sampling site, during each season. This sample size target was selected because estimates of the diet composition of salmonids often stabilize between n = 7-12 stomach content samples (Beauchamp et al. 2007, Vinson and Budy 2011). We selected n = 8, at the low end of this range, because the study objectives were focused on quantifying the broad dietary patterns (e.g., distinguishing among aquatic invertebrates, terrestrial invertebrates, and marine derived food such as salmon eggs) across a large number of sampling sites, rather than comprehensively identifying all prey taxa within any given site. Further, the study also included a stable isotope analysis to provide a complementary estimate of diet composition. One advantage of stable isotope analysis is the ability to quantify diet composition with relatively few samples, because each sample integrates the food assimilated into the consumer's tissue over a period of weeks to months (Fry 2006, Hanisch et al. 2010). The River Productivity Study collected stomach contents and stable isotope samples from the same individual fish, which is an especially effective approach to quantify dietary patterns (McIntyre et al. 2006, Vinson and Budy 2011).

This technical memorandum (TM) describes an analysis conducted after field sampling was completed to determine whether the sample size targets and the actual sample sizes were sufficient to meet the objectives. Field sampling during 2013 did not collect the full eight samples for each species during many sampling events, as described in the Initial Study Report (ISR) (AEA 2014). This was due both to logistical difficulties that prevented all sites from being sampled and also to the apparent absence or very low densities of the study species at some sites that were sampled, especially in the main channel. To determine whether this dataset was sufficient to quantify fish diet composition, we analyzed the 2013 stomach content data using cumulative prey curves. Field sampling during 2014 achieved the sample size target at many more sites with a total of 449 additional fish collected. However, the stomach content data were in the early quality control stage during the preparation of this TM, so they are not included here.

In response to the October 2014 ISR meetings, AEA informed the licensing participants that AEA would be filing this TM with the Federal Energy Regulatory Commission ahead of the January 2015 ISR meetings.

2. ANALYSIS METHODS

Cumulative prey curves were used to determine whether sample sizes were sufficient. This approach plots the cumulative number of randomly pooled stomach content samples on the *x*-axis, with the cumulative number of prey types on the *y*-axis. The point at which the curve stabilizes indicates the minimum number of stomach content samples necessary to characterize diet composition (Cortes 1997, Chipps and Garvey 2007). Cumulative prey curves were generated for each study species, at each sampling site, in each season. The order of stomach

content samples was randomized. Prey types were categorized following the methods of the overall diet composition analysis. Prey types were identified to the family level for invertebrates and to species level for fish when possible. Fish eggs were counted as a separate prey item. Due to the large number of curves representing every combination of sites and seasons, all curves were combined into a single figure for each species, and each curve was adjusted slightly up or down to show overlapping data points. To aid in interpreting the multiple curves per species, the mean increase in prey types per additional sample was also calculated.

3. RESULTS AND INTERPRETATION

The cumulative prey curve analysis indicated the sample size target of $n = 8$ was likely sufficient to adequately quantify diet composition in this study (Figure 1). Overall, the number of prey types stabilized as sample sizes approached eight for all three species. Some individual curves stabilized at lower sample sizes, suggesting that smaller samples sizes ($n = 4$-7) may have been adequate at certain sites during certain seasons. Individual curves stabilized at different numbers of prey types, ranging from 2-16, suggesting that diet breadth differed between sites and seasons. The mean increase in cumulative prey types (indicated by the red lines in Figure 1) fluctuated due to random variability but approached zero as the number of samples approached $n = 8$, providing further support for the adequacy of this sample size to achieve the study objectives.

These cumulative prey curves were interpreted with caution because the target sample sizes were not met during several sampling events in 2013. Repeating this analysis with the more complete 2014 dataset will be important to confirm these findings. However, based on the data currently available, the study design was likely adequate to achieve the objectives of the River Productivity Study, especially considering the additional information provided by the stable isotope analysis.

4. PLANS FOR FURTHER ANALYSIS

A similar cumulative prey curve analysis will be conducted using the 2014 stomach content data and included in the Updated Study Report. The USR will also include a comprehensive evaluation of the adequacy of the combined stomach contents and stable isotope datasets to meet the study objectives.

5. LITERATURE CITED

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6. FIGURES

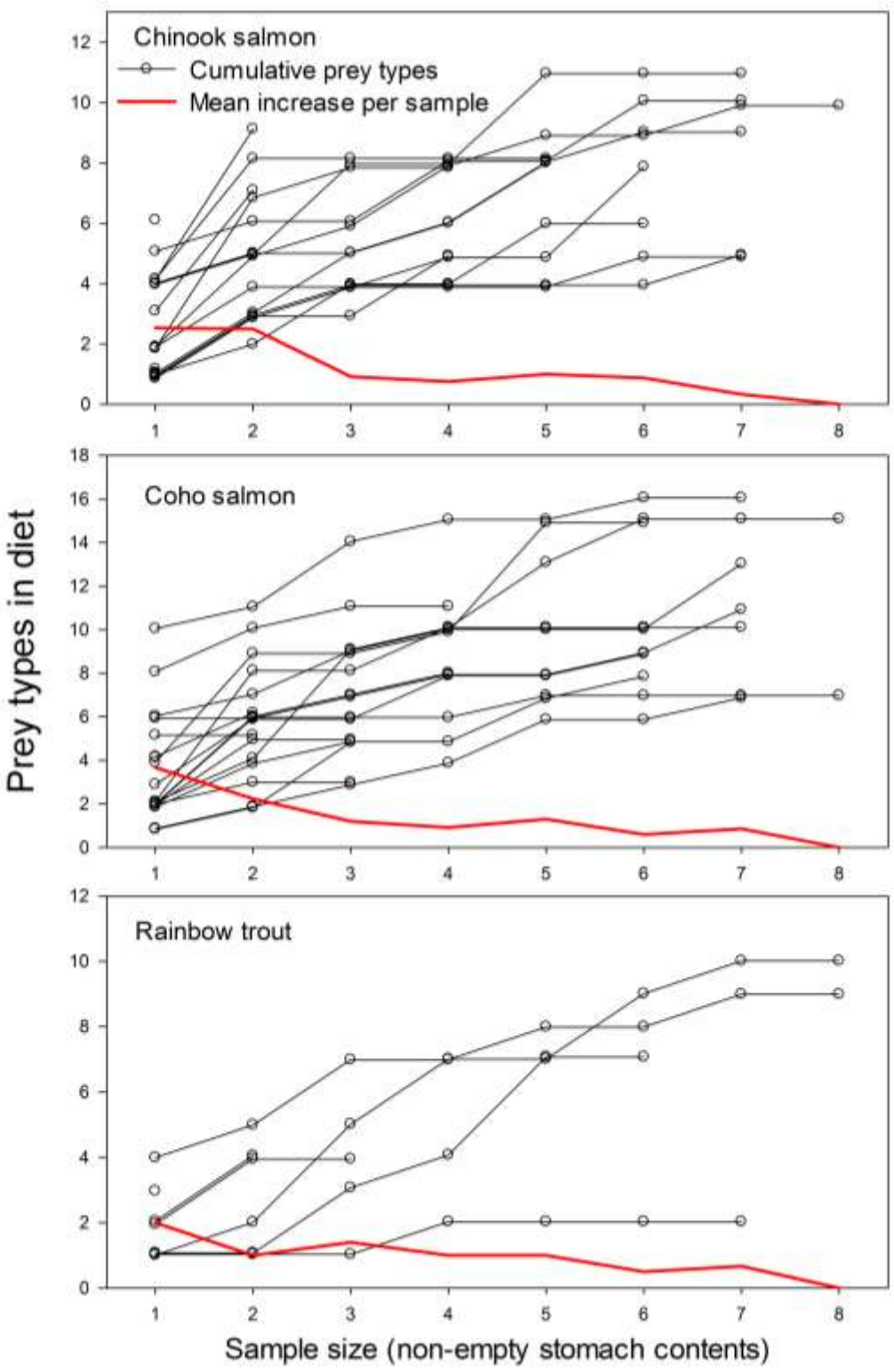

Figure 1. Cumulative prey curves for Chinook salmon, coho salmon, and rainbow trout sampled during 2013.