Macroinvertebrate Abundance in the Eklutna River, AK: an Estimate of Food Supply for Rearing Salmonids

Draft Report of Findings

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Introduction

Salmon are a valuable resource in Alaska, providing subsistence, economic benefits, and recreational opportunities for many residents. Through proper management and enhancement actions, the production of salmon can be increased, thus increasing the value of the resource. Though enhancement is often an effective tool for increasing salmon production, not all deficiencies can be addressed using standard methods. The Eklutna River is currently being studied by the Army Corps of Engineers to determine the feasibility of restoration efforts to enhance salmon production in the river. This study investigates the current food supply for juvenile salmon in the Eklutna River to determine if the river could in fact support increased salmon production. In addition, we have identified several restoration actions that we feel will increase the production capacity of the river.

Methods

Study Area

The Eklutna River is located in southcentral Alaska, approximately 25 miles north of Anchorage. The river is ultimately fed by a series of glaciers in the Chugach Mountains, and is impounded to form the reservoir from which Anchorage receives its drinking water. This study examined the lower river, which was divided into 5 separate study reaches.

Benthic Sampling

We collected quantitative samples from 5 study reaches along the river during May of 2007. With the exception of Reach 2, 20 samples, each representing $1ft^2$ of substrate surface, were collected from each of the dominant habitats using a surber sampler or a standard D-net. These samples were composited for each habitat in each reach, and preserved in 70% ethanol for laboratory identification. We used a Hess sampler to collect 5 samples from each habitat in Reach 2 due to the prevalence of soft substrates. In addition to benthic samples, pH, conductivity, and water temperature were recorded for each sample reach (table 1).

In the laboratory, samples were subsampled to 300 organisms using 350μ gridded subsampler trays. Insects in Ephemeroptera, Plecoptera, Trichoptera, and Diptera were identified to level or lower (Merrit and Cummins, 1996). Other orders and all non-insects were identified at higher taxonomic levels. Estimations of benthic invertebrate abundance by habitat in each reach were calculated and these values were then compared to abundances for other local rivers known to support significant returns of salmon. In addition, taxa were assigned a palatability rating of low, medium, or high based upon known Salmonid feeding preferences (Glova 1984; Sagar and Glova 1987; Amundsen et al. 1999) and the abundance of each class compared by reach and habitat.

Drift Sampling

Drifting macroinvertebrates were sampled in 4 of the 5 reaches during June of 2007 using a series of 3 drift nets deployed across the river. Reach 2 was not sampled for drift because the current was insufficient to allow accurate collection. All nets for a given reach were deployed simultaneously and the sampling time recorded. Generally, nets were allowed to sample for a half-hour; however, in reach 5 it was necessary for the nets to sample a full hour due to the low volume of drift. Nets were deployed in the same locations twice in each reach and samples for each period composited and preserved for laboratory identification. Each time the nets were deployed, the flow and water depth was measured directly in front of each net. In addition, discharge was calculated for each reach while the nets were sampling.

In the laboratory, drift samples were processed in the same manner as the benthic samples except that terrestrial invertebrates were identified to the order level. These data where then used to calculate the rates of macroinvertebrates drift in the water column as numbers of organisms being carried past a given point every second.

Results/ Discussion

Benthic

Average benthic density of macroinvertebrates varied widely between reaches; ranging from approximately 67/ft^2 in Reach 4 to over 350/ft^2 in Reach 2 (fig. 1). While the differences between reaches can be explained in part by the inherent variability of macroinvertebrate communities, the habitats sampled and the dominant taxa collected in each reach also provide insight. Reach 2 samples were all taken from pond/slough habitats and consisted almost entirely of Ostracoda, Sphaeriid clams, and Chironomids; of which, the former two are likely unimportant to salmonids due to their size, indigestibility, and tendencies to be obscured in fine sediments. Of the samples taken from flowing reaches, Thunderbird Creek had the highest densities, likely a result of reduced silt, increased flow, and presumably increased dissolved oxygen relative to the mainstream. Reach 5 was expected to have a lower average density due to its high turbidity; however it did not, possibly due to the large number of habitats sampled relative to other reaches. In figure 1 it is evident that if only the riffle and run samples were examined for the three Eklutna mainstream reaches there would be a gradual increase in benthic density towards downstream reaches.

Figure 2 classifies the composition of each reach's benthos by the assigned palatability ratings. While there is some variation in the palatability between reaches, it is evident that most samples were composed largely of high palatability taxa, with the exceptions of reaches 2 and 5, which were primarily made up of medium palatability taxa. Figure 3 shows the same classification of composition for each habitat type sampled, and it is apparent that the samples taken from the pool and pond/slough habitats tend to have a lower proportion of high palatability taxa. These differences between habitats help to explain the low proportions of high palatability taxa in reaches 2 and 5 as those were the only reaches in which pool and pond/slough habitats were sampled. Based upon these results, it appears that the habitats in which juvenile salmon are most likely to actively feed (riffles, runs, and LWD) support populations of primarily high palatability macroinvertebrates, and thus those benthic populations are a potential food source for juvenile salmon. However, the reduced proportion of highly palatable prey in the pool and pond/slough habitats may still play a role in determining the over-wintering capacity of the river. However, it must be noted that a summer sampling effort does not necessarily reflect year-round food availability.

River Comparison

Due to the inherently high variance in estimates of macroinvertebrate densities, even between samples taken from the same reach, it is difficult to compare measurements from different streams and attain reliable results. However, when accounting for variation, the benthic densities measured in the Eklutna River are similar, though at the lower end of the range, to those from other local rivers known to support significant salmon returns (fig. 4). Though this does not definitively show that the river could support increased salmon production, it does indicate that food availability is not likely to be a limiting factor.

Drift

The macroinvertebrate drift rates ranged from approximately 1 organism per second in Reach 5, to 40 organisms per second in Thunderbird Ck. (fig. 5).

Conclusions

Chum and pink salmon populations are generally limited by the amount and quality of spawning habitat, since these species migrate to sea upon hatching. Coho and chinook, conversely, rear in freshwater habitats for extended periods (i.e., 2 or more years). In most streams, far more fry hatch in any given year than can be supported by the habitat (i.e., spawning habitat is not a limiting factor). As such, these populations are typically limited by the interplay of food availability and instream cover. During summer months, when somatic growth is most rapid, juvenile coho and chinook establish feeding territories from which competing fishes are excluded. When both food and cover are abundant, individuals will tend to establish smaller feeding territories that, in turn, permit a larger overall population. Since ocean mortality rates are typically much lower than instream mortality rates, increased instream carrying capacity generally leads to increased numbers of returning adults.

We cannot say definitively whether coho and chinook populations are limited by spawning or rearing habitat in the Eklutna River. However, it appears as though Thunderbird Creek and, during seasonal periods of clear water, the mainstem Eklutna River likely have adequate spawning habitat to stock this small system. Additionally, based on comparisons with nearby salmon streams, food supplies in the Eklutna River seem adequate to support larger populations; however, the low drift rates indicate that much of this prey may not be easily available to juvenile salmon, which feed primarily on drift. Regardless, food resources are not the likely the most limiting factor; the Eklutna River, particularly in the mainstem, is largely devoid of instream cover. It is our opinion that supplementing instream cover, through the use of logs, boulders, rootwads, brush, etc., would likely increase the salmonid carrying capacity of the Eklutna River. Another habitat feature that is conspicuously lacking in the Eklutna River is off-channel wintering habitat, which is especially important for the survival of juvenile coho salmon. Creating such habitats and/or ensuring the year-round connectivity of current ponds would likely be beneficial.

Appendix 1: Figures

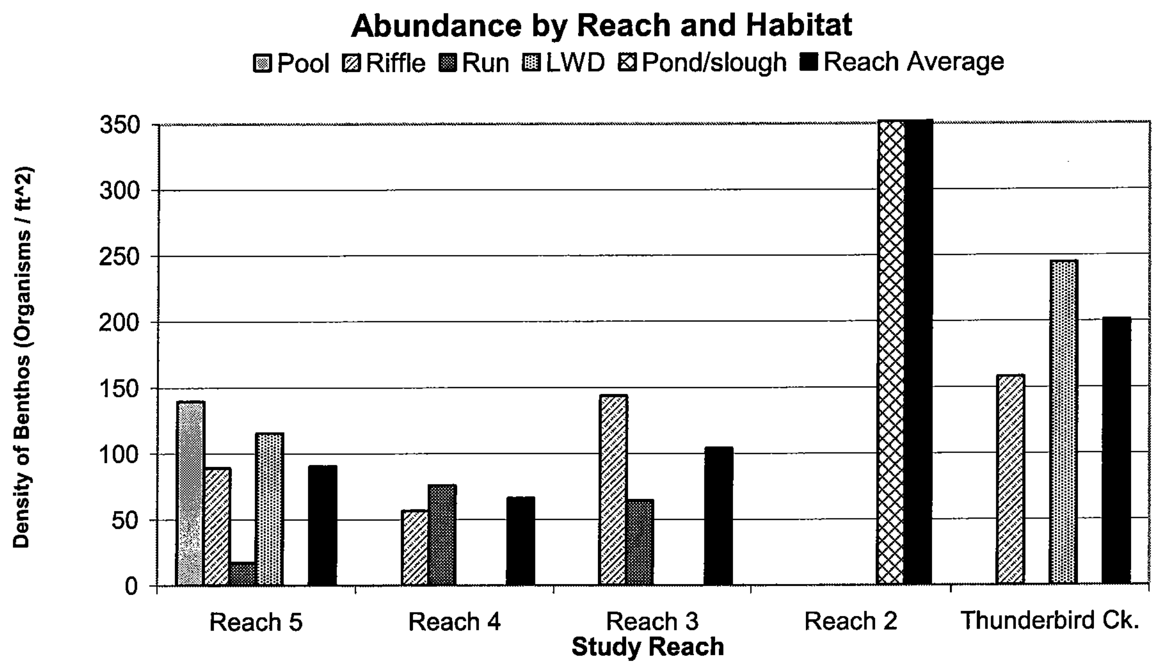

Figure 1: Estimated density of benthic macroinvertebrates by habitat in each reach for the Eklutna River, AK.

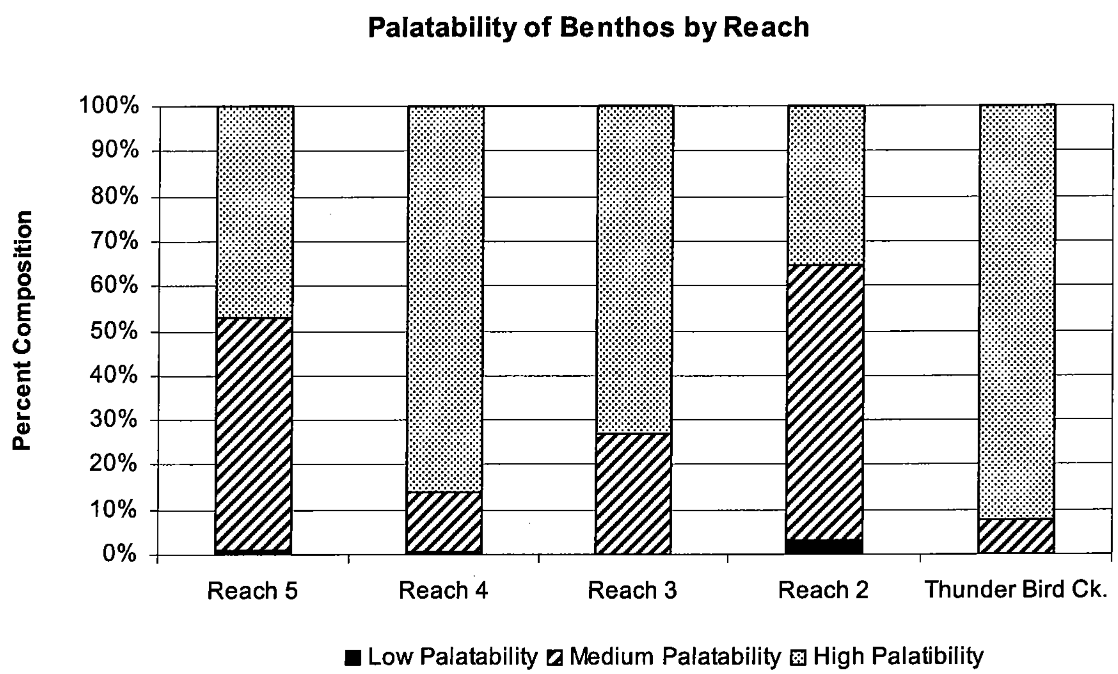

Figure 2: Palatability of benthos by reach in the Eklutna River, AK. Taxa were classified as high, medium, or low palatability based upon published food preferences of juvenile salmonids.

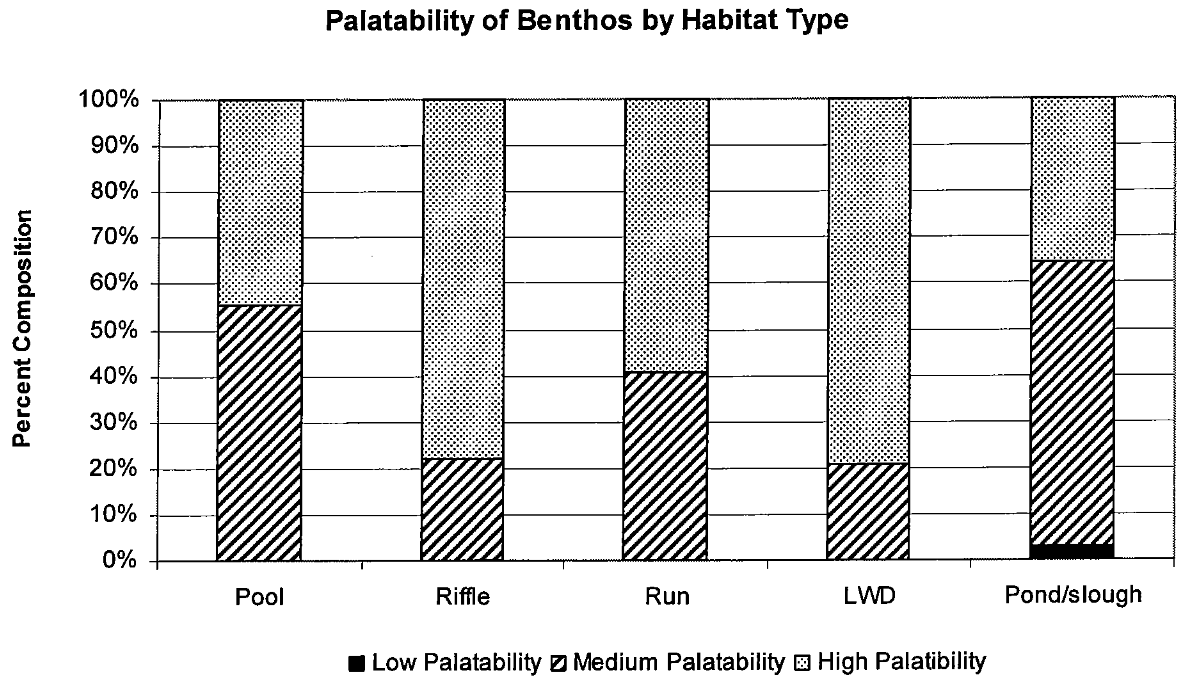

Figure 3: Palatability of benthos in the Eklutna River, AK by habitat type. Taxa were classified as high, medium, or low palatability based upon published food preferences of juvenile salmonids.

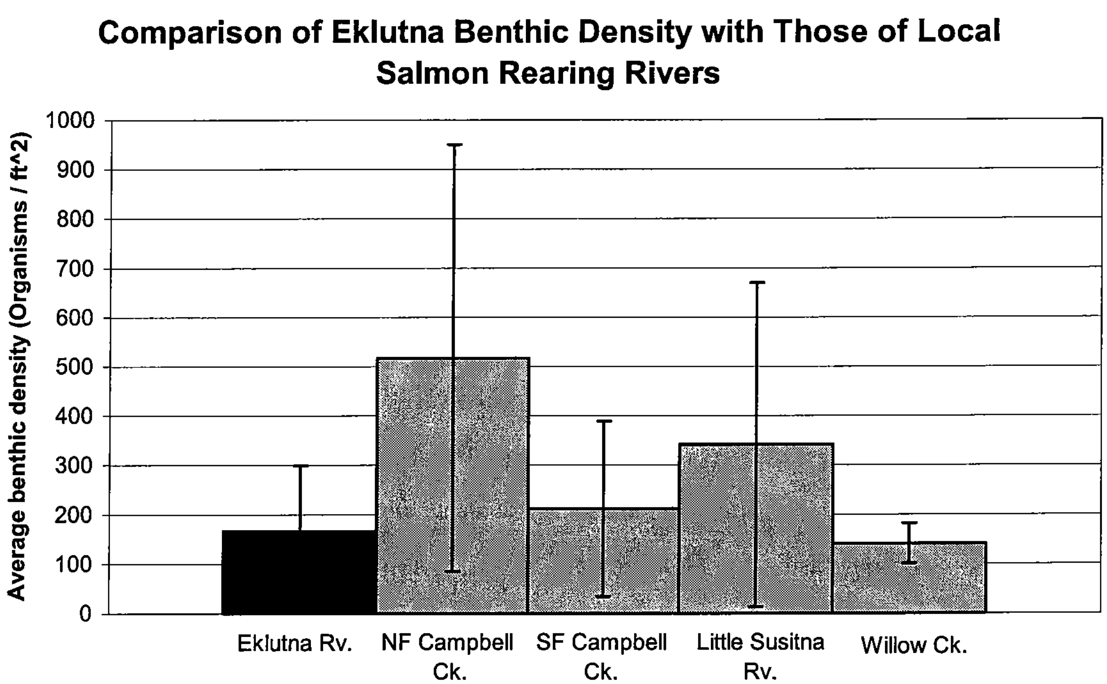

Figure 4: Comparison of the benthic densities of the Eklutna River with those of several local rivers that are known to support significant salmon returns.

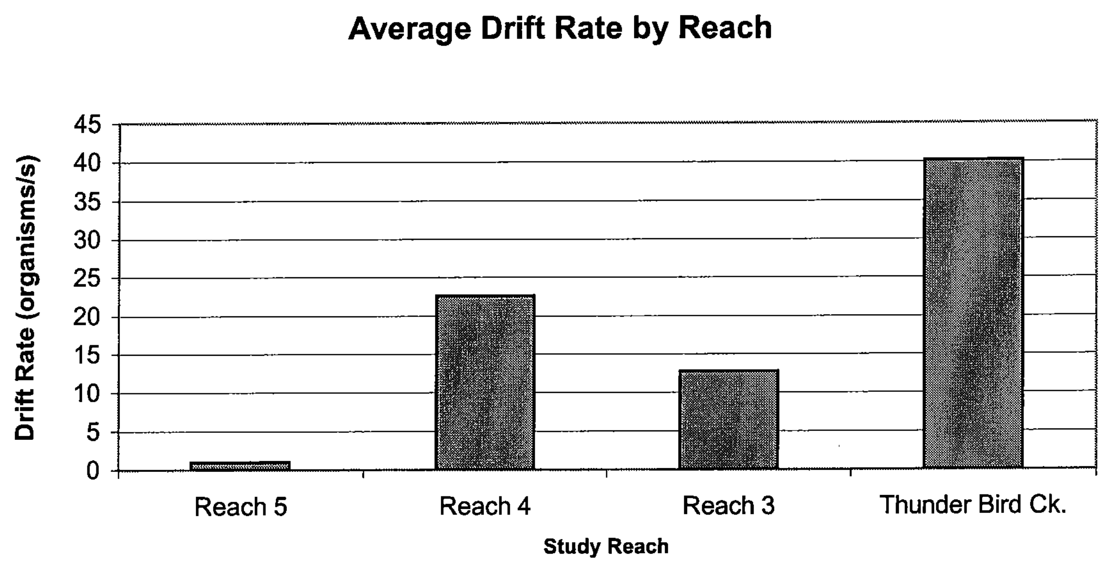

Figure 5: Depicts the average drift rate (the number of organisms passing a given point per second) for each of the 4 reaches where drift was measured.

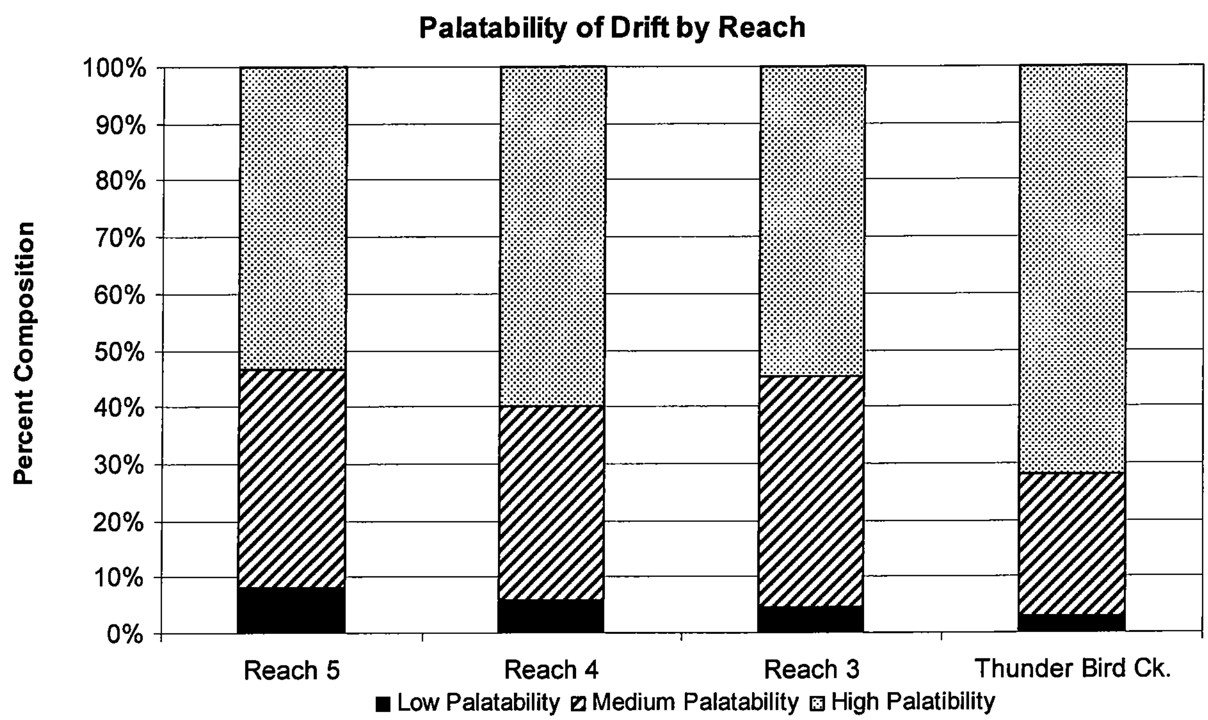

Figure 6: Palatability of drifting macroinvertebrates by reach in the Eklutna River, AK. Taxa were classified as high, medium, or low palatability based upon published food preferences of juvenile salmonids

Appendix 2: Data Tables

Table 1: Summary of physical data for study reaches.

Study Reach	Temp.	pH	Cond.	Discharge (ft3/s)
Reach 5	3.8	8.4	364	5.938
Reach 4	5.3	8.5	368	55.178
Reach 3	5.9	8.4	372	53.850
Reach 2 (pond 1)	8	7.4	405	N/A
Reach 2 (pond 2)	11.2	7.9	425	N/A
Reach 2 (slough)	6.1	8.4	384	N/A
Thunderbird Ck.	4.7	8.4	374	49.260