Project Number: EVOS GEM Project Number: 040726

Project Title: Presence and Effects of Marine Derived Nutrients (MDN) in Stream, Riparian and Nearshore Ecosystems on Southern Kenai Peninsula, Alaska: Developing Monitoring Tools for Tracking MDN in Alaska Watersheds.

Principal Investigators:
Coowe Walker, Watershed Specialist, Kachemak Bay Research Reserve, Homer, AK
Mark Wipfli, Associate Professor, University of Alaska, Fairbanks. AK
Craig Stricker, US Geological Survey, Denver, CO

Time Period Covered by Report: October 2004 – July 2005
Date of Report: August 15, 2005

1. Work Performed

During this fiscal year, we completed analysis of several data sets from our year one (2004) field season, used that information to plan our second year of investigation (2005 field season) and carried out our expanded field sampling (still ongoing). Results from year one indicated: 1) Stream invertebrates, Dolly Varden *(Salvelinus malma)* and vegetation (*Equisetum)* in the North Fork of the Anchor River, which has anadromous salmon runs, had higher levels of marine derived nitrogen (δN^{15}) compared to the same taxa in Happy Valley, which does not have anadromous runs; 2) No obvious pulse of MDN was observed in the North Fork, post-spawning, perhaps due to bear predation, the relative low density of fish, or the effects of the underlying nutrient rich geology; 3) Longitudinal enrichment was noted in both systems and likely indicates increased trophic complexity with stream size regardless of spawning salmon presence. In the 2005 field season, we have expanded the project to seven other stream systems to determine whether or not the North Fork of the Anchor is representative of other MDN subsidized streams in south central Alaska. An Operation Plan, detailing our 2005 field and data analysis plans was completed during the spring of 2005, and was included as an attachment with the third quarter progress report.

Food web sampling and analysis. The objective for this portion of the project is to use stable isotopes, lipid and fatty acid analysis as possible means for understanding how MDN subsidize stream food webs in the continuum from headwaters to stream mouth. The isotope analysis indicates the presence and magnitude of marine derived nutrients; the lipid and fatty acid analyses reveal the fitness effects of MDN.

Sampling. For year two, we expanded our sampling sites to three regions on the Kenai Peninsula: (1) Cooper Landing, (2) north side of Kachemak Bay, and (3) the south side of Kachemak Bay (Figure 1). The Cooper Landing and south side of Kachemak Bay watersheds drain systems with nutrient-poor underlying parent geology and the north side of Kachemak Bay sites are characterized by underlying nutrient-rich geology. Otherwise, all systems are similar to the extent possible (i.e., similar basin area, elevation, channel slope, climate, geomorphology and surrounding land use. One salmon-free reference stream and two salmon spawning streams are being sampled in each region. The reference streams will allow us to ensure that any signal we see in stream food webs is truly a response to MDN and not attributable to natural variability in the system. Performing the same tests in systems with and without anadromous salmon runs will allow us to determine whether the proposed methods are clearly measuring the effects of MDN. The Cooper Landing set consists of the Russian River and Quartz Creek as salmon-bearing streams and Juneau Creek as a salmon-free reference. Juneau Creek has a waterfall approximately 3 km upstream of its confluence with the Kenai River which blocks salmon access to most of the basin. The north side of Kachemak Bay set consists of the North Fork of the Anchor River and the

South Fork of the Anchor River as the salmon-bearing streams and Happy Valley Creek as the salmon-free reference. The Happy Valley System has resident Dolly Varden, but no anadromous runs due to the presence of a waterfall near the mouth of the creek. The south side of Kachemak Bay set consists of Humpy Creek, Barabara Creek, and China Poot Creek. China Poot Creek supports a terminal run of sockeye in the lower reaches, however upstream progress is blocked by a waterfall less than 2 km from the mouth. Sockeye fry are stocked in China Poot Lake, and the lake is fertilized regularly to support the fry. We are sampling China Poot Creek above the lake.

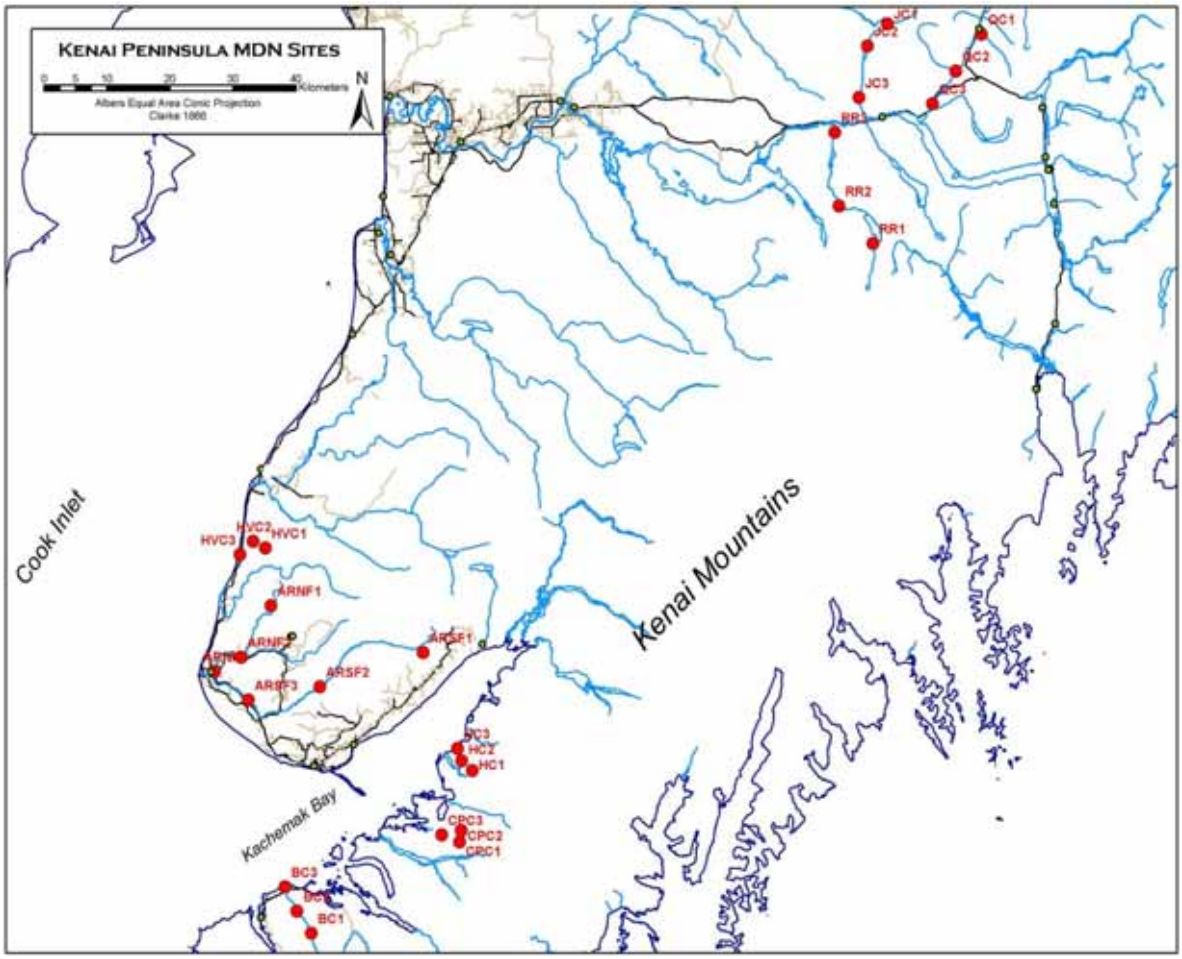

Figure 1. Map illustrating study areas for food-web and nutrient gradient responses to MDN. BC=Barabara Creek, CPC=China Poot Creek, HC=Humpy Creek, ARSF=Anchor River South Fork, ARNF=Anchor River North Fork, HVC=Happy Valley Creek, RR=Russian River, QC=Quartz Creek, JC= Juneau Creek.

At each site, we are analyzing stable isotopes in three trophic compartments: stream macroinvertebrates, Dolly Varden and riparian horsetail. Samples are being collected before and after salmon runs. The first and second rounds of stable isotope analysis ($\delta^{15}N$ and $\delta^{13}N$) from FY04 were completed during the first two quarters of FY05, and we reported on the results of these analysis in the 2nd quarter progress report. Analyses of the third round of sampling from the FY04 field season are ongoing, and we expect to see the results by the end of the next quarter. Fish lipid analyses from year one of the project were completed in January 2005. Fatty acid analysis for fish, and both fatty acid and lipid analysis on invertebrates are

ongoing, and we expect these analyses to be completed by the end of the 4th quarter of FY05. We expect to have completed analysis of our second year (FY05) samples by September 2006.

Water chemistry nutrient proxy. Results from year one indicate that the development of a nutrient proxy for salmon escapement is not straight-forward. However, we believe that the phosphorous-rich underlying geology of the lower Kenai Peninsula may make these systems relatively unresponsive to additional nutrient inputs from anadromous salmon. In the 2005 field season, we are exploring this possibility by expanding the number of study systems to include streams outside of the lower Kenai Peninsula that receive moderate to high densities of spawning salmon (Table 1). Water samples are being collected weekly and shipped to us for delivery to the Cook Inlet Keeper laboratory in Homer, Alaska, where they are being analyzed for ammonium, nitrate, total nitrogen, particulate and dissolved inorganic carbon, particulate and dissolved organic carbon, orthophosphate, total reactive phosphorous, and stable N isotope values of dissolved nitrate and ammonium. A continuous automated nitrate sampler (Satlantic MBARI ISUS) was installed on the Anchor River, at the site of the sonar and partial weirs. We will compare the results of the continuous sampler with our weekly grab samples in order to assess whether stream MDN concentrations in the Anchor vary significantly within weekly measurement periods. This information will help us determine whether the weekly sampling frequency is adequate to capture temporal variability in nutrient concentrations.

A new analysis we are exploring this year is the possibility of using chloride as a proxy for fish numbers. Chloride is known to be a component of most ground water systems, and can be used to track groundwater inputs to streams because the amount of chloride does not fluctuate with stream flow. Chloride is also known to be a metabolic by-product of fishes (Bond 1996), yet unlike nitrate and ammonia, chloride is not biologically active, creating the potential for developing a nutrient proxy that is not confounded by the inherent biological productivity of the stream system. We are analyzing weekly water samples for chloride to test this idea.

Table 1. Water chemistry proxy sites.

Site	Discharge	Species Enumerated	Type of enumeration	Density	Project (with operation plan reference)
Anchor River	USGS gauging station	chinook, coho	Sonar, weir	Moderate	Anchor River chinook and coho salmon escapement study (Kirkvliet 2005)
Buskin River	Weekly discharge measurment	sockeye, pink, coho	Weir	Moderate	Buskin River sockeye and coho salmon study (Tracy 2005)
Crooked Creek	Staff gauge	chinook	Weir	High	Crooked Creek chinook salmon enhancement project (Breakfield 2005)
Russian River	Staff gauge	sockeye	Weir	Moderate	Sockeye salmon escapement studies at the Russian River, Alaska (Marsh 2005)
Deshka River	Staff gauge, existing rating curve	chinook, pink, coho	Weir	Moderate	Deshka River chinook salmon weir (Hayes 2005)

2. Future Work.

We anticipate our project to continue on schedule, with adjustments made for laboratory analysis. We had originally anticipated receiving our sample analysis results three months after submitting them to the laboratory. However, we have learned that timeframe is closer to six to nine months.

We have made multiple attempts to develop a technique to monitor the presence and effects of MDN in the nearshore environment. All of the methods we tried were unsuccessful due to the high energy sediment environments and people traffic in these areas. We believe that developing methods to monitor MDN in the nearshore environment is too problematic to be practical for long-term monitoring. Because of this, we suspended nearshore sampling for 2005.

3. Coordination/Collaboration.

This project was developed as a collaborative effort between researchers, agency and citizen monitoring groups, with the purpose of providing valuable information towards the development of GEM's long-term watershed monitoring program, and for the benefit of regional ADF&G managers, and local coastal communities. Sport Fish personnel are assisting with water chemistry sample collection at five salmon enumeration projects around the state. ADF&G Commercial Fish managers are providing fish count data for the two salmon bearing streams on the south side of Kachemak Bay. As part of these collaborative efforts, we have engaged in several meetings with ADF&G managers to discuss the project. Additional collaborations are discussed in more detail in the FY05 quarterly progress reports for this project.

4. Community Involvement/TEK & Resource Management Applications

This project has attracted the interest of several community volunteers, who have assisted with field work.

5. Information Transfer

Posters and presentations: A presentation was given to ADF&G Division of Sport Fish Education staff on the project. Posters on the project were presented at the Marine Science Symposium, January 24-26, Anchorage, the State of the Salmon Conference, held in April 2005 in Anchorage, and at the annual North American Benthological Society meetings, held in May 2005 in New Orleans. These posters have also been on display at the Alaska Islands and Oceans Visitor Center in Homer.
Information Products: A one page 'project profile' has been developed by the Reserve as an educational outreach tool. The project was featured in the Alaska Wildlife News (ADF&G's online magazine).

6. Budget

There are no substantial differences between the expected and actual budget expenses. The project has had the good fortune to receive additional resources this fiscal year, including the use of an ISUS automated nitrate sampler (valued at $26,000) , and the assistance of ADF&G field technicians from five salmon enumeration projects in collecting weekly water chemistry samples at no cost to the project.

Signature of PI: 

Project Web Site Address:
http://www.habitat.adfg.state.ak.us/geninfo/kbrr/research/watershed.html