EVOS ANNUAL PROJECT REPORT

Project Number: 040635

Project Title: Trophic dynamics of intertidal soft-sediment communities: interaction between top-down and bottom-up processes

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Time Period Covered by Report: 1-September 2003 to 15 August 2004

Date of Report: 15 August 2004

1. Work Performed: Our overall hypothesis is that the distribution, abundance and production of benthic invertebrates residing in intertidal sediments of the Copper River Delta are controlled by a combination of top-down (predators) and bottom-up (nutrient and primary production) processes. To evaluate the central predictions of this hypothesis, a comprehensive sampling program was adopted to address four objectives. Objectives are designed under a multi-year project that leverages EVOS-GEM funding with funds provided by the Prince William Sound Oil Spill Recovery Institute (OSRI). At the time of this report, much of the 2004 field sampling is ongoing. In this report, we highlight those activities completed in 2003 and in the spring of 2004.

Objective 1: *Characterize the spatial abundance of macrobenthic species inhabiting intertidal sediments within the Copper River Delta and Orca Inlet, Southeast Prince William Sound.*

Core sampling for invertebrates was conducted in September 2003 and April 2004. Areas sampled included low, mid-and high-tide plots near the outflows of Eyak River and Pete Dahl Slough, and low, mid, upper mid and high tide plots at Hartney Bay. All core samples (10-cm diameter) with the exception of a few samples from the April 2004 collection at Hartney Bay have been sorted, with all marine invertebrates identified, measured, and enumerated. Despite its low diversity (4 species account for the majority of animals and 1 species, *Macoma balthica*, account for >80% of the biomass), mudflats f the Copper River Delta support high densities of clams (~4,000 clams/m2), amphipods, and polychaetes that serve as prey for numerous species of migratory and resident species. Diversity of benthic invertebrates is significantly higher within mudflats of Orca Inlet compared to the Copper River Delta. This higher diversity likely results from the more saline conditions within Orca Inlet and the lower frequency of ice scour compared to the Copper River Delta sites.

Objective 2: Determine and quantify those factors that best serve as predictors for primary production in the overlying water and within the sediments of tidal flat communities.

Conductivity-temperature-depth (CTD) profiles at 11 sites in Orca Inlet and the western Copper River delta were performed monthly from April through October 2003 and April though August 2004. All data from 2003 has been analyzed and placed in GIS format. Analysis of the 2004 data set will be completed after collection of the entire year's data set. GIS analysis of the 2003 data have documented the temporal and spatial influence of the Copper River's freshwater discharge on the intertidal waters and on adjacent water masses (Gulf of Alaska and Prince William Sound). Surface (Fig. 1) and bottom water salinities (Fig. 2) throughout the Delta and Orca Inlet are significantly reduced during the summer in response to the large input of freshwater from the Copper River Delta.

We analyzed all nutrients and chlorophyll *a* samples from monthly samples obtained from April to October 2003 and from March through June 2004. The remaining 2004 samples will be analyzed by November 2004. The Copper River is a large source of nitrate to the Delta ecosystem as well as to the Gulf of Alaska through exchanges between Egg Island and Pete Dahl channels (Fig. 3). Chl *a* concentrations in surface waters (Fig. 4) appear to reflect input of phytoplankton from the Gulf of Alaska. Chl *a* concentration in intertidal sediments increased as distance from the Copper River Delta increased (i.e. Pete Dahl < Eyak < Hartney Bay). Within each area, sediment chl *a* concentration was highest at mid tidal elevation, a location which generally demonstrates benthic biomass maximum.

Objective 3. Characterize the spatial and temporal abundance of demersal and avian consumers and assess the role of epibenthic predation on recruitment of intertidal macroinvertebrates.

In an effort to document the abundance and distribution of demersal fish and crabs we conducted replicate otter trawl surveys monthly at 7 stations within our study area from April through October in 2003 and March through August 2004. Trawl surveys will continue through October 2004. All animals caught in trawls were identified and measured for TL (total length) and weighed. A diverse fish assemblage (Table 1) dominated by flatfish, sculpins, snake prickleback and *Crangon* shrimp is present on the Copper River Delta. Distinct temporal and spatial variability is evident in the demersal fish and crab distributions (Fig. 5 and 6). For example, Dungeness crabs show both a distinct spatial and temporal distribution with highest abundances found east of Orca Inlet, and peak abundances recorded June – September, respectively. The spatial pattern appears to reflect the abundance pattern of sea otters: higher numbers of sea otters are found in Orca Inlet compared to the Copper River Delta sites.

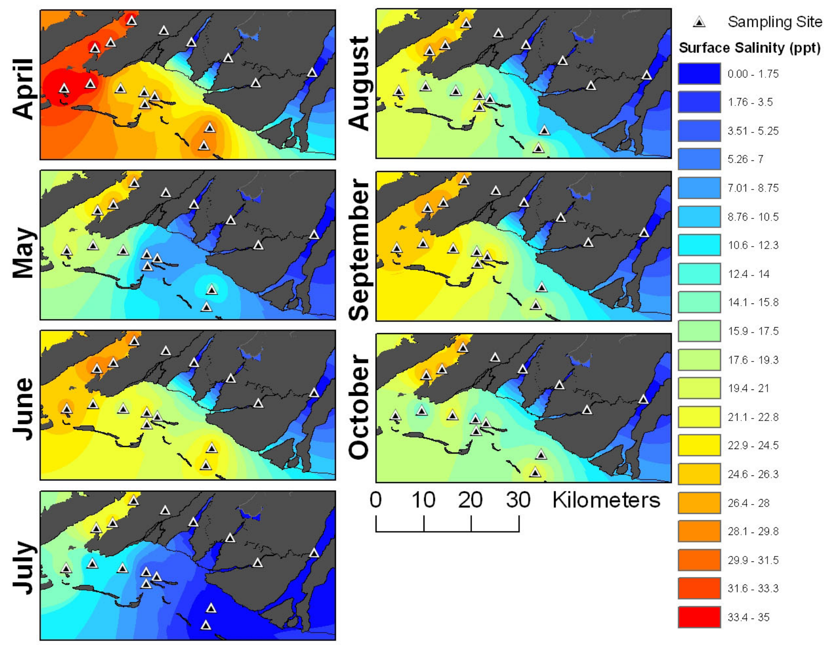

Figure 1. Interpolated surface salinity maps by month for the Copper River Delta study area, April – October 2003. Note the large influence of the Copper River outflow (far right river in images) in July during peak outflow.

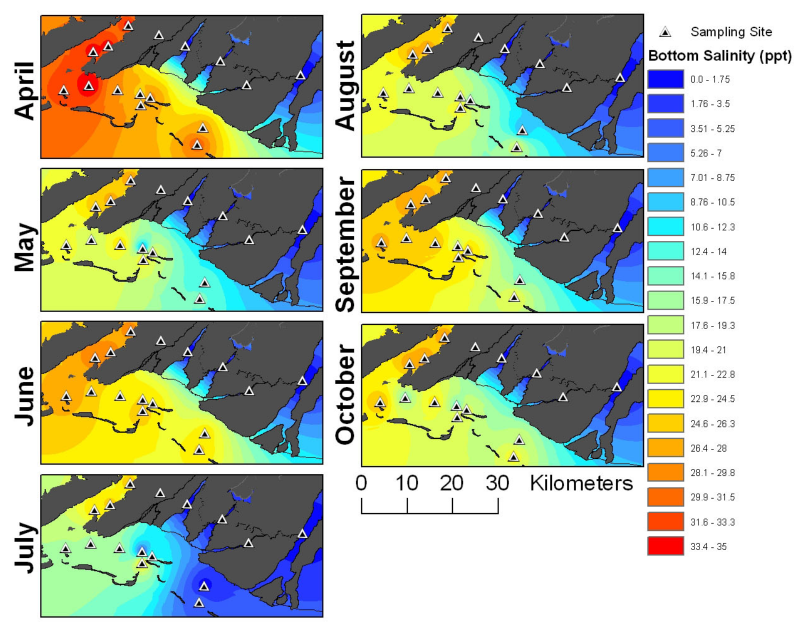

Figure 2. Interpolated bottom salinity maps by month for the Copper River Delta study area, April – October 2003. Note the large influence of the Copper River outflow (far right river in images) in July during peak outflow.

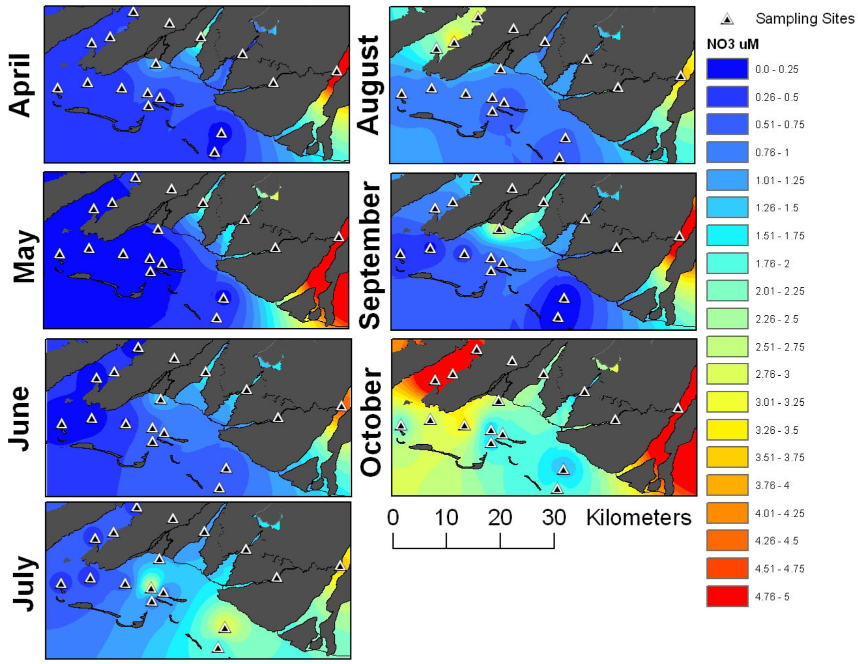

Figure 3. Surface nitrate concentrations on Copper River Delta, April – October 2003. Large inputs of nitrate from the Copper River Delta enter the Delta through exchanges between Egg Island and Pete Dahl channels with highest concentrations in late spring and late summer/fall.

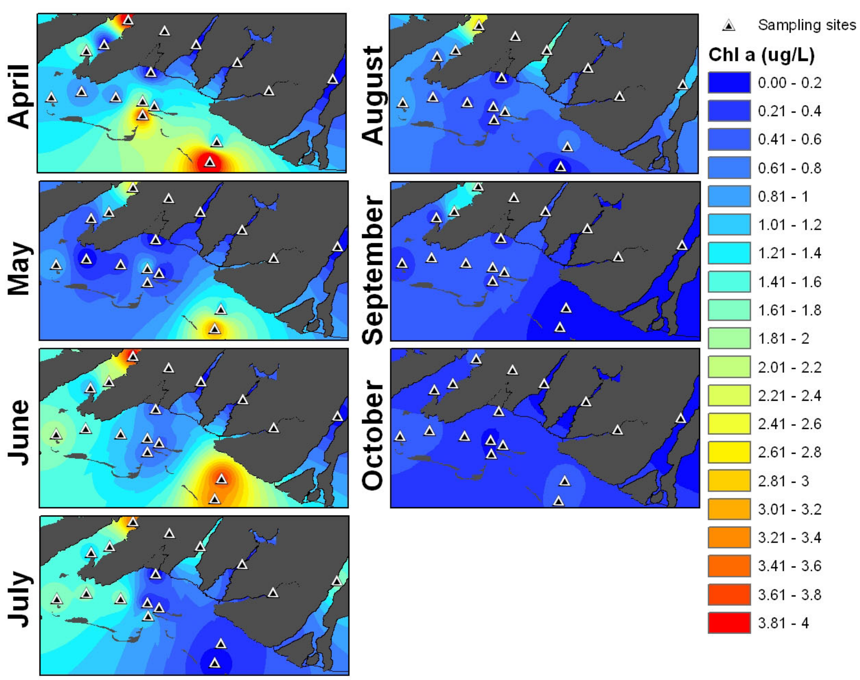

Figure 4. Surface chlorophyll *a* concentrations on Copper River Delta study area, April – October 2003. Chl *a* maximums are associated with higher salinity waters entering Pete Dahl Channel and in Orca Inlet during spring/early summer. Large inputs of freshwater and high suspended solids may decrease photosynthesis during July and August.

Table 1. Fish species collected in the Copper River Delta and Orca Inlet study area from 2002-2003. Taxonomic classification scheme for fishes based on *Fishes of Alaska* (2002) and for invertebrates *Southeast Alaska's Rocky Shores* (1998).

Family	Species	Common Name	Size Range (mmTL)
Fishes:			
Clupeidae	*Clupea pallasii*	Pacific herring	112-170
Osmeridae	*Osmerus mordax*	Rainbow smelt	57-160
	Thaleichthys pacificus	Eulachon (smelt)	39-192
Salmonidae	*Oncorhynchus kisutch*	Coho salmon	155
Gadidae	*Gadus macrocephalus*	Pacifc cod	177
	Microgadus proximus	Pacific tomcod	55-997
Gasterosteidae	*Gasterosteus aculeatus*	Three-spine stickleback	75-84
Syngnathidae	*Syngnathus leptorhynchus*	Bay pipefish	106-260
Hexagrammidae	*Ophiodon elongatus*	Lingcod	89-224
	Hexagrammos decagrammus	Kelp greenling	79-145
	Hexagrammos lagocephalus	Rock greenling	65-82
	Hexagrammos octogrammus	Masked greenling	66-135
	Hexagrammos stelleri	Whitespotted greenling	22-235
Cottidae	*Enophyrs bison*	Buffalo sculpin	86-169
	Enophrys diceraus	Antlered sculpin	74-180
	Icelinus borealis	Northern sculpin	45-102
	Leptocottus armatus	Pacific staghorn sculpin	50-271
	Myoxocephalus polyacanthocephalus	Great sculpin	250
	Myoxocephalus scorpius	Shorthorn sculpin	106
Hemitripteridae	*Blepsias bilobus*	Crested sculpin	110
Agonidae	*Pallasina barbata*	Tubenose poacher	85-105
	Podothecus accipenserinus	Sturgeon poacher	60-240
Zoarcidae		Eel pouts	135
Stichaeidae	*Stichaeus punctatus*	Arctic shanny	-
	Lumpenus sagitta	Snake prickleback	55-300
Pholidae	*Pholis laeta*	Crescent gunnel	118-140
Trichodontidae	*Trichodon trichodon*	Pacific sandfish	69-190
Ammodytidae	*Ammodytes hexapterus*	Pacific sand lance	65-145
Gobiidae	*Lepidogobius lepidus*	Bay goby	52

Family	Species	Common Name	Size Range (mmTL)
Pleuronectidae	*Hippoglossus stenolepis*	Pacific halibut	80-352
	Hippoglossoides elassodon	Flathead sole	55
	Psettichthys melanostictus	Sand sole	20-299
	Isopsetta isolepis	Butter sole	150
	Lepidopsetta bilineata	Rock sole (southern)	56-461
	Limanda aspera	Yellowfin sole	55-260
	Parophrys vetulus	English sole	48-248
	Platichthys stellatus	Starry flounder	41-1116
	Pleuronectes quadrituberculatus	Alaska plaice	69-162
Decapods:			
Crangonidae	*Crangon* spp.	Crangonid shrimp	48-101
Majidae	*Pugettia producta*	Northern kelp crab	21-22
Atelecyclidae	*Telmessus cheiragonus*	Helmet crab	69
Cancridae	*Cancer magister*	Dungeness crab	12-219

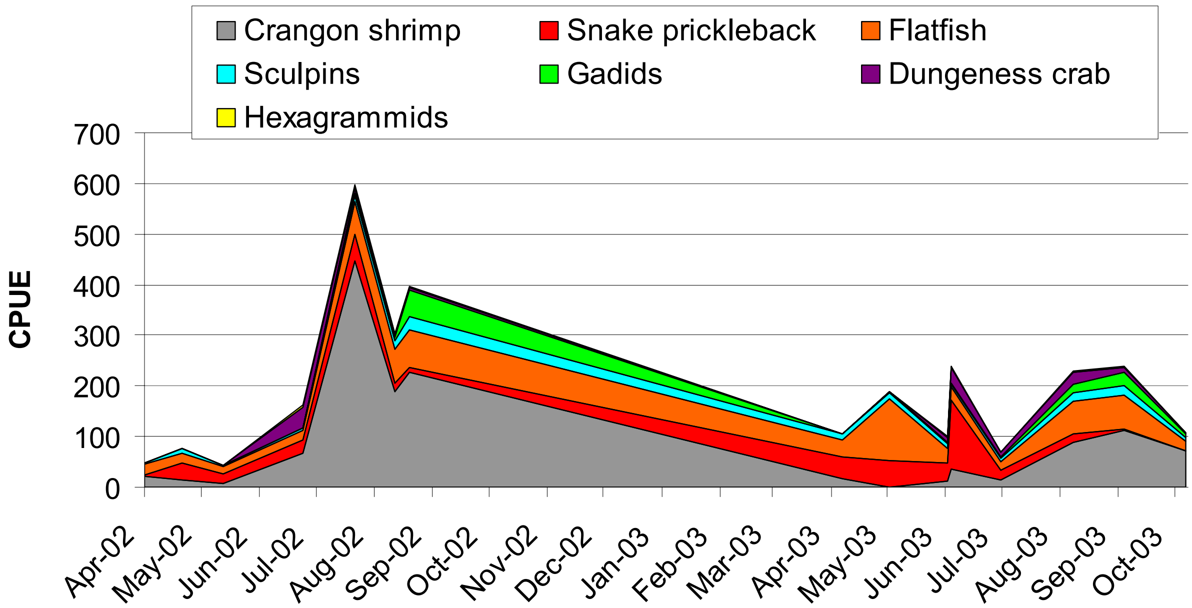

Figure 6. Temporal changes in the demersal fish and invertebrate community over the 2002 and 2003 field sampling period. Each sampling date represent the average catch per unit effort (CPUE) from 24 otter trawls (10 minutes each) collected at 7 stations. Data points from November 2003 through March 2004 are interpolated.

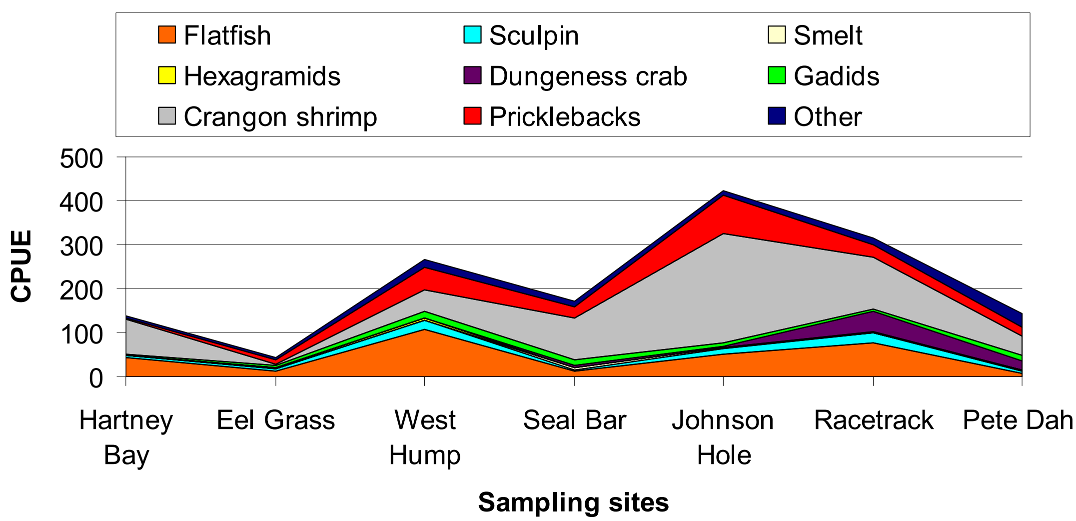

Figure 7. Spatial changes in the demersal fish community. Stations on the x-axis are arranged from West to East from Orca Inlet to the Copper River. Each data point represents the average catch per unit effort (CPUE) for trawls collected over all sampling dates. One of the most striking patterns is the absence of Dungeness crabs west of the Seal Bar sampling site.

Objective 4. Develop a cost-effective strategy and sampling design for long-term monitoring of the intertidal sedimentary habitats.

Objective 4 requires completion of the three years of field collections according to the observation program detailed in the proposal. We will continue to evaluate future monitoring activities as data from the current OSRI/GEM program are analyzed.

2. Future Work: We will complete the sampling schedule as outlined in the original proposal for 2004. Field work in 2005 will also be conducted as detailed in the original proposal.

3. Coordination/Collaboration: Describe efforts undertaken during the reporting period to achieve the coordination and collaboration provisions of the proposal, if applicable.

This study is a multi-year project that couples funding from EVOS-GEM and the Prince William Sound Oil Spill Recovery Institute (OSRI). All data will be archived by the project staff in accordance with GEM standardized procedures. Our project also complements and benefits from the North Pacific Board supported project "Estuaries as essential fish habitat for salmonids: Assessing residence time and habitat use of coho and sockeye salmon in Alaska estuaries", which is being conducted on the Copper River Delta.

Our project also provides logistical support and data to the GEM sponsored project G-040712 "Research for nutrient-based resource management in watersheds and estuaries". This project is being jointly conducted by Dr. Carol Woody (USGS Alaska Science Center) and Dr. Tom Kline (Prince Willam Sound Science Center). To date we have provided fish from our monthly fish trawls and macroinvertebrate samples from our invertebrate plots. During our June 2004 macro and micro-algae sampling at our invertebrate plots, we deployed periphyton samplers for this project. In June 2004 Dr. Woody visited Cordova. We provided Woody with an overview of our project and provided her with an opportunity to assist on a fish trawl survey. Finally, during 2004 we were approached by and collaborated with Dr. Roger Green who is studying parasitism in *Macoma balthica*.

4. Community Involvement/TEK & Resource Management Applications: Describe efforts undertaken during the reporting period to achieve the community involvement/TEK and resource management application provisions of the proposal, if applicable.

Because of the extensive knowledge of local fishers and the historic knowledge of native Alaskans, an interactive exchange with local fishermen is of great benefit to the project. Direct input to the project is provided through public presentations (see below) as well as direct fishermen involvement on the project (local charters for field work are performed by fishermen in the Cordova area).

- Sept 2003 Marine Biology Class, Cordova High School field trip to observe and conduct invertebrate core samples at Hartney Bay; developed & provided scientific poster for the classroom.
- Jan 2004 Assisted high school senior Amanda Kelly in study design and analyses for her Cordova Science Fair project. Kelly compared her January invertebrate core samples with our September 2003 data. Kelly took First Place in the Cordova Science Fair.

- Feb 2004 Cooperated with The Alaska Sea Otter & Steller Sea Lion Commission on sea otter biosampling.
- April 2004 Presentation, The Copper River Delta's mudflats. By Bishop & Powers for the Prince William Sound Science Center, Community Program in conjunction with Cordova's Earth Day celebration.
- April 2004 Collected and prepared fish specimens for public display at Cordova's Earth Day fair.
- April 2004 Aerial tour of Copper River Delta mudflats to Gail Phillips, Executive Director of Exxon Valdez Oil Spill Trustee Council.
- June 2004 Project tour to Dr. Carol Woody, USGS Alaska Science Center, and Co-Principal Investigator of "Research for nutrient-based resource management in watersheds and estuaries", EVOS project G-040712.

5. Information Transfer: List (a) publications produced during the reporting period, (b) conference and workshop presentations and attendance during the reporting period, and (c) data and/or information products developed during the reporting period.

Publications: no publications were planned for 2004. Two publications will be submitted in 2005.

Presentations:

- Sept 2003 - Spatial and temporal variation in the foodweb of a subarctic estuary: the Copper River Delta, Alaska. Estuarine Research Federation Conference. Seattle, WA. Powers & Bishop.
- Sept 2003 - Copper River Delta Studies at PWS Science Center: 2003-04. PWSSC-hosted lunch for Cordova's Resource Managers. Cordova, AK. Bishop.
- Oct 2003 - Copper River Delta Ecosystem Project Update. Prince William Sound Nowcast-Forecast Meeting. Seattle, WA. Powers, Bishop, and Peterson.
- Jan 2004 - Trophic dynamics of intertidal mudflats: Copper River Delta. 2004 Marine Science in Alaska. Anchorage, AK. Powers, Bishop, & Peterson.
- Feb 2004 - Contaminant pathways in subarctic estuarine habitats: the ecology of tidal flat communities of the Copper River Delta, Alaska. Scientific Advisory Committee, Prince William Sound Regional Citizens' Advisory Council. Anchorage, AK. Bishop, Powers & Clesceri. (tele/web conference)
- Mar 2004 - Ecology of the Copper River Delta, Alaska: evidence for a bottom-up regulation in a subarctic benthic community. 33rd Annual Benthic Ecology Conference. Mobile Alabama. Geraldi, Powers, & Bishop
- Mar 2004 - Contaminant pathways in subarctic estuarine habitats: the ecology of tidal flat communities of the Copper River Delta, Alaska. Prince William Sound Regional Citizens' Advisory Council Board Meeting. Anchorage, AK. Bishop, Powers & Clesceri.
- July 2004 - Conservation of Sub-Arctic Tidal Flats: Copper River Delta Alaska. 18th Annual Society for Conservation Biology Conference. New York City, New York. Bishop & Powers.

6. Budget: Explain any differences and/or problems between actual and budgeted expenditures, including any substantial changes in the allocation of funds among line items on the budget form. Also provide any new information regarding matching funds or funds from non-EVOS sources for the project. [**PLEASE NOTE:** Any request for an increased or supplemental budget must be submitted as a new proposal that will be subject to the standard process of proposal submittal, technical review, and Trustee Council approval.]

As originally budgeted, for FY04 Prince William Sound Oil Spill Recovery Institute (OSRI) provided $100,000. In addition, the Prince William Sound Science Center provided oceanographic equipment. For FY05, OSRI will provide $75,000 and the Prince William Sound Science Center will provide an additional $25,000 through funding from a Congressional earmark.
No requests for budget increases are anticipated for FY05.

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