Project 2B – Amendment No. 1
Great Salt Lake Synoptic Survey of Selenium in Water, Seston, and Brine Shrimp
2007 Sampling Season

CONTRACT WITH:	Parliament Fisheries
PRINCIPAL INVESTIGATOR:	Brad Marden
CONTRACT VALUE:	$95,033
SCHEDULE:	March 1, 2006 through November 1, 2007 (elapsed time: 9 months)

Project Objectives:

The project objectives are to:

1. Document the temporal and spatial characteristics of total selenium (T-Se) in water and correlate with seston and *Artemia* tissue concentrations.
2. Document isotopic ^{15}N and ^{13}C levels in *Artemia* tissue.
3. Monitor primary production indicators and record *Artemia* population dynamics.
4. Document algal population characteristics and dynamics.

Background And Justification

This project proposal is a request for an extension of the Great Salt Lake (GSL) Selenium Study Project 2B that was funded for the 2006 sampling season. The primary goal of this project extension is to collect and analyze water, seston, and *Artemia* samples during the avian nesting season on the GSL. Detailed assessment of selenium trophic exchange during this time of year can provide critical details for modeling trophic transfer and potential exposure concentrations to foraging birds via invertebrate food sources. This project extension also proposes to overlap with sampling program dates during the 2006 season as a means of validating, or at least corroborating, the trophic transfer rate calculations from the 2006 season.

Although Project 2B began in April 2006, funding for the project was not finalized and disbursed until July 26, 2006. Due to funding delays and budgetary constraints, many aspects of the project sampling, analysis, and reporting were substantially delayed. Some components of the sampling program were not included during the initial sampling programs on the GSL because equipment purchases were not made until funding was available, so some critical components of the study were not determined during the avian nesting season. Most notable of the samples that were not included during the initial sampling programs were water and seston samples. Equipment purchases necessary for these samples were postponed during the project plan negotiating period. It is therefore recommended that sampling during the 2007 season be resumed to include sampling in April, May, June, and July. This time

period will include the critical exposure time for nesting birds and is sufficiently long to document at least one *Artemia* population growth and collapse cycle.

Although there were some delays during the 2006 sampling season, more sampling programs were conducted for Project 2B than were proposed. The additional sampling programs were made possible by equipment, vessel, fuel, and manpower assistance made available by the brine shrimp industry. Four additional sampling programs were conducted that provided samples and information regarding selenium in the GSL ecosystem in November, December, January, and March.

Samples from Project 2B extension will provide information on *Artemia* and algal population dynamics, abiotic factors, and isotopic nutrient ratios for *Artemia* biomass. They will also include the collection of water, seston, and *Artemia* biomass for selenium analysis. This information should be of value in understanding the ecological linkages that contribute to selenium transfer and that support the prey base of avian predators. Furthermore, the *Artemia* resource itself has demonstrable ecological value to the GSL ecosystem and economic value to the State of Utah. *Artemia* population dynamics information coupled with details on contaminant loads can provide insights into potential impacts of contaminant exposure to the *Artemia* resource.

Scope of Work

Sampling Programs

Sampling Program #16: April 21st to 27th
Sampling Program #17: May 5th to 8th
Sampling Program #18: May 21st to 25th
Sampling Program #19: June 15th to 18th
Sampling Program #20: June 25th to 27th
Sampling Program #21: July 9th to 13th

One additional sampling program to collect *Artemia* for inter-laboratory and method comparisons will be done on May 7th.

Sampling program dates are proposed but are ultimately determined by weather, vessel and vehicle availability, and may also be altered by conflicting personnel schedules. However, efforts will be made to adhere to the schedule.

Deliverables

Deliverables from Project 2B extension will include a finalized report detailing and synthesizing the results of 2006 and 2007 sampling programs and sample analyses.

1. Draft Report: August 30, 2007
2. Final Report November 1, 2007

(Report submissions are contingent upon receiving laboratory analysis by 30 days prior to the report deadline date.)

Reports to include:

- *Artemia* population dynamics and date-specific age-class structure of population

- Phytoplankton population composition and dynamics
- Selenium in water
- Selenium in seston
- Selenium in *Artemia*
- Isotopic nutrients in *Artemia*
- Abiotic factors in the GSL

Sampling Sites and Sampling Program

Six sites will be sampled during each sampling program. The sites are depicted in Appendix B (GSL Map). Sites will include a "deep" site (8-9 meters) and a "shallow" site (1-2 meters within each of three regions of the GSL. Deep sites will include site numbers 3, 6, and 9 and the shallow sites will include sample sites number 1, 4, and 7. The location of each site is shown below:

Site #1: N: 41.07.76 W: 112.17.62
Site #3: N: 41.05.21 W: 112.24.38
Site #4: N: 41.05.14 W: 112.35.48
Site #6: N: 41.06.45 W: 112.38.27
Site #7: N: 40.52.68 W: 112.13.83
Site #9: N: 40.50.76 W: 112.16.74

At each sampling location the following samples will be collected:

Abiotic Measurements

- Temperature at 1, 3, 5, 6, 7, 8 meter intervals from the surface
- Dissolved oxygen at 1, 3, 5, 6, 7, 8 meter intervals from the surface
- Secchi disk

Artemia Samples for Population Assessment

- Plankton net hauls for population assessment
    - 165-um plankton net
    - 50-cm diameter
    - Net lowered to 1 meter (shallow site) or 5 meters (deep site)
    - Two net hauls per location collected and pooled together
    - Samples pooled & stored on ice in Nalgene bottles (1000-ml) until enumeration (within 12 to 24 hours)

Artemia Samples for Selenium Analysis

- Plankton net hauls for selenium assessment in *Artemia* tissue
    - 165-um plankton net
    - 50-cm diameter
    - Net lowered to 1 meter at a shallow site or to 5 meters at a deep site
    - Multiple net hauls per location collected and pooled together to ensure adequate sample size
    - Samples then filtered through 850-, 500-, 125-micron sieves
    - Each sieve fraction rinsed thoroughly with filtered GSL water

- Sieve contents then collected into pre-labeled Whirl-Pak® bags
- Whirl-Pak® bags stored on ice and transported to the laboratory
- Prior to freezing, samples are cleaned of debris or other invertebrate material in the laboratory and excess water is removed.
- Samples are then frozen at -25° C until shipment to LET for selenium analysis.

Chlorophyll A and Phytoplankton

- Depth-integrated water samples from the water column are collected for Chlorophyll-A analysis and phytoplankton identification and quantification.
  - Equivalent GSL water volumes will be collected from 1 meter (shallow sites) or 1, 3, and 5 meters (deep sites).
  - GSL water filtered through 125 micron sieve
  - Samples stored in Amber Water Bottles on ice
  - Samples shipped within 24 hours to ARI laboratory for Chlorophyll A and phaeophyton analysis
  - If samples are not shipped within 24 hours then preservative (magnesium carbonate solution) is added to the GSL water sample and the sample is stored at 5° C until shipment.
  - Samples for phytoplankton identification are initially preserved with Lugol's solution and then with formaldehyde.
  - Samples are stored under refrigeration and then shipped to the Laboratory of Ichthyology and Hydrobiology (LIH), Uzbekistan Academy of Sciences, Tashkent, Uzbekistan.
  - The Uzbek laboratory is used due to much lower costs per sample. This lab had a demonstrated reliable background and has been used for algal determination for NATO-funded research and for projects overseen by the *Artemia* Reference Center, Ghent University, Gent, Belgium.

Water Samples for Selenium Analysis

- Depth-integrated water samples from the water surface to 1 meter (shallow sites) or to 5 meters in deep sites for T-Se analysis
  - Teflon-lined polyethylene tubing
  - Peristaltic pump
  - Pre-filtering with 125-micron sieve to remove zooplankton and large particulates
  - 0.45-micron capsule filtration for dissolved selenium water samples
  - Samples collected in acid-rinsed polyethylene bottles
  - Acidification with nitric acid to <2.0 pH
  - Pre- and Post-sampling field blanks
  - Samples stored under refrigeration until shipment to Frontier laboratory for analysis

Water Samples for Seston Collection

- Integrated water sample of suspended particulate matter (seston) from 1 meter (shallow sites) or 5 meters (deep sites).
  - Fluorocarbon/Teflon-lined tubing
  - Peristaltic pump

- Equivalent volume sampling at discrete intervals in water column: 1 meter (shallow sites) and 1, 3, and 5 meters (deep sites)
- Pre-filtering with 125-micron sieve to remove zooplankton and large materials
- Composite sample collected into 3000-ml graduated cylinder
- Composite sample then pumped through a pre-weighed 155-mm, 0.45-micron pore size, cellulose-acetate filter
- Composite sample is filtered until filter is clogged (usually between 1.5 and 3.5 liters).
- Filter is removed, folded and placed in a pre-labeled Whirl-Pak® bag and stored on ice.
- Samples are transported to laboratory and then stored at -25° C until shipment to LET for analysis.

Artemia Samples for Isotopic Nutrient Analysis

- Adult Artemia samples are filtered via vacuum suction through a 0.45-micron glass fiber filter.
- Filter contents are dried.
- Filters and dried Artemia are then stored in Whirl-Pak® bags at -25° C until shipment to Northern Arizona Stable Isotope Laboratory (NASIL).

Artemia Enumeration in Laboratory

- Samples are filtered through 850-, 500-, 125-micron sieves.
- Sieve contents resuspended in known volume of water
- Multiple sub-samples taken
- Sub-samples counted
- Age-classes identified and counted: cysts, nauplii, meta-nauplii, juveniles, male and female adults.
- Dry biomass is also determined and recorded if sufficient sample size is available.
- Reproductive information determined includes number of gravid females, brood size and type (cysts, embryos, or nauplii).
- Counts in # organisms per liter

PROJECT 2B
GSL/Selenium