RESTORING AND SUSTAINING THE SALTON SEA

Supporting Science and Environmental Data Collection and Analysis

R 826552-01-0

5/21/01

Annual Progress Report

April 20, 2000-April 20, 2001

SALTON SEA AUTHORITY

Overview

This annual report is provided in accordance with condition #8.a as a part of assistance identification R 826552-01-0. Following receipt of this assistance grant RFPs to conduct reconnaissance investigations of the Sea were issued to solicit potential contractors. Studies of the Sea's fishery, biological limnology, algal toxins, microbial pathogens, chemical and physical limnology, sediments and birds were funded during '98 – '99. These reconnaissance investigations were completed during the '00 – '01 reporting period and final reports have been received from all but two of these studies. Additional studies were funded through additional solicitations for proposals by prepared by the Science Subcommittee in late 1999. These projects are still in the process of being completed and have project completion dates ranging from 06/01 to 07/02.

Over 90% of funds budgeted for scientific inquiries have been obligated by the end of the reporting period. As in past reports, non-contractual expenditures (personnel, indirect costs, etc) continue to be well below budgeted amounts, providing additional funding for scientific inquiry. The quality assurance program has been integrated with pre-award, award and contract administration activities in order to more efficiently utilize staff resources.

Work Status/Progress and Data Results

The following studies were initiated in early 1999 as one-year reconnaissance projects. They were completed by early 2000. All of these project teams have either submitted a final report or are in the final stages of preparation of such a report.

Physical and Chemical Limnology – Ecosystems Research Group, Bureau of Reclamation, Denver; Principal Investigator: Chris Holdren – all sampling data, a symposium paper and model have been submitted, the final report is pending

Microbial Toxins – U.S. Geological Survey, National Wildlife Health Center, Madison, Wisconsin; Principal Investigator: Tonie Rocke

Algal Toxins – Scripps Institute of Oceanography; Principal Investigator: John Faulkner

Sediments – Levine-Fricke-Recon, Irvine, California; Principal Investigator: Richard Vogl

Bird Populations –Point Reyes Bird Observatory, Stinson Beach, California; Principal Investigator: Nils Warnock

Fish Biology –University of Southern Mississippi; Principal Investigator: Barry Costa-Pierce

Biological Limnology – Center of Inland Waters, San Diego State University, Principal Investigator: Stuart Hurlbert – twenty-six progress reports and manuscripts submitted -- final report pending

Additional studies were initiated in 1999 by the Science subcommittee, following release of additional RFPs, to provide information not covered by the initial set of reconnaissance projects. These were scheduled for completion in approximately one to two years from the date of initial

funding. As a result, the fieldwork for most of these projects has been or will be completed in 2001, with final reports being submitted within 3 months after project completion.

Desert Pupfish – Ecosystems Research Group, Bureau of Reclamation, Denver; Principal Investigator: Ron Sutton – project concluded 03/01 – final report received

Avian Botulism – United States Geological Survey; Principal Investigator: Tonie Rocke – project continues until 07/02

Eared Grebe Disease Agents – United States Geological Survey; Principal Investigator: Tonie Rocke – project continues until 07/02

Avian Disease Related to Algal Toxins – Wright State University, Dayton, Ohio: Principal Investigator: Wayne Carmichael – project concludes 08/01

Tilapia Feeding Study – University of Southern Mississippi: Principal Investigator: Barry Costa-Pierce – project concludes 07/31/01

Nutrient Cycling Study – University of California, Riverside; Principal Investigators: Michael Anderson and Chris Amrheim – project concludes 09/01

As previously reported some highlights of project findings are listed below:

- The sediments were not found to contain detectable amounts of most priority pollutants. This was especially true for organic contaminants, such as PCBs, semi-volatile organic compounds, chlorinated pesticides, organophosphate and nitrogen pesticides, and chlorinated herbicides. A few trace elements (cadmium, copper, molybdenum, nickel, zinc and selenium) were found at elevated concentrations.

- Nutrient concentrations are high, leading to frequent algal blooms, which in turn contribute to low dissolved oxygen concentrations. The concentrations of ammonia are often greater than 1 mg/L – much higher than in most lakes, and possibly high enough to be toxic to fish.

- Based on taxonomic work conducted as part of the limnological reconnaissance, the number of species of cyanobacteria, diatoms, dinoflagellates, ciliates, and amebas known to inhabit the Salton Sea has grown from 70 to nearly 400. Some of these species are new to science, not just to the Salton Sea.

- The pileworm *Neanthes succinea* – the key food chain organism for fish and birds – is the dominant species on the sea bottom between depths of 2 and 12 meters. It can reach densities exceeding 80,000 individuals per square meter.

- Ten fish sampled between 1999 and 2000 with Gulf croaker and tilapia being the most abundant followed by orangemouth corvina and sargo. Salton Sea tilapia are a faster growing, shorter lived fish than other strains. Gulf croakers were the most abundant fish in the Salton Sea. The croaker is likely in better condition now than when studied in 1961. Orangemouth corvina was the third most abundant species and might be in

better condition than the stock of decades ago. Sargo was the least abundant species sampled but evidence indicated that this species is still reproducing at the current Salton Sea salinity. There is also some evidence that Sargos grow at a faster rate than along the Pacific coast of southern California.

- There is no evidence of widespread deformities or external abnormalities in the adult corvina, sargo, tilapia, or croaker populations. Rates of deformities or external abnormalities are less than expected to occur in wild populations.

- The Salton Sea hosts hundreds of thousands, and at times low millions, of migratory, wintering, and breeding birds, and is the destination for many post-breeding birds moving north from Mexico. Salton Sea populations of a number of species are of regional, continental, or worldwide importance.

- Movements of desert pupfish (*Cyprinodon macularius*) were documented between adjacent habitat types. In some cases, deteriorating habitat conditions may have caused this.

- Some species of algae known to produce toxins have been found in the Salton Sea. Toxicity screening tests, using a brine shrimp lethality assay, show moderate to high lethality, but no toxicity was found when tested in a vertebrate system (mice).

- Microcystin hepatotoxins can be produced by two genera of blue-green algae – filamentous *Oscillatoria* and unicellular *Synechocystis* – that have been found to be common in the Salton Sea. Certain *Oscillatoria* species are also known to produce neurotoxins.

Some highlights from the more recently funded projects are –

- In the survey for the presence of *Clostridium botulinum* type E DNA extractions of sediment samples indicated detectable levels of the type E toxin gene. Analyses are continuing for the presence of type C botulism in fish-eating birds and in freshwater wetlands.

- From 44 necropsied eared grebe carcasses *Pasteurella multocida* has been isolated from nine of them and *Salmonela sp.* has been isolated from an additional ten. Skin samples from ten grebes were inoculated in cell cultures to test for viruses that may infect the feather follicles or skin of birds. All ten were negative.

- Efforts to culture isolated strains of *Synechocystis* and *Oscillatoria* continue to be successful in the algal toxins – eared grebes study. As soon as sufficient biomass is accumulated critical chemical analyses of microcystins will be performed. Research continues on developing methods for the grebe tissue analysis. Solvent extraction methods for measuring bound microcystin in tissue by an oxidation method is now complete. The toxin levels detected after sample preparation and extraction correlate to actual exposure doses in a linear manner.

- Tilapia gastrointestinal materials (tilapia feeding ecology) have been sampled at five stations. Stomachs were significantly more acidic during mid afternoon indicating that

tilapia were more actively feeding during the day. Eleven taxa have been identified from stomachs indicating that tilapia are ingesting more sediment at all stations. Proportions of plant materials in stomachs were significantly different through time; a lower proportion of plant material was found during the evening and night.

- Sediment characterization and distribution within the Sea have been completed. *In situ* sediment equilibrium dialysis chambers (peepers) have been deployed periodically at selected locations in the Sea since last fall. Selected porewater profiles have been used to estimate the flux of $NH_4 - N$, PO_4-P and HS^- from sediments. Significant diffusive flux of $NH_4 - N$ and HS^- from the sediments at more than two orders of magnitude greater than that of PO_4-P has been observed. Thus the peepers indicate limited internal loading of PO_4-P relative to $NH_4 - N$ and HS^- at the time of sampling.