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Theron G. Miller
Utah Division of Water Quality, Salt Lake City

Heidi M. Hoven
Institute for Watershed Sciences, Kamas, UT

John F. Cavitt
Department of Zoology, Weber State University, Ogden

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Farmington Bay Wetlands of Great Salt Lake: Nutrient Criteria, Macroinvertebrate Studies and Beneficial Uses

Theron G. Miller[1], Heidi M. Hoven[2] & John F. Cavitt[3]

[1]Utah DEQ, Division of Water, 288 North 1460 West, Salt Lake City, UT 84114, USA; [2]The Institute for Watershed Sciences, 1937 Mirror Lake Highway, Kamas, UT 84036; USA; [3]Department of Zoology, Weber State University, Ogden, UT 84408-2505, USA

Corresponding author:
Theron G. Miller
Utah DEQ, Division of Water, 288 North 1460 West, Salt Lake City, UT 84114, USA
E-mail: tmiller@utah.gov

The US Federal Clean Water Act requires States to develop water quality standards for their surface waters, including wetlands. For most toxic pollutants the EPA has conducted extensive acute and chronic bioassays to establish numeric thresholds of toxicity. The States further refine these values by identifying the appropriate beneficial uses for the various types of water bodies. However, for nontoxic pollutants, including the nutrients phosphorus and nitrogen, local ecosystems characteristics such as elevation, watershed land use, geology, and other water quality parameters and even biological components of the ecosystem can drastically alter ecosystems responses to nutrient loadings. Consequently, EPA has not developed nationwide numeric criteria for nutrients. Rather, they have suggested that States adopt nutrient threshold concentrations based on a national probabilistic study or to perform site-specific water quality and ecological studies in order to develop nutrient criteria based on local chemical and biological conditions. Only a few States have proceeded to develop site-specific nutrient criteria and most of these have been in response to overwhelming evidence of, or public concern for, eutrophication and associated problems with dissolved oxygen or pH in specific water bodies. In Utah, agency, academic and public concerns over the trophic condition of Farmington Bay of Great Salt Lake (GSL) and its wetlands prompted the Utah Division of Water Quality (DWQ) to begin a project in 2004 to develop local water quality criteria for phosphorus for Farmington Bay wetlands. This effort has included developing appropriate measures that will be used to develop the site-specific criteria as well as subsequent assessment protocols that will determine whether the beneficial use of '*support for waterfowl and shorebirds and the aquatic life in their food chain*' is being fully supported. With that objective we focused on the availability of nesting habitat and direct measures of reproductive success for the vast numbers of shorebirds that nest on the sloped, lacustrine playa wetlands of GSL and the forage items (macroinvertebrates) that occur in these shallow waters. Several thousand American avocet (*Recurvirostra americana*) and black-necked stilt (*Himantopus mexicanus*) nests were evaluated for nest site habitat preference and monitored for nesting success and several dozen adult and juvenile birds were sacrificed to identify preferred food items. Both American avocets and black-necked stilts preferred the early-successional vegetative community of pickle weed (*Salicornia* sp.) and alkali bulrush (*Scirpus maritimus*) that develop in vast acreages of the transitional zones between freshwater tributaries and the hypersaline open water of GSL. Nesting success ranged from 93 to 98%, among the highest ever measured globally. Typically, adult birds lead their young to shallow channels or open water areas fringed by the protective cover of older bulrush, where forage and cover are in close proximity. Stomach contents from collected birds were dominated by midges (Chironomidae) and water boatman (Corixidae), followed by other insects and plant seeds. The relative abundance of organisms in stomachs was similar to the co-located macroinvertebrate samples. These insects are known to be tolerant of moderate salinity (TDS ranging from 3 to 50 g l^{-1}) and meso- to hypereutrophic conditions, including large diel swings in pH and dissolved oxygen. Despite the dominance by these pollution-tolerant taxa, our observations suggest that the shallow, brackish-water wetlands of GSL provide ideal shorebird nesting habitat that includes ideal vegetative structure and high densities of preferred forage items. Together these conditions offer excellent support for shorebird populations that use sloped wetlands in Great Salt Lake.