Sustainable Rivers Program

Waterbird and Vegetation Responses to Reservoir Water Management at Lake Red Rock, Iowa

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Waterbird and vegetation responses to reservoir water management at Lake Red Rock

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PURPOSE: This technical note describes the purpose, hypotheses, and methods to be implemented for a study to quantify the waterbird use of exposed mudflat habitat, document stopover-use of a shorebird species during fall migration, and characterize vegetation responses to dropping water levels in late summer from the execution of environmental pool management (EPM) at Lake Red Rock on the Des Moines River, Marion County, IA in 2021 and 2022.

BACKGROUND: The U.S. Army Corps of Engineers (USACE) operates more than 700 dam and reservoir projects for navigation and flood risk management (USACE 2021). Conventional means of regulating pool levels alters sediment dynamics and floodplain and riparian communities (TNC and USACE 2017). EPM, or modification of reservoir and navigation pools to better mimic natural flows while remaining consistent with project authorizations, has resulted in observed benefits to floodplain and riparian communities. However, data are necessary to quantify biological benefits that EPM provides so that these benefits can be incorporated into dam operation decision-making. Using a 2016 report from the Institute for Water Resources (IWR) that captured 356 reservoir projects owned and operated by USACE, 14% of operating changes were conducted to incorporate seasonal patterns of rising and falling pool levels to support environmental benefits (IWR 2016). Currently EPM is not a frequent driver for managing dam operations, so data quantifying the environmental, social, and economic benefits of this approach will empower districts to make informed decisions regarding operating changes.

Multiple programs and projects value the development of data to quantify environmental and ecological benefits of EPM, and therefore this project leveraged the combined interests of several USACE civil works research programs. This project was initiated by the Sustainable Rivers Program (SRP), which funded waterbird research, sediment delta mapping, and the denitrification literature review for the current Engineering with Nature (EWN) research. The SRP, formerly the Sustainable Rivers Project, was initiated in 2002 as a collaborative effort between The Nature Conservancy (TNC) and USACE. Within SRP, environmental-flow assessments are conducted to evaluate opportunities for implementation of EPM and downstream-management alternatives. TNC defines environmental flows as “scientific prescriptions for the timing, quality and quantity of water flow that must occur downstream and upstream of dams to revive and sustain critical ecological functions and habitat for species” (TNC 2020). These assessments were conducted within 8 rivers by 2015 and 16 rivers by 2019 (TNC 2020). A 2016 environmental-flow assessment supported by SRP focused on the Des Moines River, where EPM for flood-control reservoirs was introduced at Lake Red Rock and was the impetus for the current research.

The aim of this three-year project is to communicate and quantify environmental benefits of EPM at Lake Red Rock, Des Moines River, Iowa. Environmental benefits of EPM will be quantified through a variety of efforts across multiple projects. This technical note outlines efforts to monitor waterbirds, vegetation, and shorebird stopover dynamics at Lake Red Rock.

INTRODUCTION: Lake Red Rock is a flood control reservoir that encompasses 6,171 ha and is located along the Des Moines River just southeast of Des Moines. Red Rock Dam became operational in 1969 and is managed by the USACE primarily for flood control (Austin and Glanville 1979, USACE 2022). Other benefits include wildlife and fish management and recreation. Historically, this reservoir was managed by initiating a fall pool raise to flood backwaters, primarily to benefit migratory waterfowl and increase access for hunters. There was no late summer drawdown to promote vegetation growth that could be flooded to increase food resources for migratory waterfowl. Furthermore, the pool raise was done in step increments beginning in early September rather than continuously throughout fall. In 2016 additional environmental benefits of Lake Red Rock pool management were explored through the SRP environmental-flows assessment process. This process incorporates workshops to identify water-management recommendations using stakeholder input. An updated reservoir regulation manual was completed in 2019 that incorporated stakeholder recommendations into updated reservoir-operation plans (USACE–Rock Island District 2021). Implementation of EPM in Lake Red Rock provides the opportunity to capture data focused on environmental and other benefits of this approach in a USACE reservoir with the potential for application to other reservoirs. A summary of this process is available in Calomeni et al. (2022).

WATERBIRD STUDY OBJECTIVES:

1. Monitor migratory waterbird use in response to decreasing-water levels during fall migration
2. Monitor Least Sandpiper stopover-use and determine if water level has influence on duration
3. Analyze vegetation and habitat development in response to decreasing-water levels

FIELD METHODS:

For **Objective 1** we will conduct waterbird surveys between mid-July and mid-September, which coincides with the fall migration period for most of these birds. Surveys will be conducted weekly at minimum and begin once the season's water level drawdown is initiated. Surveys will conclude for the season when water level begins to rise due to an associated and intentional reduction of outflows by the USACE. Unintentional pool raises may occur during the study period when inflow is stored, causing previously exposed habitat areas to be reflooded, though these events will not delay surveys.

Monitoring of migratory non-breeding waterbirds will follow the protocol framework of the Integrated Waterbird Management and Monitoring (IWMM) program such that monitoring efforts are standardized. The IWMM program monitoring protocols were developed from a collaborative mix of federal and state agencies to allow for use at local, regional, and flyway scales (Loges et al. 2021). Each survey will include a count of the number of individuals of all waterbird species present. Waterbirds to be focused on will include shorebirds, waterfowl, wading birds and all other bird species that are ecologically dependent on wetlands, as defined by Delany (2005) for the International Waterbird Census. The sampling method used will be adapted from what is described by Watson (2003) as the "standardized search". Through this method surveys are not conducted at fixed points or along transects, but instead as the observer moves amongst the study site until completion. This approach will allow the observation vantage points to change and increase in number as the draw-period progresses and more mudflat habitat

becomes exposed. Using a modified sampling method with results-based stopping criteria will then define the entire site (per each survey) as the standardized unit effort instead of the number of observation point counts within such area. Survey data will be analyzed using a linear mixed modeling approach where we explore relationships between waterbird counts and explanatory variables such as survey date, pool elevation, and others. Results will provide the first detailed assessment of the species composition, abundance, and timing of fall migrating waterbirds at Lake Red Rock.

For **Objective 2** we will quantify the stopover ecology of migratory Least Sandpipers. This common migratory shorebird breeds in the Arctic and winters from the southern U.S. southward into the tropics (Nebel and Cooper 2020). It is relatively easy to capture and has been the focus of similar studies at nearby Saylorville Lake (Vanausdall and Dinsmore 2021). Least Sandpiper trapping will begin in late July when sufficient numbers of individuals arrive following breeding. Birds will be captured with 12 m x 2.6 m mist nets placed along the edges of exposed mudflats where shorebirds are actively foraging. Mist nets with a 30 mm mesh size will be used to match the body size of the target species and will be set in tandem (typically in pairs), with multiple net sets deployed simultaneously to maximize captures. Least Sandpipers will be fitted with a model A2415 (Advanced Telemetry Systems, Isanti, MN) VHF transmitter to monitor stopover use. The tag weighs 0.5 g (Advanced Telemetry Systems 2022), so an individual will have to weigh >15 g for the tag to be <3% of the body mass, which is the lower end of the recommended 3-5% body mass rule for tag placement (Barron et al. 2010, Bridge et al. 2011). The goal is to tag ≥60 Least Sandpipers with transmitters each year of the study.

Before affixing tag to bird, plumage is used to assign age and morphological measurements are recorded to determine sex and assess body condition for each individual. Morphological measurements will include body mass (g), tarsus length (mm), and flattened-wing chord (mm), following methods by Obernuefemann et al. (2013). Tags will be attached similarly to methods described and successfully used by Warnock and Warnock (1993). The tag is positioned and secured with glue to the base of clipped feathers on the birds interscapular region of their back, with the antenna orientated towards the tail. Trimming feathers and using glue provides better tag attachment, which results in increased attachment time until the tag is lost during feather molt (Rohweder 1999). This method was used successfully in previous studies of stopover ecology in Iowa (Murphy and Dinsmore 2014, Vanausdall and Dinsmore 2021). Tags will eventually fall off when the bird molts later in fall. The VHF transmitters in this study have a battery life of 18-45 days (Advanced Telemetry Systems 2022). Tagged birds are relocated with a hand-held VHF YAGI antenna and receiver by thoroughly scanning the study area. Tags can be detected at distances up to 1 km dependent on environmental conditions and terrain (Bridge et al. 2011). Individuals will be tracked every 1-2 days until they depart the area. This work will provide the first detailed understanding about the migratory use of Lake Red Rock by a shorebird. We'll use known fate or Cormack-Jolly-Seber survival models (White and Burnham 1999, Cormack 1964) to estimate daily local survival and resighting probability. Local survival can then be converted into an estimate of residency time (in days), providing a measure of how long individual birds are using this site during fall migration. We'll also explore the influence of pool elevation, date, and individual body condition on local survival and residency times.

For **Objective 3** we will monitor vegetation responses to a fall pool drop at Lake Red Rock. Line transects will be used to sample the diversity, relative abundance, and productivity of plants colonizing the exposed mudflats. These surveys will explicitly focus on the wet mud/water interface to better document the timing and species composition of the plant response when mud areas are exposed by receding water levels. Twenty-five line transects will be randomly placed within the delta area in year 1 and will be resampled in year 2. Transects locations were randomly placed along the conservation pool elevation (226.2 m: 743 ft) line using aerial imagery from 2020. Starting points for each transect are on the edge of the high-water line (conservation pool level) within the already present vegetation and will run perpendicular to the shoreline into the receding water.

Vegetation will be sampled in a series of 20 cm x 50 cm quadrats that are placed along each transect line. Each transect will be sampled once per week to characterize responses throughout the fall sampling period (late July to early September). One challenge is that the pool level is expected to fluctuate during this period with an overall decline. To accommodate the possibility that quadrats may be underwater after a pool raise, we decided to take weekly quadrat samples at the current waterline rather than at fixed distances from the conservation pool elevation. Thus, quadrats will "retreat" along the transect line when the pool rises but extend further out on the line during pool drops. A single quadrat will be added to each transect per survey week and always placed along the front edge of the receding water line. In addition to the new quadrat, all previous quadrats (if exposed above water) along a transect will be sampled each week. Data collected within each quadrat sample on each visit include a count for the number of stems present, an estimate of visual percent-cover (Anderson and Davis 2013), a binary response of whether a species is producing seed, and the number of stems with seed for each species present, per week. Height measurements (cm) of the ten tallest stems allocated among all species present within a quadrat will also be recorded. Vegetation data will be analyzed using a linear mixed modeling approach where we explore relationships between line/quadrat plant data and explanatory variables such as survey date, pool elevation, and others. These results will provide the first detailed assessment of the species composition, relative abundance, and timing of emergence and going to seed for plants in the Lake Red Rock delta region. This has important implications for wildlife as a source of food and could impact the timing of future fall pool raises to benefit migratory waterfowl.

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