AN EVALUATION OF ECOSYSTEM RESTORATION AND MANAGEMENT OPTIONS FOR THE OURAY NATIONAL WILDLIFE REFUGE, UTAH

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EXECUTIVE SUMMARY

Ouray National Wildlife Refuge (NWR) contains 11,987 acres of riparian woodlands, floodplain wetlands, upland grasslands, and shrublands bordering 16 miles of the Green River in northeastern Utah. The majority of the refuge consists of a series of floodplain bottoms that adjoin the Green River behind channel bends. These bottoms support a diversity of habitats that are rare and decreasing throughout the Intermountain West. Many alterations to the physical structure and ecological processes of the Green River ecosystem have occurred since Ouray NWR was established. Most significantly, the hydrology of the Green River was greatly altered after Flaming Gorge Reservoir was built upstream on the Green River. Other major changes to the refuge include extensive construction of levees, ditches, and water-control structures; invasion of exotic plants and animals; contamination from selenium in irrigation water draining onto the refuge; and declining populations of many rare, threatened, and endangered animal species.

A primary challenge for future management of Ouray NWR is understanding how the Green River floodplain ecosystem can sustain historic ecological functions and values given its highly modified landscape and hydrologic regime. This report provides an analyses of options for restoring and managing native ecosystems at Ouray NWR. Objectives were to: 1) synthesize information on geological formations, geomorphic features, hydrologic condition, and natural history of the Green River ecosystem in the vicinity of Ouray NWR, 2) identify how the structure and function of the Green River ecosystem at Ouray NWR have been altered, and 3) identify restoration approaches and ecological attributes needed to restore and manage specific habitats and ecological conditions on Ouray NWR.

Ouray NWR is located within the Unita Basin of northeastern Utah; its geology was mostly shaped and formed during the Tertiary period. The modern day Green River that flows through the Unita Basin runs 730 miles from its headwaters in the Wind River Range in Wyoming to its confluence with the Colorado River. The Green River at Ouray NWR is a relative wide, low gradient, sand bed system that has cut meandering channels through the soft Unita geological formation. A complex of alluvial-derived surfaces are present in this stretch of the Green River and includes point bars, natural levees, floodplain terraces, backswamps, older abandoned channels, and the active channel of the Green River. Historic alluvial processes created a heterogeneous distribution of topography, soils, and hydrological regimes on Ouray NWR that support a diversity of habitats. During the last 70 years, channel migration of the Green River at Ouray has apparently been very limited and meander patterns may have been close to the present location for considerable time.

Ouray NWR has a semiarid climate. Because of relatively limited local precipitation, the hydrology of the Green River in the vicinity of Ouray NWR is controlled by spring snowmelt in the Rocky Mountains of Wyoming, Colorado, and Utah. Historically, annual discharge and peak yearly flows in the Green River were highly variable. Prior to closure of Flaming Gorge Dam, peak discharge of the Green River at Ouray NWR typically was in late May and averaged 24,000 cubic feet/second (cfs) with a range from 8,000 cfs to 37,000 cfs. During the last 100 years only 5 peaks occurred outside of May or early June; river discharges decline significantly in July to low base flows from September through March.

The historic Green River mean annual peak discharge of 24,000 cfs at Ouray NWR occurred at a frequency of about 2.3 years. From 1923-1962, recurrence intervals of 1.25, 2, 5, and 10 years were associated with flows of 15,764 cfs, 21,967 cfs, 27,952

cfs, and 30,707 cfs, respectively. This mean annual discharge of 24,000 cfs historically was equaled or exceeded 1.3% of the time (about 5 days/yr). Prior to construction of levees on Ouray NWR and closure of Flaming Gorge Dam, water from the Green River began overtopping banks of the river and extensively flooded floodplain bottoms at Ouray NWR from 14,000 to 18,600 cfs. The floodplain bottoms on Ouray have different sizes and flood frequencies, but recurrence intervals of initial flooding for all bottoms historically was from 1.2 to 1.7 years. Johnson and Woods bottoms are smaller than other bottoms on Ouray NWR and most areas in these bottoms are filled quickly once Green River flows overtop natural levees. In contrast, the large Wyasket Bottom begins to flood at about 19,000 cfs, but flows > 22,000 are required to fill it.

Historically, the Green River first entered floodplain bottoms at Ouray NWR at low elevation sites along natural levees at downstream ends of bottoms, and last at higher elevation point bars on inside bends of the river. This pattern of flooding caused most flooding at Ouray NWR to occur as relatively slow "backwater" floods. For example, at Leota Bottom, slow backwater floods entered the south part of the bottom near L7A at flows of 13-14,000 cfs with a return interval of about 1-1.2 years, whereas higher velocity "headwater" floods that overtopped the inside bend point bar at L3 occurred only at flows > 27,000 cfs with a return interval of > 5 years.

Groundwater levels under Ouray NWR floodplains are influenced by geomorphic surfaces, soils, and subsurface connectivity with the Green River. The degree and location of subsurface connectivity on Ouray NWR has not been determined, however, sites that probably have the greatest connection include sites immediately behind point bars where water can move through sandy soils in and out of backswamp depressions. In these wetland sites, some seasonal "ponding" may occur when the Green River is at a high stage, even if the river does not overflow natural levees and backflood these areas.

The types and distribution of historic vegetation communities at Ouray NWR were determined using a combination of historic and contemporary information. A gradation of vegetation types and ecological processes occurred from high elevation upland benches to the present river channel. High elevation upland benches formed by the Unita Formation contain grasslands interspersed with low shrubs. Clay bluffs occur on slopes of upland benches and are barren and highly eroded. Terrace fan remnants contain material eroded from upland benches and bluffs and support sparse semidesert shrub communities. Occasional fire, herbivory, and local precipitation drive ecological processes in these upland areas.

Alkali flats occur between the bottom slopes of shrubland terraces and upland sides of floodplain wetlands. These flats contain many relatively salt tolerant shrubs, forbs and grasses and may be seasonally flooded depending on precipitation and snowmelt in the local area. During very high flood events on the Green River, alkali flats may be shallowly flooded for short periods and attract large numbers of shorebirds, gulls, swallows, wading birds, and waterfowl.

Backswamp floodplain wetlands are present in all floodplain bottoms on Ouray NWR. Historically each bottom had slightly different water regimes depending on topography and frequency of inundation by the Green River. The depth, duration, and extent of flooding in these wetlands was driven by flood pulses of the Green River and were highly variable among years; the norm being a relatively short pulse (1-2 weeks) of flood entry followed by gradual drying through summer and fall. Consequently, most floodplain wetlands, excepting deeper depressions, had seasonal or semipermanent water regimes. Vegetation in floodplain wetlands reflects water duration. Annual and perennial herbaceous plants occur at higher edges and more water tolerant emergentsoccur in deeper depressions. During wet periods with extended flooding, many aquatic-dependent birds, mammals, and amphibians use floodplain wetlands and many waterbirds nest in or near these wetlands. However, in most years few waterbirds nested successfully and most waterbird use occurs in fall and spring. Several native fish species historically moved into floodplain wetlands on the ascending limb of flood pulses and used resources for reproduction and survival depending on the species. Analyses of long-term river level data suggests that year-long inundation of at least some of the deeper depressions in at least Woods and Johnson bottoms historically occurred about every 5-7 years.

Perhaps the most basic and important alteration to the Ouray NWR ecosystem, since the refuge was established, has been the marked reduction in the frequency, magnitude, and duration of flooding from the Green River after Flaming Gorge Reservoir was built and its dam closed in November 1962. Mean annual peak flow in the Green River at Jensen, Utah immediately upstream of Ouray NWR

decreased from 24,000 cfs prior to 1963 to 17,400 cfs after 1963. The total amount of water released from Flaming Gorge Reservoir is not different now from total annual discharges prior to closure of the dam, but the timing is altered such that spring flood peaks now are lower, shorter duration, and less frequent. Historic flows that would result in 2, 5, and 10-year flood recurrences at Ouray NWR now have been reduced 26%, 19%, and 13%, respectively, from the period prior to dam closure. The mean peak flow of 24,000 cfs prior to dam closure occurred about every 2.4 years, now that same flow occurs on average every 8+ years. The mean peak of 24,000 cfs historically was exceeded about 5 days/year. Now, that same discharge is equaled or exceeded only about 1 day/year. Prior to 1963, some overbank flooding of floodplain bottoms on Ouray NWR occurred almost every year; now substantial overbank flooding occurs only about 2 of every 5 years.

Local topography and hydrology on Ouray NWR also has been altered from the construction of roads, levees, water-control structures, spillways, ditches, and facilities of the Ouray National Fish Hatchery. Each floodplain bottom, except for Wyasket Bottom, has extensive levees, ditches, and water-control structures that have altered water permanence, entry and exit points for Green River flood flows, and vegetation composition and system processes. Many impounded floodplain wetlands have been managed for more permanent water regimes than historically occurred and created monotypic stands of emergent vegetation and reduced seasonally-flooded habitats needed, and used, by migrant waterbirds. Exterior levees have altered and reduced flood frequency from the Green River and changed deposition and scouring processes and allowed invasive species to increase.

Despite significant alterations to the Ouray NWR ecosystem, many areas retain at least parts of historic community structure and ecological processes. Floodplain wetlands comprise the largest, but also most altered, habitat type on Ouray NWR and restoration will require that each bottom be carefully evaluated to: 1) understand geomorphic surfaces; 2) realistically assess opportunities to emulate ecological processes especially flooding frequency, duration, and extent; and 3) determine relative costs and benefits of management actions. We offer certain ecological principles that can help guide decisions and restoration activities including: 1) what is the appropriate conservation objective for each area and habitat type, 2) how to restore both structure and function of wetlands, 3) restoring like-for-like habitats where degradations have been severe, 4) reconnecting the Green River to Ouray NWR floodplains, and 5) designing practical infrastructure that can reduce management intensity and cost.

Important general goals for habitat restoration on Ouray NWR are to: 1) maintain a complex of habitat types that match historic distribution related to soils, geomorphic surfaces, topography, and hydrological regime; 2) improve the connectivity between the Green River and floodplain wetlands; 3) emulate natural hydrological regimes where possible; 4) enhance riparian woodlands to provide a corridor of cottonwood-dominated forest along the Green River; and 5) enlarge the size of habitat "patches" where possible and reduce compartmentalization and/or restrictions to surface water flows into and across floodplains.

Upland areas are the most intact habitats on Ouray NWR and should be protected from further development or disturbance. Alkali flats also need protection from development and unnecessary roads and ditches should be removed to improve surface water sheetflow across these flats. Improved frequency of overbank flooding is needed to improve regeneration of cottonwood in riparian areas. Existing areas of cottonwood should be protected and mechanical soil disturbance on point bar ridges in Sheppard and Leota bottoms should be evaluated to stimulate cottonwood germination.

Wyasket Bottom is the least disturbed of floodplain bottoms on Ouray NWR and its topography and water flow patterns should be protected by eliminating roads and ditches where possible and restricting further development. All levees and water-control structures in the old Wyasket Pond area should be removed to restore ridge-and-swale topography, and the inlet structure and ditch that provided water to Wyasket Pond at flows of > 4000 cfs should be abandoned.

Slow backwater flooding of Johnson Bottom should be promoted by widening the current 200 foot breach and constructing at least one additional breach; breaches should not be constructed at the upstream end of Johnson Bottom. Water regimes in Johnson Bottom should be managed for regular seasonal and annual drying; it should not be continuously flooded for >2-3 years.

The upstream inlet and interior drain canals in Woods Bottom are in unnatural locations and costly to maintain. The inlet structure can be retained to provide management flexibility, however, the interior

drains should be filled. All interior levees in Woods Bottom should be removed to facilitate sheetflow of water across this floodplain wetland. A new levee breach at least 400 foot wide should be constructed at the southern part of the Main Unit of Woods Bottom. Water regimes in Woods Bottom should be managed for long-term dynamics, and not continuously flooded for > 2-3 years.

Leota Bottom is the most modified of Ouray NWR floodplain areas and future management should seek to simultaneously enhance backwater flooding, reduce constrictions or diversions of flood water across the bottom, and maintain many units in intensive seasonally-flooded wetland management. Levees along the river-side of Leota Bottom and cross levees that impede sheetflow of water across Leota should be removed. The levee breach at L7A should be widened and armored. Levee breaches should not be constructed at point bar locations at the upper parts of Leota in L1, L2, and L3. Areas > 4663 feet elevation should be managed for riparian woodlands. Low elevations in L3, L5, and L7/L7A should be managed as semipermanent wetlands. L4, L6, L8, L9, and L10 should be managed as seasonal wetlands with shorter duration flooding regimes.

In Sheppard Bottom the drain canal in S3 should be isolated from the floodplain. As with other floodplain bottoms, levee breaches should not be constructed at the upstream ends of Sheppard Bottom; the more natural breach site is on the south side of S1. S1, S2, and S4 should be managed as a complex of seasonal and semipermanent wetlands. Higher elevations can be managed as riparian woodland, and crop fields should continue to be provided for predictable forage for geese, sandhill cranes, and ungulates. The Parker impoundments should be managed as seasonally flooded units to produce herbaceous vegetation and moist-soil foods.

Habitat restoration projects on Ouray NWR should be accompanied by an active monitoring and evaluation program. At Ouray NWR, 4 restoration and management issues have considerable uncertainty and will require careful evaluation; they include: 1) long-term impacts of levee breaches, 2) mechanical disturbance to increase cottonwood germination and survival, 3) intensive management of wetland impoundments, and 4) location and degree of subsurface groundwater connection between the Green River and floodplain wetlands.