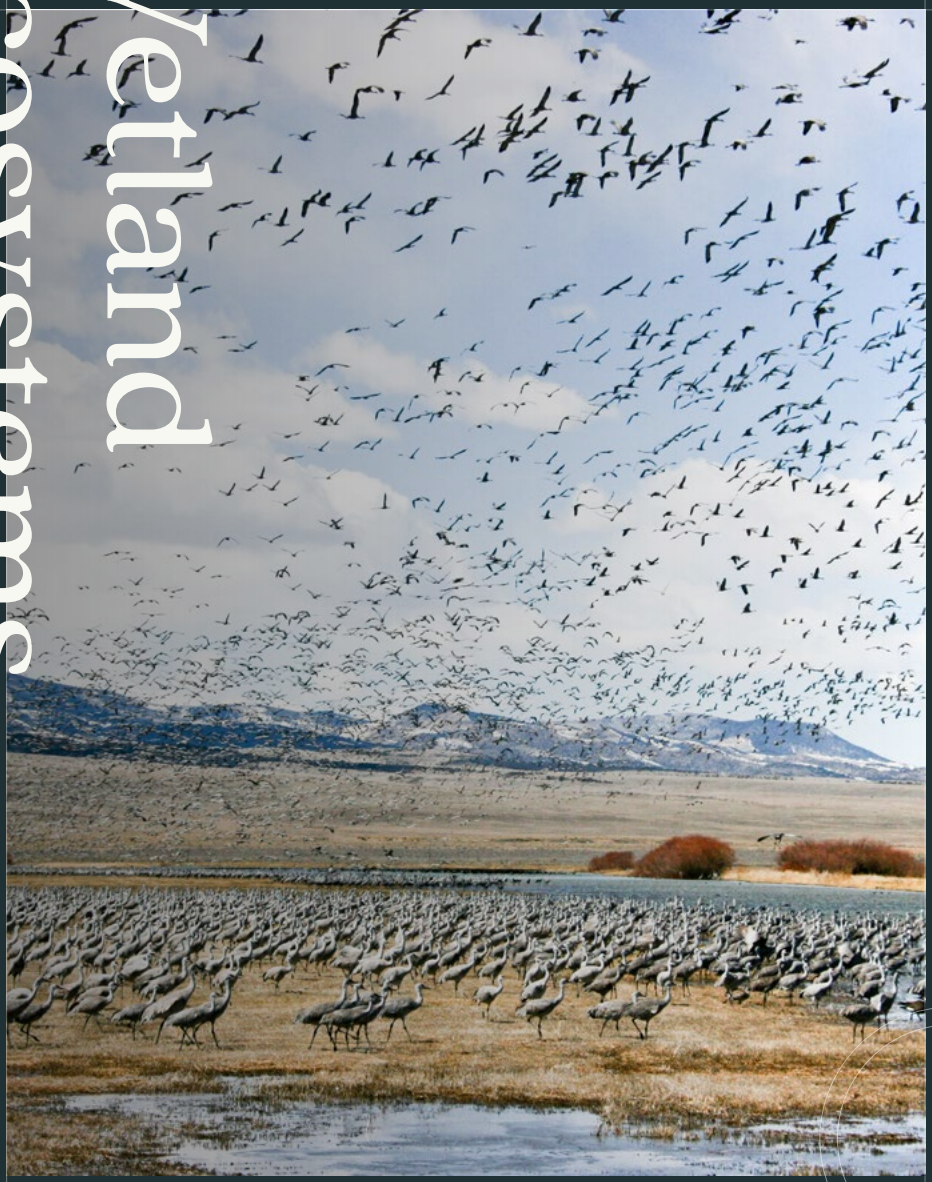
CHAPTER FIVE:

Wetland Ecosystems



Introduction

The IWJV has focused on conserving wetlands since its inception. Wetlands are widely dispersed across the Intermountain West and characterized by high biological diversity and productivity, making them among the region's most important wildlife habitats[1]. Wetlands also provide many essential ecological and cultural benefits (Box 1)[2]. Given their limited distribution and support of critical ecosystem functions, wetlands in the region are inordinately valuable to wildlife and people.

Wetland systems in the Intermountain West have been highly modified and are at considerable risk of loss and degradation[3]. Furthermore, a new threat has emerged in recent years: decreases in water availability leading to sustained wetland drying (i.e., wetlands flood for shorter durations within and among years). Research by the IWJV and partners has shown significant wetland declines across snowmelt-driven watersheds in the West, with climate change and overallocation of water resources acting as the primary drivers of this loss[4]. Drought in the West is not a temporary, regional issue; it is a long-run, landscape-scale problem with implications for food security, human health and communities, the economy, and fish and wildlife populations.

Water is one of the West's most critical and high-stakes natural resource issues. To ensure the persistence of migratory bird habitat into the future, we need intact wetland landscapes and water to sustain the intermittent flooding that defines them. All states within the IWJV boundary use some version of the prior appropriation doctrine[5] to allocate water, which relies on the priority of initiation of use to determine the order in which water rights are served. This system is especially important when supplies are short. As such, sustaining wetland habitats in the future requires a strategic investment in people and partnerships that are interwoven into the land and water. For example, supporting wetland-dependent migratory birds necessitates working with agricultural water users who hold some of the region's most senior water rights, particularly by maintaining flood-irrigated grass hay production, which represents a substantial contribution to temporary and seasonal wetland habitat early in the growing season.

In addition, managed wetland complexes often fill a complementary niche by providing essential habitat such as semi-permanent wetlands. These wetland complexes complete the life cycle needs of many migratory bird species and may represent the only water resources remaining on the landscape during drier times of the year, making collaboration with the managers of these wetlands important.

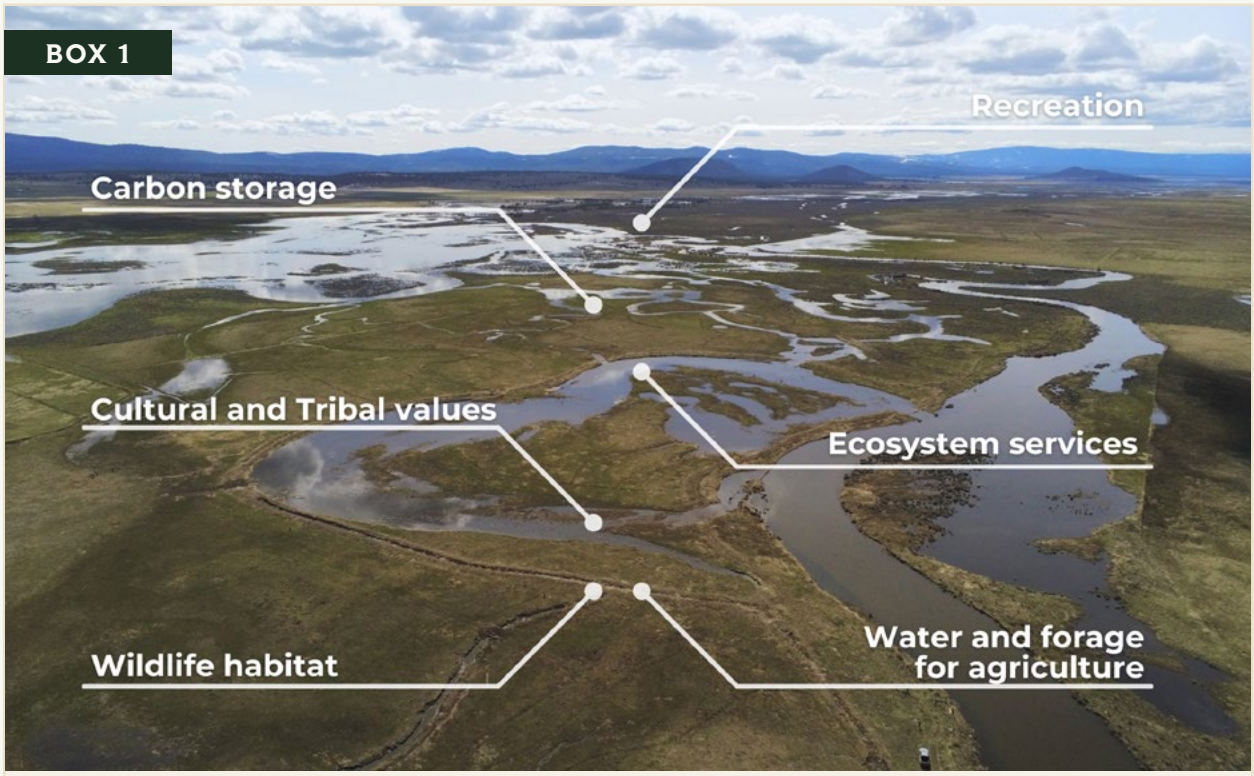
As a migratory bird joint venture established through the North American Waterfowl Management Plan (NAWMP) and tasked with coordinating cross-boundary habitat conservation, the IWJV plays a unique role in supporting wetlands across the Intermountain West.

Continued on next page →

[1] Donnelly and Vest 2012, [2] Ingram and Lewandowski 1999, Sketch et al. 2020, Conlisk et al. 2023, [3] e.g. Copeland et al. 2010, [4] Donnelly et al. 2020, [5] Waters and Spitzig 2018

Wetlands in this region provide essential resources for many populations of wetland-dependent birds (Box 2). However, these habitats lack a formal prioritization framework such as those developed for activities in the sagebrush biome. Although traditional habitat planning successfully provides measurable objectives for maintaining waterbird populations, these objectives are often established without considering ongoing environmental change. Rapid loss of flyway wetlands due to climate and land use change has raised concerns about the inability of the traditional approaches to effectively assess evolving environmental conditions and associated impacts on waterbird habitat. Recent NAWMP guidance suggests that joint ventures address these challenges by adopting an ecosystem approach to conservation design that uses landscape monitoring as an adaptive framework to inform habitat investments under changing flyway conditions.

The IWJV has taken a cue from recent sagebrush conservation prioritization frameworks by investing in wetland science that identifies emerging threats to long-term wetland resilience. In this chapter we leverage this new science to identify priority habitats and provide guidelines, concepts, and tools that will lead to meaningful conservation actions for western wetlands. Ultimately, this framework should be used to advance effective and collaborative wetlands conservation amid increasing water-related challenges.



Benefits Provided by Wetlands in The Intermountain West

Carbon Storage
In part due to their abundance, freshwater inland wetlands hold nearly tenfold more carbon than tidal saltwater sites in North America—making them an important contributor to regional carbon storage[1].

Cultural and Tribal Values
Indigenous peoples have had and still have relationships with wetland systems since time immemorial, and wetland plants and wildlife provide important food, medicine, and other cultural resources.

Wildlife Habitat
Wetlands are widely dispersed across the Intermountain West and characterized by high biological diversity and productivity, which make them among the region's most important wildlife habitats[2].

Recreation
Wetlands offer important outdoor recreational opportunities such as hunting, fishing, wildlife viewing, and nature photography, which are significant economic drivers for many western communities[3].

Ecosystem Services
Wetlands provide important ecological goods and services, including temporary storage of surface water (i.e., flood control and attenuation), aquifer recharge, streamflow maintenance, sediment retention, shoreline stabilization, and transformation of nutrients and pollutants[4].

Water and Forage for Agriculture
Wetland systems are critical to ranching economies in the western United States, providing water resources and high-productivity forage for livestock[5].

[1] Nahlik and Fennessy 2016, [2] Donnelly and Vest 2012, [3] Ingram and Lewandowski 1999, [4] Conlisk et al. 2023, [5] Sketch et al. 2020

BOX 2

Wetland-Dependent Bird Populations of Note in The Intermountain West

Percent of continental populations for wetland-dependent birds of note occurring in the Intermountain West by annual cycle

Guild	Species	Breeding	Migration	Winter
Waterfowl	Cinnamon Teal	>60%	-	-
	Northern Pintail	-	30%	-
	Tundra Swan *(Western)*	-	80%	-
	Trumpeter Swan *(Rocky Mountain)*	10%	-	>80%
	Greater White-fronted Geese *(Pacific Flyway, Tule)*	-	>50%	-
Shorebirds	American Avocet	56%	93%	-
	Black-necked Stilt	69%	-	-
	Snowy Plover *(Interior)*	75%	-	-
	Long-billed Curlew	57%	-	-
	Marbled Godwit	-	75%	-
	Wilson's Phalarope	-	50%	-
	Long/Short-billed Dowitchers	-	53%	-
Waterbirds	White-faced Ibis	73%	-	-
	California Gull	75%	-	-
	Eared Grebe		90%	
	American White Pelican	32%		
	Greater Sandhill Crane			
	Central Valley	42%	>90%	
	Lower Colorado River Valley	100%	>90%	
	Rocky Mountain	100%	100%	90%
	Lesser Sandhill Crane *(Pacific Flyway)*		>90%	

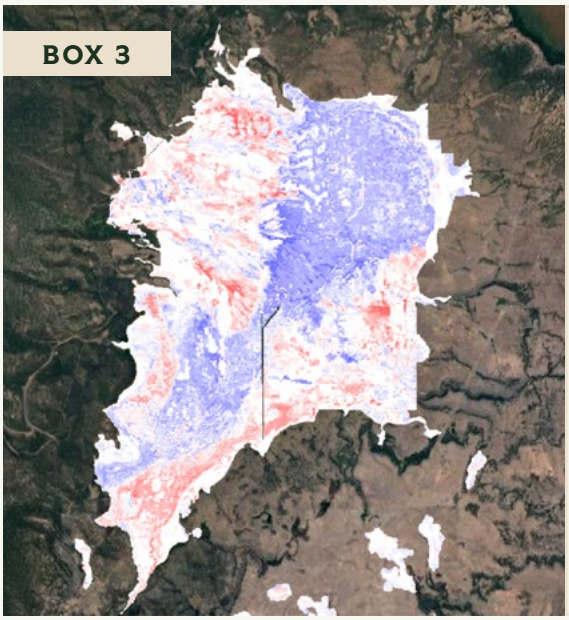
Adapted from Donnelly and Vest 2012

Tracking Wetland Change

The variable nature of water in the Intermountain West has created challenges for tracking wetlands due to wide fluctuations in surface water presence within and between years. A lack of accurate information about flooding over space and time has historically been a significant barrier to monitoring wetland trends and prioritizing conservation activities.

As a direct response to this information gap, the IWJV developed surface water models that comprehensively analyze surface water dynamics from 1984 to the present day. These models are packaged for users as the "Wetland Evaluation Tool," or WET[6] (Box 3). The tool encompasses the entirety of all 11 western states that the IWJV's region overlaps and can be used to analyze nearly four decades of landscape change in the wetland and flood-irrigated agricultural complexes that comprise the "green ribbons" of the West's intermountain valleys and floodplains.

Unlike traditional habitat objective-based planning, where progress is measured in isolation from evolving environmental conditions, this framework allows investments and outcomes to be evaluated through continuous landscape assessment that tracks the combined effects of conservation actions, climate, and land use change on surface water. This science provides a new lens through which the IWJV and our partners can better understand surface water dynamics and develop strategies for addressing wetland loss.



BOX 3

The Wetland Evaluation Tool

In 2023, the IWJV rolled out the full, 11-state **Wetland Evaluation Tool (WET)**. When paired with local knowledge, WET provides a powerful new way to track surface water and wetlands across our ever-changing landscape. Here, red shows wetlands that are trending dryer, while blue shows wetlands that are trending wetter.

[6] IWJV 2023

The IWJV's Water 4 Program

In 2016, the IWJV Management Board met to chart the future course of the IWJV's wetland habitat conservation efforts. The board identified a clear opportunity to modernize the IWJV's approach to wetlands conservation around themes of achieving multiple benefits and relevancy to people. This concept was developed concurrently with new wetland science and tools, and, in 2018, the IWJV Management Board took a bold step to catalyze accelerated wetland habitat conservation by developing the Water 4 Initiative. Now a fully fledged IWJV program, Water 4's goal is to conserve wetland habitat in the Intermountain West to sustain populations of migratory birds at continental goal levels through partnership-driven, science-based programs, projects, and collaborative efforts. This fresh approach centers on conserving wetland habitat and "water for" irrigated agriculture, wildlife and fisheries habitat, groundwater recharge, and landscape resiliency in ways that matter to people.

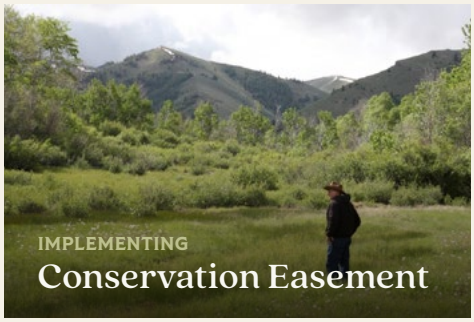
Water 4 supports a functional network of diverse wetlands across public and private boundaries by working with agricultural producers, land managers, and other partners. It yields expanded and accelerated results that benefit multiple stakeholders, deploying an approach that includes:

- Science that identifies vital working wetlands and enhances access to and use of science for strategic conservation, from field implementation to funding and decision-making.
- Capacity that addresses conservation bottlenecks and works through existing partnerships to increase the pace and scale of conservation. Adding capacity requires putting the right people with the right skills in the right place.
- Communications that advance conservation through stories about partnership-driven efforts, outcomes, and the tools that get the job done.

Examples of key practices that align with Water 4 goals and priorities are identified in the Water 4 Toolbox (Box 4). Water 4 uses science, communications, and capacity-building to support partners implementing these and other practices to advance multi-benefit wetland conservation efforts. The Water 4 program recognizes that people are an essential part of successful wetland habitat conservation. As such, the program focuses on functional wetland types that are grouped by both ecological characteristics and water management regimes. This approach connects threats to wetland habitats with opportunities to implement on-the-ground actions that support migratory birds under the existing framework of water management in the West.

BOX 4

The Water 4 Toolbox



Wetland Habitats of the Intermountain West

Much of the Intermountain West is characterized as North American Desert Biome (58 percent)[7], where low precipitation combined with high evaporation rates constrict the distribution of water resources. Although wetland abundance is relatively low here compared to other regions of North America, wetlands occur throughout the Intermountain West and primarily occupy areas of high hydrologic discharge within and adjacent to high-elevation mountainous regions. These systems are driven primarily by accumulated winter snowpack[8]. Snowmelt in mountain streams peaks from late spring to early summer, resulting in intermittent surface flows that feed many wetland basins. Stream discharge rates vary widely and are affected by seasonal, annual, and decadal shifts in precipitation. Additionally, high evaporative rates in many areas result in intermittent and ephemeral wetland patterns.

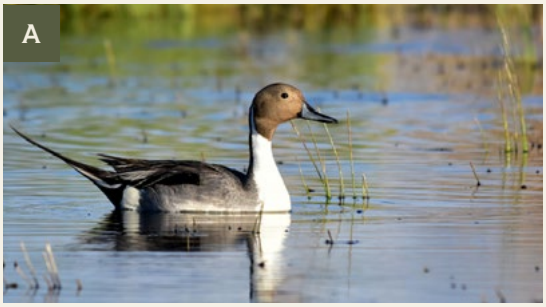
Combined, these characteristics sustain exceptionally dynamic wetland cycles that exhibit high annual temporal and spatial variability across regional scales. These wetlands are keystone habitats within the region because they help drive ecosystem form and function and structure biotic communities far beyond their areal extent. Over 80 percent of wildlife species common to the region depend partly on wetlands, including migratory waterbirds[9], which often rely on specific wetland types to meet annual life cycle needs (Box 5).

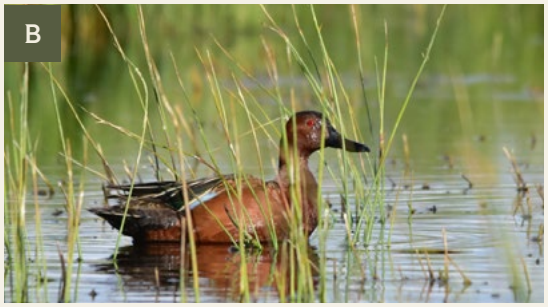
The variability of the region's wetland systems has given rise to an abundance of wetland diversity further structured by human water management (Box 6)[10].Three wetland habitats are identified as the primary focus of this plan due to their importance for migratory birds and the conservation opportunities offered by their connections to human water management. We further recognize other wetland types that provide essential habitat for migratory birds and represent additional opportunities for regional conservation efforts outside of this plan through the work and planning of other organizations. For more detailed descriptions of habitat types and functions, refer to the IWJV's 2013 Implementation Plan[11].

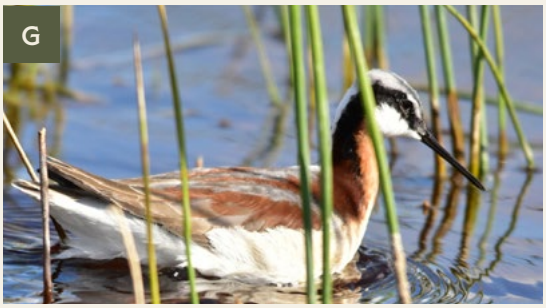
[7] CEC 1997, [8] Fyfe et al. 2017, [9] McKinstry 2004, [10] Downard and Endter-Wada 2013, [11] IWJV 2013

BOX 5

Wetland-Dependent Birds of the Intermountain West







Over 80% of wildlife species common to the Intermountain West depend on wetlands to meet some portion of their annual life cycle needs, including migratory wetland-dependent birds. The flagship species shown include waterfowl, shorebirds, and waterbirds that are emblematic of the wetlands of the Intermountain West.

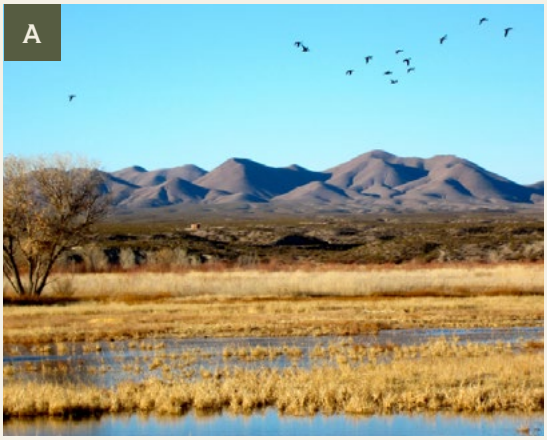
A) The Northern Pintail *(Anas acuta)* and **B) the Cinnamon Teal** *(Spatula cyanoptera)* rely on flood-irrigated agriculture and public wildlife management areas. **C) Greater Sandhill Cranes** *(Grus canadensis)* and **D) White-faced Ibis** *(Plegadis chihi)* frequent flood-irrigated agricultural areas. **E) The American Avocet** *(Recurvirostra americana)*, **F) Black-necked Stilt** *(Himantopus mexicanus)*, and **G) Wilson's Phalarope** *(Phalaropus tricolor)* rely on public wildlife areas and saline lakes, like the Great Salt Lake.

Photos: Tom Koerner/USFWS Mountain Prairie Region.

BOX 6

Wetlands of the Intermountain West

Wetland habitats in the Intermountain West provide outsized ecological benefits for their relatively small footprint on the landscape. The diverse geography of the Intermountain West, in combination with temporally dynamic water resources, creates tremendous wetland diversity.



A) Managed wetlands include many wetland types and provide a unique opportunity to adapt in the face of environmental change due to existing infrastructure and staffing dedicated to habitat stewardship. Many of these areas, such as the Bosque del Apache National Wildlife Refuge in New Mexico (pictured), were originally designated for the purpose of protecting habitat for migratory birds, especially waterfowl, and thus create a network system of protected wetland habitats that are used by birds as they migrate across the landscape.

B) Flood-irrigated agriculture, like this field in the Bear River Watershed of Utah, provides important seasonal habitat in historical riparian footprints. These areas support nearly 60 percent of temporary wetlands in the Intermountain West.

C) Riparian areas, like this stream outfitted with beaver dam analogues at Knott Ranch in Colorado, can provide important water resources for wildlife in otherwise dry landscapes.

D) Terminal saline likes, such as the Great Salt Lake, support enormous concentrations of birds during key stages of their life cycle, including breeding, migration, staging, and molting. Many lakes are experiencing drying, reducing important habitat for migratory birds

Managed Wetlands

The network of managed wetlands on national wildlife refuges, Tribal lands, state wildlife areas, private wetlands such as duck clubs, and parks and preserves sustain migratory bird populations during all stages of their annual life cycles. Although many of these areas are composed of multiple habitats (including grasslands and other upland habitats, riparian areas, playas, unmanaged freshwater wetlands, and managed wetlands), we focus on the managed wetlands within these complexes. The biotic setting within these wetlands may vary widely, but the opportunity created by management makes them unique in that they can be effectively conserved and enhanced through management actions.

An IWJV analysis of a subset of managed wetlands shows that national wildlife refuges and state wildlife areas support approximately 193,600 acres of flooded and managed wetland habitat. This limited area represents a significant conservation opportunity (Box 7). Further opportunity exists with privately managed wetlands, such as duck clubs, where conditions are targeted for specific waterfowl habitat needs.

BOX 7

Managed wetlands within state and federal wildlife areas in the Intermountain West

State	Acres
Washington	7,992
California	32,953
Utah	63,208
Nevada	*28,496*
Colorado	*8,554*
Oregon	17,035
Montana	749
Idaho	*23,627*
New Mexico	6,815
Wyoming	4,217
Totals	**193,646**

Results represent maximum mean annual wetland inundation extents from 2015 to 2023. Summaries exclude a) large unmanaged water bodies and unmanaged wetlands within state and federal wildlife areas, and b) managed wetlands outside of state and federal wildlife areas.

[12] Donnelly et al. 2024, [13] Sueltenfuss et al. 2013, Donnelly et al. 2024, [14] GAO 2019, [15] Ferencz and Tidwell 2022

Flood-Irrigated Grass Hay Agricultural Lands

Flood-irrigated grass hay agricultural fields and pastures provide essential seasonal habitat for many species of migratory birds, with flood irrigation tied to grass hay production supporting 58 percent of temporary wetlands in the Intermountain West[12]. These systems primarily occur within historical riparian habitats. Flood irrigation practices convey large volumes of water through systems of canals and ditches before being applied to fields as sheet flow to saturate soils, creating wetlands that are both directly and indirectly supported by irrigation water[13]. Flood-irrigated systems such as these are often considered "inefficient," meaning substantially more water is diverted for irrigation than is required to produce the grass hay crop[14]. Excess water not consumed through evapotranspiration may percolate back into soils as recharge to local groundwater tables or follow subsurface flow pathways that eventually return the water to the stream from which it was diverted[15].

BOX 8

Acreage of wetlands associated with flood-irrigated grass hay by state in the Intermountain West

State	Acres
Washington	20,428
California	29,019
Utah	46,756
Nevada	*51,609*
Colorado	*77,992*
Oregon	115,213
Montana	140,459
Idaho	*154,482*
Wyoming	182,197
Totals	**818,156**

Approximately 818,000 acres of wetland habitats associated with grass-hay production exist in the valleys and river corridors of the Intermountain West (Box 8). These wetlands are human-managed systems that support many species of dabbling ducks, shorebirds, and waterbirds during the breeding, migration, and winter seasons. For instance, 67–96 percent of habitat use by migrating greater sandhill cranes occurs on private lands, where many wetlands are associated with irrigated agriculture.

Terminal Saline Lakes & Associated Wetlands

The large, terminal (*endorheic*) saline lakes within the Intermountain West are renowned for their unique biographic features and significance to wetland-dependent birds. Although the number of saline lakes is small, these water bodies are vital links in continental flyways, with numerous sites designated as critically important to waterbird populations[16].

Depending on their salinity, these sites often provide an abundance of brine shrimp (*Artemia spp.*) and brine flies (*Ephydra spp.*), critical food resources for various waterbird species. Terminal saline lakes support enormous concentrations of birds during critical stages of their life cycle, including breeding, migration, staging, and molting[17].

[16] e.g., NAWMP 2012, [17] Haig et al. 2019

Other Wetland Habitats

Many other types of wetlands exist in the Intermountain West and may be of local, regional, or flyway-scale importance for migratory birds, depending on their location and habitat characteristics. These include:

Riparian areas:

Riparian areas in the Intermountain West vary widely, including diverse deciduous tree and shrub floodplain vegetation, open meadows, cobble bars, and stream banks. Tree- and shrub-lined rivers, streams, springs, and ponds provide nesting habitats for various species, and islands create predator-free breeding habitats for ground-nesting waterbirds. Sandbars and mudflats along rivers and streams also support breeding and migrating shorebirds[18].

Reservoirs and other impoundments:

The construction of dams and other water projects in the Intermountain West has created open-water habitats beneficial to breeding, migrating, wintering, and roosting waterbirds. Islands provide breeding habitats for colonial waterbirds, and smaller species like shorebirds use shallow impoundments and levees during breeding and migration seasons.

Playas and ephemeral wetlands:

Small ephemeral wetlands, playas, and salt flats abound and are typically shallow depressions lined with a salt or alkali crust, limiting vegetation growth along the shore. These depressions fill with water seasonally, intermittently, or temporarily, depending on the depth of the water table or the amount of precipitation. In wet years, ephemeral wetlands can support high numbers of shorebirds, but this is contrasted by dry years when water may not be present[19].

[18] IWJV 2013; [19] Oring et al. 2013

Threats to Wetland Habitats

Habitat Loss

Functional Habitat Loss: Wetland Drying

Science produced by the IWJV and partners has revealed dramatic declines in wetland flooding within snowmelt-driven watersheds of the Intermountain West. In endorheic basins, lake areas declined by approximately 27 percent and wetland flooding was reduced by 47 percent between the mid-1980s and 2018[20]. These declines are the result of functional habitat loss, where lakes and wetlands still physically exist but the water needed to support migratory birds, fisheries, and other wildlife dries up quicker and more often. This trend is driven primarily by rising evaporative demands due to increasing global temperatures, as well as increasing human water use. Changes suggest that a regional tipping point in the ecosystem water balance has been reached, where supplies are overdrawn more quickly than they can be replenished.

Wetland drying trends compound habitat loss by creating temporal mismatches between migratory bird movement chronology and wetland abundance. For example, in the Southern Oregon–Northeastern California (SONEC) region, significant wetland losses have been driven by landscape drying as semi-permanent wetlands transition into temporary and seasonally flooded habitats[21]. This shift means an important habitat niche—deeper, late-season water for molting and migrating waterbirds—also disappears.

Physical Habitat Loss: Land Use Conversion and Exurban Development

Although 70 percent of all land in the Intermountain West falls within federal, state, or Tribal trust, approximately 70 percent of emergent wetlands occur on private lands[22]. Expanding urban and exurban development causes physical wetland loss by increasing habitat fragmentation rates, altering hydrologic patterns, diminishing water table recharge rates, and reducing habitat suitability for many plant and animal communities, especially wetland-dependent birds[23]. Ongoing physical wetland loss means remaining habitats become increasingly important because they must sustain wildlife demands with a diminished footprint.

[20] Donnelly et al. 2020, [21] Donnelly et al. 2022, [22] Donnelly and Vest 2012, [23] Maestas et al. 2003, Downard 2010

Changing Water Management

Water supplies that support wetlands are directly impacted by water management policies and decision-making at multiple levels, from individual landowners to local, state, and national governments. In riparian corridors, changing agricultural water management, particularly conversion from flood irrigation practices to more water-efficient systems such as sprinkler irrigation, may result in direct losses of temporary wetlands and indirect losses of surrounding habitats like riparian corridors[24]. The large-scale adoption of more efficient irrigation practices can also increase consumptive use, reducing groundwater recharge and associated return flows in streams and rivers[25]. In areas where urbanization encroaches on existing agriculture, a decrease in agricultural land productivity can increase the risk of subdivisions that fragment open landscapes used by wildlife[26].

Habitat Degradation

Plant Community Succession and Invasive Species

Timing and duration of flooding and disturbance influence the density and abundance of plant species within a wetland community. In wetlands where disturbance has been dramatically reduced or removed entirely, plant community succession can result in decreased seed production, reduced vegetative diversity, and increased populations of invasive species[27]. All of these factors can decrease the suitability of wetland habitats for migratory birds, even when water is present.

Alteration of Historic Floodplain Hydrology

Hydrologic connections between riverine systems and surrounding riparian habitats are essential for maintaining the high natural water tables necessary for sustaining wetlands within floodplains. River-wetland corridors were once common across the western U.S., but anthropogenic activities like channelization, dam construction, river regulation, floodplain drainage, and artificial levees have greatly reduced their extent[28]. These actions restrict seasonal flooding into channelized reaches and can lower the water table, uncoupling surrounding wetlands from the hydrologic processes on which they depend.

Water Quality

Many major wetland complexes in the region are located at the terminus of snowpack-driven systems and are impacted by upstream human activities such as mining and agriculture[29]. These water sources can be relatively high in concentrations of salts, nutrients, sediment, or contaminants that accumulate in terminal basins. Poor water quality and wetland water supply reductions can further concentrate contaminants, impacting wildlife habitat and threatening human health.

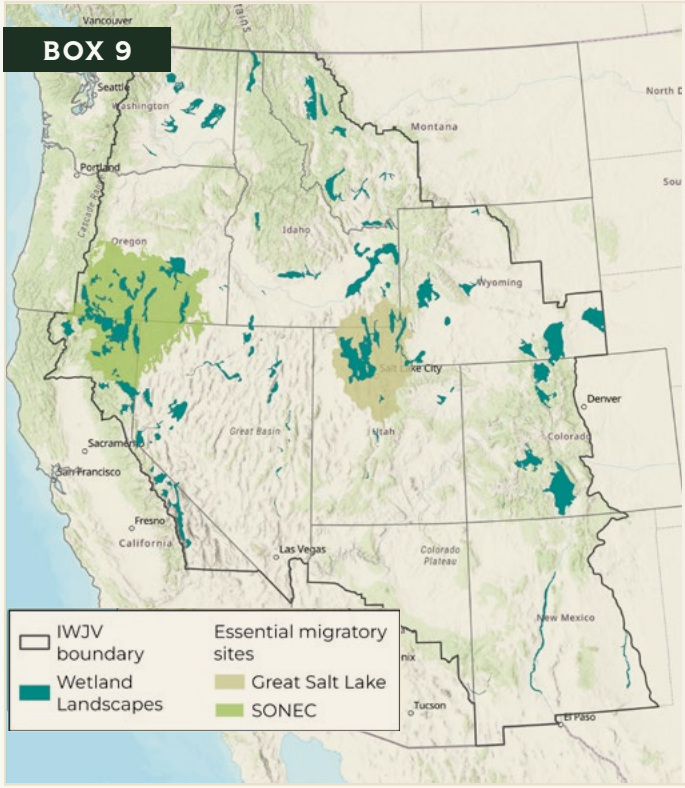
[24] Vanderhoof et al. 2019, [25] Ketchum et al. 2023, Morisette et al. 2023, [26] Dozier et al. 2017, [27] Gray et al. 2013, [28] Wohl et al. 2021, [29] US EPA 2000

Priority Geographies

In 2012, the IWJV published a series of science priority reports that summarized available knowledge of migratory bird habitat in the Intermountain West and identified key priorities for future science development[30]. A critical component of this effort was the establishment of the IWJV's 2013–2018 Wetland Focal Strategies, which delineated 18 wetland landscapes that encompassed approximately six percent of the Intermountain West but accounted for 50 percent of the inventoried emergent palustrine wetland systems in the region as identified by the National Wetlands Inventory. This effort also recognized challenges in mapping wetland availability, primarily in data extent and relevance to current conditions[31]. Science developed since 2012 by the IWJV and research partners across the West has filled many previously identified information gaps, thanks to wetland mapping products, expanded tracking efforts for waterbirds using new technologies, and research linking changes in water availability to migratory bird movement patterns. These focused scientific advances have dramatically expanded our understanding of wetland distributions and migratory bird ecology. The 2024 Focal Wetland Landscapes are updated to incorporate this new information (Box 9).

The IWJV identifies two levels of conservation opportunity within these landscapes: Essential Migratory Sites and Focal Wetland Landscapes. Collectively, these areas represent wetland habitats of significant importance for migratory birds in the Intermountain West. Strategic investments in these areas can maximize on-the-ground benefits for wetlands and flyway-scale conservation impacts. Further information detailing the significance of these landscapes to migratory birds is provided in the IWJV's Regional Wetland Profiles[32].

BOX 9



Focal Wetland Landscapes and Essential Migratory Sites of the Intermountain West

The 2024 IWJV Focal Wetland Landscapes represent wetlands that provide significant habitat for wetland-dependent birds in the Intermountain West. These priority areas reflect an updated version of the IWJV's 2012 Wetland Landscapes, incorporating new wetland and migratory bird science developed over the last decade.

[30] Donnelly and Vest 2012, [31] Donnelly and Vest 2012, [32] Anticipated completion in FY 2025

Essential Migratory Sites

Two regions identified in the 2024 Focal Wetland Landscapes are prioritized because they provide the highest value for multiple species of migratory birds at the flyway scale: The SONEC region and the Great Salt Lake. Both regions were acknowledged as "major migration hubs" within the IWJV's 2013 Implementation Plan[33]. These regions provide essential wetland habitats important for migratory birds, collectively representing approximately 25 percent of the inventoried wetland abundance in the Intermountain West[34]. They also provide crucial breeding and wintering habitats for many species.

Dramatic surface water declines have impacted both systems in recent years, with significant implications for migratory bird populations within the Central and Pacific Flyways[35]. Recognizing these challenges, the IWJV has engaged heavily in science to better illuminate the wetland dynamics of these regions[36], as well as the movement patterns of migratory birds such as cinnamon teal[37], white-faced ibis[38], and sandhill cranes[39]. Changing water availability will necessitate innovative solutions that meet the needs of both people and wildlife in these regions.

The SONEC Region

The SONEC region (Box 9) is continentally significant for North America's waterfowl, shorebird, and waterbird populations. Bird use of SONEC is closely linked with the Central Valley of California, where many species overwinter. Collectively, the two regions support habitat for over 60 percent of waterfowl in the western half of the continent[40]. They also provide essential breeding, wintering, and stopover habitats for a variety of shorebird and wading bird species[41]. In the spring, waterfowl use in SONEC occurs immediately before the breeding season and hence is particularly influential on population dynamics and reproductive success within the birds' annual life cycles.

Given the significance of SONEC wetlands during spring migration, the IWJV has developed specific spring migration population objectives that step down from the NAWMP to guide regional actions[42]. These objectives focus on dabbling ducks because species like Northern Pintail have continued to decline[43], even while goose populations have generally exceeded their population goals in recent years[44]. During spring migration, key habitats for dabbling ducks include managed wetlands in designated wildlife

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[33] IWJV 2013, [34] Donnelly and Vest 2012, [35] Donnelly et al. 2020, [36] Donnelly et al. 2019, Donnelly et al. 2022, [37] Mackell et al. 2021, [38] Coons et al. 2021, [39] Donnelly et al. 2021, [40] Petrie et al. 2013, CVJV 2020, [41] American Bird Conservancy 2015, [42] Report: Spring Habitat and Population Objectives for Waterfowl in SONEC, [43] State of the Birds 2022, [44] Olson 2022

areas and private, flood-irrigated agricultural wetland habitats. Models assessing landscape capacity to sustain dabbling duck populations at goal levels indicate that it is essential to maintain a spring wetland habitat objective of no net loss. Opportunities may exist to improve habitat quality and waterfowl carrying capacity in some locations using the strategies outlined herein.

Wetland habitat availability in the SONEC region is changing rapidly. Recent assessments of shifts in wetland abundance show a loss of semi-permanent wetlands resulting from shortened hydroperiods caused by excessive drying. These drying trends have initiated a transition from semi-permanent to seasonal and temporary hydrologies. This process currently offsets concurrent seasonal and temporary wetland declines, a trend that is likely finite as the landscape continues to dry. Semi-permanent wetlands in SONEC act as a top-down indicator of wetland decline due to their position at the top end of the hydroperiod spectrum[45] (Box 8). These habitats provide crucial fall migration, molting, and over-wintering habitat for birds like diving ducks, coots, terns, and grebes, which need habitats provided by deeper water and longer hydroperiods. Detailed information about wetland habitats in the SONEC region is detailed in the IWJV's Regional Wetland Profiles[46].

BOX 10

Cascading Effects of Wetland Drying In Sonec & The Intermountain West

Functional wetland declines cause disproportionate impacts to waterbird species reliant on semi-permanent wetlands during all or portions of their annual life-cycle in the SONEC region. Semi-permanent losses from shortened hydroperiods caused by excessive drying force the transition of these habitats to seasonal and temporary hydologies—a process that offsets concurrent seasonal and temporary wetland declines[1].

[1] Donnelly et al. 2022

[45] Donnelly et al. 2022, [46] Anticipated completion in FY 2025

The Great Salt Lake Region

The Great Salt Lake (Box 9) is the largest saline lake in the Western Hemisphere. Although it receives only 15 inches of rainfall annually, it is surrounded by more than 470,000 acres of wetlands[47] that are supplemented by fresh water from the Jordan, Ogden, and Bear Rivers. In addition to the saline lake itself, surrounding habitats include marshes, mudflats, playas, and many managed wetland areas. Managed wetlands above and below the lake's annual meander line (excluding the lakebed itself) offer tremendous conservation opportunities contingent on the availability of continued water for flooding[48]. These wetlands are among the largest complexes in the western U.S. and are internationally recognized for their importance to wetland-dependent migratory birds[49].

The Great Salt Lake is a continentally important staging area for millions of waterfowl. It links northern breeding areas in the U.S. and Canada with terminal wintering areas such as the Central Valley of California, the West Coast and mainland of Mexico, and the Gulf Coast[50]. It has also been recognized as North America's most important inland shorebird site[51]. Modeling conducted by the IWJV in 2013[52] established population and habitat objectives for waterfowl and shorebirds at the Great Salt Lake and surrounding wetlands. The majority of waterfowl use-days occur during fall migration, followed by the spring migration and winter seasons. Similarly, shorebird modeling indicated the highest levels of shorebird use in the fall, followed by spring. Habitat that supports submerged and emergent aquatic vegetation is essential to meet waterfowl needs during these non-breeding periods. During these times, shallow-water wetlands conducive to foraging are also essential to meet the needs of migrating shorebirds.

The Great Salt Lake and surrounding wetlands have consistently declined since historic highs in the mid-1980s, with the lake reflecting losses of nearly a million acre-feet of water per year from 2020–2022, culminating in a record-low lake elevation in 2022[53]. Invasive and exotic species such as common reed (*Phragmites australis*) also pose a significant threat to habitat for migratory birds. Continued decreases in flows to the Great Salt Lake may have catastrophic consequences for migratory birds, other wildlife, regional economies, and human health[54]. Activities that support hydrologic function and water resources in these watersheds will be crucial to sustaining wetlands in the region into the future. Further information about the Great Salt Lake Region is provided in the IWJV's Regional Wetland Profiles[55].

[47] Aldrich and Paul 2002, [48] Great Salt Lake Comprehensive Management Plan and Record of Decision 2013, [49] NAWMP 2004, [50] IWJV 2013, [51] Oring et al. 2013, [52] IWJV 2013, [53] Abbott et al. 2023, [54] Abbott et al. 2023, [55] Anticipated completion in FY 2025

Focal Wetland Landscapes

The 2024 IWJV Focal Wetland Landscapes (Box 9) represent wetlands that provide significant habitat for wetland-dependent birds in the Intermountain West. These priority areas reflect an updated version of the IWJV's 2012 Wetland Landscapes[56] that incorporate new science developed over the last decade. For example, recent advances in migratory bird tracking data have reinforced the importance of high bird-use sites with relatively small footprints that sustain flyway connectivity across arid regions, particularly in the desert Southwest and Great Basin. Collectively, the geographies highlighted in Box 7 represent strategic areas where conservation efforts can have outsized impacts on migratory bird populations. Further information about the characteristics of these Focal Wetland Landscapes is provided in the IWJV's Regional Wetland Profiles[57].

Wetland Habitat Values & Hydrologic Connectivity

Wetlands across the Intermountain West hold high ecological value and are inherently dispersed across the landscape. As such, the IWJV recognizes that many wetland complexes are not captured in the 2024 Focal Wetland Landscapes but may still provide ecosystem services and habitat values of local importance. Conservation activities not located within core wetland habitats but that support functional hydrologic processes within the same watershed may directly or indirectly benefit habitats farther down in the hydrologic gradient[58]. Localized, project-specific assessments are necessary to determine if and how conservation investments will result in clear beneficial outcomes for migratory birds. Key considerations may include whether the project supports hydrologic function at the headwaters of a watershed with priority wetlands, movement patterns and seasonal habitat use of migratory birds in the area, and how water rights may influence project feasibility and success. In addition, wetland resiliency[59] (i.e., persistence of wetland function while experiencing the effects of climate and land use change) can guide investments in wetland complexes that show stable or increasing flooding over the long term.

[56] Donnelly and Vest 2012, [57] Anticipated completion in FY 2025, [58] Yeo et al. 2019, [59] WET Resilience Module

Leveraging IWJV Science to Target Conservation Investments

The IWJV's investments in wetland science and decision-support tools have culminated in a body of technical information that supports conservation planning and monitoring in the Intermountain West. A strength of these resources is their applicability on multiple scales. These tools can inform wetland conservation at the flyway scale (e.g., to support funding entities with purview over large regions) and at the local scale (e.g., to support local efforts in identifying and monitoring wetlands within individual watersheds and basins). The following examples show how this science can be applied to support the Conservation Strategies outlined herein.

The Wetland Evaluation Tool

The WET (Box 3) provides a visual interface to track and assess surface water changes over time. Models included within WET classify wetland data and trends as outlined below:

- **Surface Water Monitoring (SWM):** The SWM module depicts the monthly extent of flooding within wetland, riparian, and agricultural systems. Historical data can be viewed as averaged monthly conditions within four approximately ten-year periods spanning the mid-1980s to 2022. Monthly conditions are provided for 2022 to the present day.
- **Hydroperiod:** The underlying surface water data shown in SWM can also be used to track wetland hydroperiods that reflect the duration of flooding within a given year and provide ecological context to wetland function and agricultural irrigation practices supporting wildlife habitat[60]. Layers depict wetlands classified by hydroperiod defined as temporary (flooded less than 2 months), seasonal (flooded between 2 and 9 months), or semi-permanent (flooded more than 9 months). Data is provided as monthly averages over approximately four ten-year periods from the mid-1980s to 2022.
- **Resilience:** Resilience data depicts long-term surface water trends (1984–2021) in temporary, seasonal, and semi-permanent wetlands[61]. Trends are displayed monthly within the averaged surface water extent from 2015 to 2021 to reflect changes influencing more recent flooding conditions.

Practitioners can leverage this data for a wide variety of applications, including:

- **Identifying resilient landscapes** for land protection projects or focused conservation funding.
- **Assessing flooding trends** to identify candidate areas for restoration when coupled with on-the-ground assessments of local conditions.
- **Tracking changes in hydroperiod abundance** within and among years. This information can be leveraged by wetland managers who are targeting projects for specific habitat needs of migratory birds.
- **Monitoring changes in surface water flooding** following implementation of on-the-ground conservation action.

[60] Cowardin 1979, [61] Mann 1945

Greater Sandhill Crane & Flood Irrigation Science

Science developed by the IWJV indicates that greater sandhill cranes rely on flood-irrigated habitats in the Intermountain West during migration[62] and for breeding. Private lands account for 78 percent of the predicted sandhill crane breeding distribution, with flood-irrigated agriculture supporting nearly 60 percent of the wetland habitats used by cranes during the breeding season[63].

The spatial data underlying this science is available in a web-based application that includes the migration network (stopover locations, Box 9), crane GPS data, predicted crane summer range, small grain footprint, and wetland data from WET[64]. Collectively, this data provides a powerful tool for targeting sandhill crane habitat conservation at flyway and local scales. For example:

- Migration network data can be leveraged to identify areas of significance for sandhill crane migrations, such as the San Luis Valley of Colorado and the Middle Rio Grande corridor of New Mexico, both of which are disproportionately influential for maintaining flyway connectivity relative to other landscapes. This stopover information can be used to direct funding for wetland conservation into areas that will impact the greatest number of birds during their annual migratory movements.
- Summer range data can be applied locally to target and monitor restoration projects and water trends within predicted habitats using WET.

Sandhill crane summer ranges are linked closely to wetlands supported by flood-irrigated grass hay agriculture. As much as 93 percent of these wetlands are concentrated in historical riparian ecosystems, mimicking natural hydrology in many instances[65]. Despite representing only 2.5 percent of irrigated lands, flood-irrigated grass hay operations support a majority (58 percent) of temporary wetlands in the Intermountain West, a rare and declining habitat for wildlife in the region. Given the tremendous effort to increase irrigation efficiency in the Intermountain West, these ecosystem benefits are at risk due to conversion to alternate irrigation systems or water leasing/acquisition programs. To address the potential loss of flood-irrigated habitats, the IWJV developed a web-based application that maps the flood-irrigated grass hay providing wetland habitat in historical, riparian ecosystems[66].

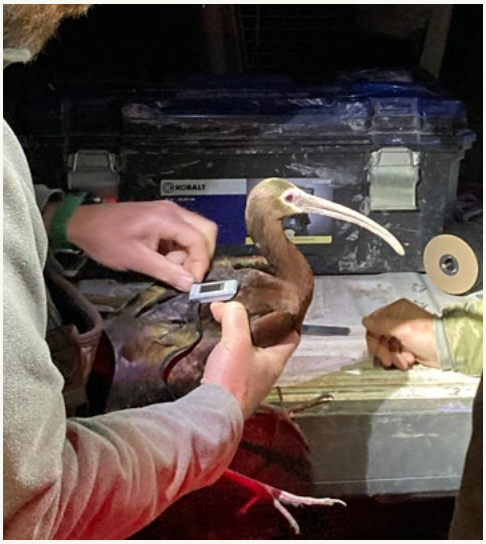
Partners can use the application to identify flood-irrigated grass hay agriculture that supports wetland habitats. This detailed mapping can inform activities such as:

- Targeting funding to support flood-irrigated grass hay agriculture in areas where it sustains riparian wetland habitats.
- Conservation activities to support breeding sandhill cranes as well as migrating waterfowl and other wildlife that rely on temporary and seasonal wetland habitats in the spring when fields are flooded.

[62] Donnelly et al. 2021, [63] Donnelly et al. 2024, [64] Sandhill Crane application, [65] Donnelly et al. 2024, [66] Flood-irrigated grass hay application

White-Faced Ibis Science

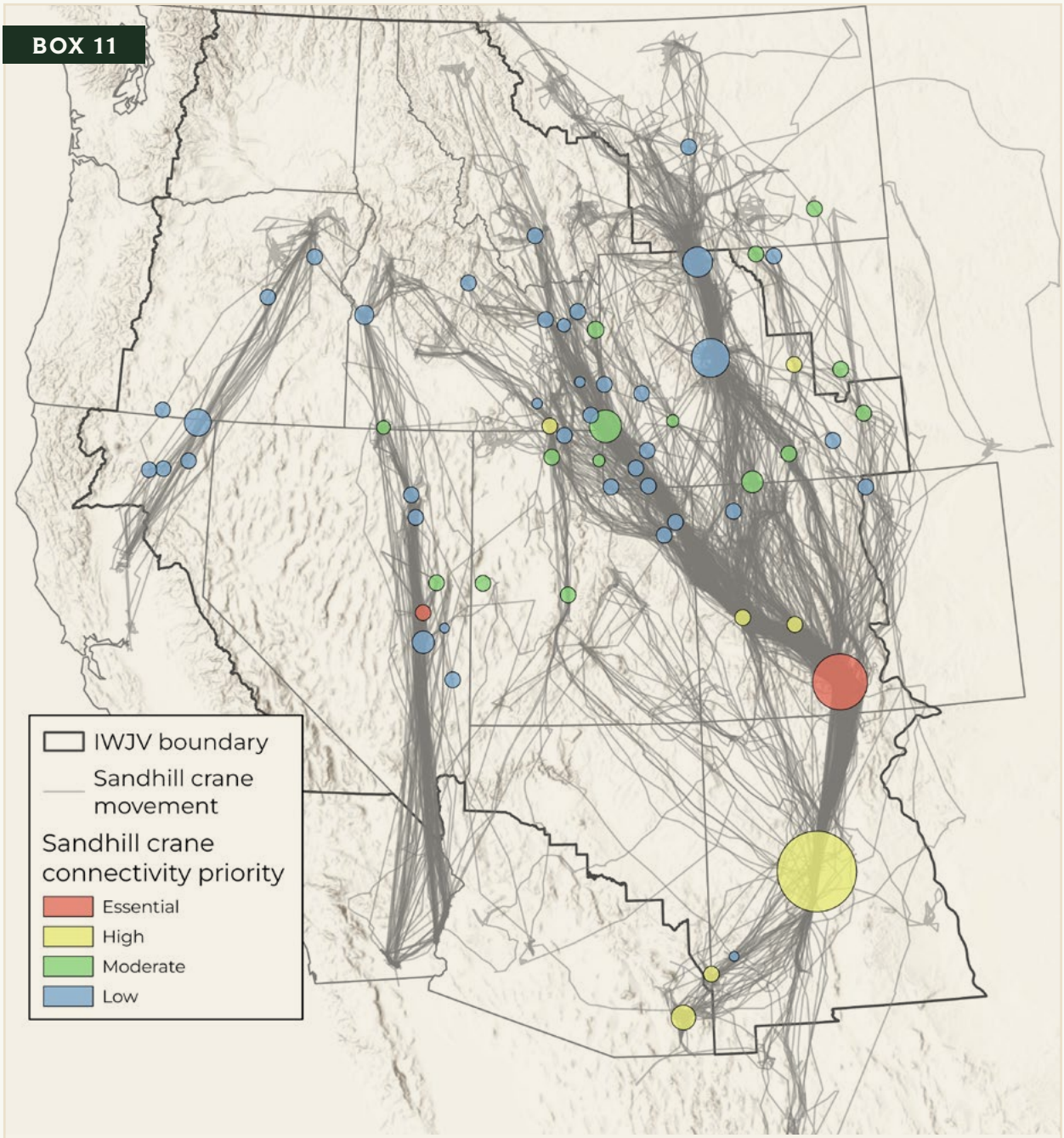
A greater diversity of wetland habitats in a given wetland landscape supports a greater variety of wetland-dependent birds, plants, and other wildlife. White-faced ibis serve as useful indicators of wetland diversity due to their reliance on semi-permanent wetlands for colonial nesting (often associated with managed wetlands) and temporary and seasonal wetlands for foraging (often associated with flood-irrigated agriculture). Ongoing research uses GPS tracking technology to collect ibis location data to inform flyway-scale models of seasonal movements, resource selection, and distribution. Collectively, this data will expand existing knowledge of white-faced ibis habitat selection and inform activities such as:



- Communicating the interconnected function of managed wetlands and surrounding flood-irrigated grass hay agriculture.
- Targeting landscapes for habitat restoration to support ibis breeding and foraging habitats.
- Planning conservation work to prioritize protection of private lands surrounding managed wetlands.

[67] Coons et al. 2022

BOX 11



Greater Sandhill Crane Spring Migration Networks in the Intermountain West

Sandhill crane migration networks for the Central Valley, Lower Colorado River Valley, and Rocky Mountain population segments, representing 150 individuals (2014–2022). Circles indicate spring stopover locations. Priority ranking colors are a measure of stopover site importance to maintaining crane flyway connectivity. Circle size varies by stopover location to encompass wetland, riparian, and agricultural resources tied to observed bird use. Not all areas within stopover circles represent sandhill crane migration habitat[1].

[1] Donnelly et al. 2021

Conservation Strategies

Sustaining wetlands in the Intermountain West requires a more expansive approach than one focused strictly on protecting or restoring wetland acreages. Functional habitat loss through wetland drying impacts even protected wetlands, decreasing or eliminating their value to migratory birds. This threat bypasses traditional "wetland protection" and "wetland restoration" habitat objectives that assume that protected and restored wetlands will support birds at desired levels in perpetuity. Likewise, the wetland habitat value of flood-irrigated agricultural lands can vanish due to shifts in agricultural market demand, changing water management, and water leasing or acquisition programs that may reallocate irrigation water for other uses. These new threats warrant a new and innovative approach to wetland conservation.

The wetland habitat conservation strategies for the Intermountain West we present herein fundamentally differ from those in other regions of North America, where acquisition, protection, and restoration are the leading wetland conservation approaches. Here, water is the limiting factor, so actions must align with the framework of existing water management in the West.

What the IWJV's wetland conservation strategies *are*: A set of concepts, approaches, and ideas that partners can adapt and use to sustain key wetland habitats strategically and successfully in the face of new threats and challenges.

What the IWJV's wetland conservation strategies *aren't*: A comprehensive assessment of the amount and location of habitat needed to support waterfowl, shorebirds, and waterbirds at specified goal levels and a related set of prescriptive wetland protection and wetland restoration habitat objectives.

Herein, the IWJV outlines strategies for the implementation of wetland conservation through its Water 4 program. In doing so, we also provide a framework for partners to accelerate effective wetland conservation in a rapidly changing landscape. The framework is built around attainable strategies aligned with two types of wetland habitats in the region that are managed and provide resources for migratory birds: flood-irrigated grass hay wetland habitats and managed wetlands. We also identify one area (saline lake habitats) where ongoing conservation work needs additional engagement and support. These strategies are versatile, ensuring they can be used by partners across the West. Furthermore, applying these activities within the IWJV's Focal Wetland Landscapes offers a targeted opportunity to benefit migratory birds at the flyway scale. Collectively, these strategies provide a vision for the IWJV partnership in this new era of wetland conservation.

Strategies: Managed Wetlands

Local, state, federal, Tribal, and private managed wetlands have long provided some of the most important habitats for migratory birds in the Intermountain West. These lands serve as "anchors" of wetland habitat in many landscapes and are often surrounded by flood-irrigated grass hay agriculture, forming systems that meet the seasonal needs of waterfowl, shorebirds, and waterbirds[68]. Targeted management to support wildlife has been ongoing for years in many of these geographies, presenting an important opportunity to support wetland managers in their existing and ongoing work. Funding and capacity challenges, as well as changes like decreasing water availability, may limit a manager's ability to manage these habitats to their fullest potential. Specific opportunities for IWJV and partners to support managers in sustaining or improving habitat quality on these lands are described below.

1. Identify the niche in the flyway through conservation planning

Managed wetlands typically fill an important niche for migrating and breeding waterfowl, shorebirds, and waterbirds because many of these complexes have semi-permanent wetlands in the form of emergent marshes with flooded habitat during the summer months. Many of these areas use additional flooding to support public waterfowl hunting opportunities during the fall. In contrast, the bulk of the flood-irrigated grass hay wetland habitat in the West is flooded during the spring and early summer. New remote-sensing tools like WET provide opportunities to further tailor water deliveries to managed wetlands within the context of the surrounding landscape.

For example, in regions with substantial agricultural wetlands available during spring, wildlife area managers could consider bolstering fall-flooded seasonal wetlands and summer-flooded semi-permanent wetlands (if possible within the constraints of existing water rights). Many managers have deep knowledge of the dynamics of their managed wetlands and understand the opportunities and limitations within their landscape better than anyone else. The IWJV partnership should support managers to:

- **Evaluate the area's role in providing habitat for waterfowl, shorebirds, and waterbirds** during the spring migration, breeding, molting, and wintering life cycle events in the context of the surrounding landscape. Apply the WET and migratory bird data to identify key niches for the wildlife area in providing habitat within a flyway.
- **Use this flyway-scale information to identify the habitat features needed to provide key resources to wetland-dependent migratory birds** (e.g., timing of flooding, water depth, ratio of emergent vegetation to open water).
- **Assess water supply reliability and develop options for providing the needed habitats within realistic water scenarios.** This planning is essential given our understanding of water scarcity and how it affects managed wetlands, particularly those with limited or junior water rights.
- **Communicate the importance of managed wetlands in the flyway and larger landscape through collaborative storytelling.** Use communications tactics and tools to build support for wildlife areas in terms of budgetary allocations, staff capacity, and grant funding.

[68] Downard and Endter-Wada 2013, Coons et al. 2022

2. Modernize water management infrastructure

In the face of functional wetland loss, wetland managers must have state-of-the-art water conveyance and management infrastructure to enable full operational flexibility in managing available water to maximize wetland habitat quality. The IWJV partnership should support managers with resources to:

- **Identify and help implement infrastructure improvements needed to efficiently and effectively use water supplies to provide key habitats** consistent with the previously described conservation planning. Design projects that circumvent water management infrastructure limitations. Address administrative and capacity challenges to streamline project implementation.
- **Develop proposals to attain funding from traditional wetlands conservation funding sources (e.g., the North American Wetlands Conservation Act and agency funding) non-traditional funding streams such as the Bipartisan Infrastructure Law, and new funding sources such as private foundations.** Explore the potential for water management infrastructure projects and subsequent wetland management to provide multiple ecosystem service benefits including carbon sequestration, aquifer recharge, flood attenuation, and native fisheries recovery. Multi-benefit projects, while often beyond the traditional wildlife habitat objectives of the managed wetland, can result in an expanded list of public awareness, support, and funding sources for wetland conservation work.
- **Communicate the importance of water management infrastructure projects to sustain wetland habitat despite increasing water scarcity.** Effective communications can unlock new sources of funding. Audiences include leadership of federal and state agencies that own and manage many of these resources, congressional members and staff, and public users of these wetland complexes.

3. Implement strategic water and vegetation management

Managing wetland habitats involves complex decision-making related to the purpose of the wetland; limitations in budgets, staff capacity, and water supplies; and the expectations of public and private user constituencies. Managers routinely make hard decisions when balancing multiple priorities. Maximizing habitat quality in the face of limited water supplies is essential to sustain managed wetland habitats. The IWJV partnership should support managers with resources to:

- **Manage vegetative communities on wetland tracts with reliable water supplies to produce the highest quality wetland habitat.** By strategically using water, managing vegetation, and emphasizing habitat quality over quantity, managers can remove invasive or late-succession vegetation. In turn, these actions will help them achieve targeted habitat objectives such as (a) increasing open-water habitat conditions and foraging access to aquatic invertebrates as required by shorebirds and (b) increasing moist-soil seed production and food energy for migrating and wintering waterfowl.
- **Innovate water management approaches to fill the habitat niche(s) identified for the managed wetland.**
- **Support the manager's vision for the wetland and engage support from partners**, as needed, in wetland habitat restoration, enhancement, and management.
- **Support increases to wildlife area operational budgets and staff capacity** to manage public wetlands strategically.
- **Support the development of incentives for managing private wetlands,** recognizing the multiple benefits these privately held habitats provide.

Strategies: Flood-Irrigated Grass Hay Wetland Habitats

As previously described, the 818,000 acres of flood-irrigated grass hay agriculture in the Intermountain West provide important temporary and seasonal wetland habitat for migratory birds. Approximately 93 percent of these lands are located in historical riparian corridors where flooding mimics natural hydrologic functions and may provide ecosystem services like groundwater recharge and delayed return flows to streams and rivers[69]. Spring habitat on working lands complements summer and fall flooding on managed wetlands where managers can target water resources for habitat creation during drier times of the year; therefore, keeping flood irrigation on the landscape at critical times such as spring migration should be a priority. Specific strategies to sustain these important wetland habitats for people and wildlife are described below.

1. Tell the story of flood-irrigated grass hay wetland habitats

Flood-irrigating pastures and hay meadows is a long-standing practice. However, research showing the value of these irrigated agricultural habitats to migratory birds and other ecosystem services is relatively recent. As such, it is essential to communicate the benefits provided by this practice and the systems that sustain it. The IWJV partnership can promote and expand this narrative in the following ways:

- **Collaborate with and support agricultural organizations, irrigators, and livestock producers that manage flood-irrigated grass hay meadows in showcasing their contributions to migratory bird habitat conservation.** Communicate the value of these wetland habitats to a wide range of decision-making audiences to raise awareness of the multiple ecosystem services provided by this irrigation practice. Audiences include water managers, congressional members and staff, state engineers' offices, water commissioners, traditional conservation organizations, and key federal agencies engaged in irrigation water management (e.g., NRCS, Bureau of Reclamation).
- **Implement a robust science-to-implementation effort** that helps practitioners and decision-makers access, interpret, and apply the relatively new body of science that articulates the value and function of flood-irrigated grass hay wetland habitats.
- **Build the conservation of these habitats into federal and state programs** to unlock funding that will support partners in implementing on-the-ground conservation practices.

[69] Donnelly et al. 2024

2. Modernize flood irrigation infrastructure

For many years, the focus of irrigation water management by NRCS and other agencies has been addressing water quantity concerns by improving agricultural irrigation efficiency. However, supporting continued flood irrigation in areas where it meets the common goals of agricultural producers and other stakeholders offers an important opportunity to sustain both wetland habitats for migratory birds and, in some cases, other hydrologic benefits. Investing in flood irrigation infrastructure can improve the effectiveness of irrigation management actions, creating benefits for producers and enabling more strategic water application to benefit wildlife.

The IWJV partnership can support flood irrigation modernization as follows:

- **Identify lands with potential high migratory bird value where flood-irrigation modernization would help producers improve forage production and habitat** via more timely spring flooding. IWJV flood irrigation mapping products can be used to locate opportunity areas for these upgrades.

  Example: Northern Pintails move through the SONEC region in March and early April, so improving flood-irrigation infrastructure can help producers effectively flood their meadows during this crucial early spring migration window.

- **Help partners implement modernization projects** that prepare producers to effectively and efficiently flood irrigate hay meadows and pastures to produce high-quality migratory bird habitat. Support the development of funding pools focused on flood irrigation modernization in key landscapes to ensure these projects are evaluated against each other rather than in statewide pools prioritizing irrigation efficiency. Bring together groups with shared values (fisheries communities, land trusts, agricultural groups) to leverage multiple funding sources to ensure conservation success.

- **Build flood irrigation modernization into larger landscape-scale projects** (e.g., NRCS Watershed and Flood Prevention Operations Program) that use a variety of irrigation treatments and should include flood irrigation as an appropriate practice. A systems-based approach can sustain important flood-irrigated grass hay wetland habitats while achieving water use efficiency through sprinkler irrigation and other practices at the larger project scale. There is no one-size-fits-all solution to irrigation practices.
- **Connect partners to flood-irrigation modernization innovations** including labor-saving automation such as "auto-tarps," remote monitoring systems, and, in some instances, hybrid approaches that install modern flood-irrigation infrastructure and sprinklers to enable early-season flooding and late-season sprinkler irrigation.

3. Accelerate the pace of conservation easements

Wetlands, streams, and riparian areas—the "green ribbons" of the Intermountain West—are primarily located on private land and were historically managed following Euro-American colonization as large working ranches. Well-stewarded working ranches offer intact wildlife habitat managed across public and private boundaries through fee-title ownership and public grazing leases. These lands are increasingly threatened by development and fragmentation. Rural subdivisions have been shown to decrease biodiversity[70] and can alter water management[71].

Conservation easements offer an outstanding tool for keeping ecologically important ranches intact, sustaining water management systems that support wetland and riparian habitats important to migratory birds. Land trusts throughout the Intermountain West have effectively protected these important habitats despite funding and capacity limitations. The IWJV partnership can support conservation easement acquisition to protect wetland habitats as follows:

- **Identify lands with high migratory bird value that exhibit resilient water resources.** Work collaboratively with land trusts to protect these areas through conservation easements and support land trusts in their strategic planning to prioritize projects in these areas.
- **Support the NRCS and the land trust community in developing mechanisms to increase the pace and scale of conservation easement implementation** through the Agricultural Conservation Easement Program–Agricultural Lands Easements (ACEP-ALE) program[72]. This includes establishing partner easement specialist capacity in state offices, fully utilizing the certified entities authorization, developing innovative approaches for implementing ACEP-ALE to benefit historically underserved producers, and identifying other means for the NRCS and land trusts to work collaboratively and efficiently to acquire conservation easements.
- **Champion strong conservation funding for ACEP-ALE and complementary programs** that can support the acquisition of conservation easements.
- **Communicate the public benefit of working lands conservation easements that protect high-value and resilient flood-irrigated grass hay wetland habitat for migratory birds.** Audiences include congressional members and staff, key federal agencies engaged in landscape conservation (e.g., NRCS, USFWS), the land trust community, traditional conservation organizations, and livestock producers.
- **Support efforts to streamline and more efficiently implement NRCS's Regional Conservation Partnership Program** so that conservation resources are strategically focused in high-priority areas.

[70] Maestas et al. 2003, [71] Cox and Ross 2011, [72] DNRCS Agricultural Land Easements

Opportunity Area: Saline Lakes

Surface water declines that adversely impact wetlands throughout the Intermountain West also contribute to the decline of saline lake habitats. It is increasingly urgent to sustain the function of saline lakes for a suite of reasons, including migratory bird habitat, public health, and industry (such as brine shrimp harvesting at the Great Salt Lake). The IWJV has long recognized the enormous importance of saline lakes to shorebirds and, in many cases, waterfowl and waterbirds. The 2013 Implementation Plan Shorebird Chapter[73] included substantial details on shorebird population objectives, habitat needs, and habitat threats. It included 18 Shorebird Key Sites representing crucial habitats for shorebirds across the Intermountain West. Of the habitats included in these sites, saline lakes were the most important to spring- and fall-migrating shorebirds. The IWJV's past conservation planning remains relevant in capturing the essential role saline lakes play in shorebird ecology by establishing priorities for shorebird habitat conservation.

Saline lakes are inherently at the bottom of watersheds and often lack dedicated water rights, so solutions to water scarcity are highly complex and require collaborative action. Because saline lake declines result from watershed-scale processes, conservation strategies need to be tailored to specific geographies and developed at multiple levels, from land management to conservation programs and water policy. Watershed-scale solutions can be supported by strategies that sustain hydrologic function in wetland habitats. For example, managed wetlands are often located within saline lake systems, and partners can leverage the strategies described above to support managers of these habitats. Further, many saline lakes are fed by watersheds that include flood-irrigated grass hay agriculture. The interconnected nature of these systems necessitates solutions that meet the needs of both agricultural producers and stakeholders downstream. Actions that support overall functional hydrology in saline lake watersheds will help sustain water resources and migratory bird habitats into the future.

Partners within saline lake watersheds are making substantial progress toward finding solutions in the face of complex challenges created by managing water for multiple uses. For example, the 2024 designation of the Great Salt Lake Sentinel Landscape Partnership[74] recognizes overlapping priorities of conservation, working lands, and national defense by the USDA, Department of Defense, and Department of the Interior within areas immediately surrounding the Great Salt Lake. In the same geography, the state of Utah is championing legislation to benefit the Great Salt Lake through initiatives such as HB453, which adds protection for the waters of the Great Salt Lake and ensures extraction industries work with state leaders to improve the health of the lake and surrounding wetlands[75]. At the national level, new science is in development to assess saline lakes and inform conservation decision-making, including an Integrated Science Strategy led by the U.S. Geological Survey[76]. The conservation community will play a key role in translating and implementing this new science in the future.

Watershed-scale solutions for saline lakes will require engagement from partners at all levels. Overall success will only be possible through collaborative, proactive, non-regulatory actions focused on sustaining saline lake habitats. The IWJV encourages the development of site-specific habitat goals and strategies for saline lake conservation that are driven by local input to ensure durable conservation outcomes. The IWJV will further develop tools and resources to support local partners in their conservation of these important places.

[73] 2013 IWJV Implementation Plan: Shorebirds, [74] Great Salt Lake Sentinel Landscape, [75] Utah Senate 2024, [76] Frus et al. 2023

Success in Wetland Habitat Conservation

In the Intermountain West, successful wetlands conservation requires supporting innovative solutions that sustain water resources in the face of wetland drying and other rapid landscape changes. Activities that build landscape resilience, such as managing water strategically, preserving or restoring hydrologic processes, and enhancing ecosystem function, should be prioritized. Continued science development for conservation planning, prioritization, and monitoring is essential. Ensuring stakeholders can access, interpret, and apply this science is also necessary to integrate new information into conservation planning and delivery.

The developing field of science to implementation (or technical transfer) helps practitioners effectively link on-the-ground needs with the best available science to support their activities. Tools like WET can be used to track surface water presence over time, evaluate long-term flooding trends, and determine whether on-the-ground implementation is meeting targeted management needs. Continued research and technical transfer efforts by the IWJV and partners must evaluate wetland trends in key landscapes and link these changes to seasonal habitat requirements for migratory birds, identifying emerging bottlenecks and informing conservation decision-making within the diverse landscapes of the Intermountain West. By focusing efforts on key habitats such as flood-irrigated grass hay and managed wetlands while supporting collaborative, partnership-driven work in saline lakes systems, conservation investments can be leveraged to maximize on-the-ground success for people and wildlife.

Within Water 4, success will be measured by the IWJV's ability to build and enhance durable partnerships that sustain wetlands and result in shared water resource benefits for multiple stakeholders. In support of this goal, the IWJV will advance a multidisciplinary approach to wetland conservation that integrates government relations, conservation program innovations, science development and implementation, and compelling communications and storytelling alongside more traditional wetland protection and restoration practices. Ultimately, as a partner-driven wildlife habitat organization, the success of Water 4 will be the conservation and restoration of wetland bird habitat through innovative approaches and new and continued partnerships.