WIND RIVER BASIN WETLAND COMPLEX

Regional Wetland Conservation Plan

The Wyoming Wetlands Working Group

Wyoming Joint Ventures Steering Committee

Version 1.0

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Acronyms and Abbreviations

BLM ……	U.S Bureau of Land Management
BOR……..	U.S. Bureau of Reclamation
BMP …….	Best Management Practice
BOC …….	Board of Control (State Engineer's Office)
CRP ……..	Conservation Reserve Program
CWA ……	Federal Clean Water Act of 1972
DEQ …….	WY Department of Environmental Quality
DEQ/WQD ……..	DEQ Water Quality Division
DU ……	Ducks Unlimited
EPA ……..	U.S. Environmental Protection Agency
EQIP …….	Environmental Quality Incentives Program
IWJV ……	Intermountain West Joint Venture
LWCF ……..	Land and Water Conservation Fund
NAWCA ……..	North American Wetland Conservation Act
NGO …….	Nongovernmental Organization
NGPJV …….	Northern Great Plains Joint Venture
NPS ……..	Nonpoint Source
NRCS ……...	Natural Resources Conservation Service
PFW ……..	Partners for Fish and Wildlife
PIF ……	Partners in Flight
SCORP …….	Statewide Comprehensive Outdoor Recreation Plan
SEO ……..	WY State Engineer's Office
SGCN ……...	Species of Greatest Conservation Need
SWANCC …….	Solid Waste Agency of Northern Crook County, Illinois
SWAP ……	State Wildlife Action Plan
SWG …….	State Wildlife Grants
TNC ……..	The Nature Conservancy
USACE or COE ……	U.S. Army Corps of Engineers
USDA ……	U.S. Department of Agriculture
USFWS …….	U.S. Fish and Wildlife Service
USGS ……	U.S. Geological Survey
UW ……	University of Wyoming
WGFD ……..	Wyoming Game and Fish Department
WHIP ……	Wildlife Habitat Incentives Program
WHMA …….	Wildlife Habitat Management Area
WRIP…….	Wind River Irrigation Project
WRP ……..	Wetlands Reserve Program
WRR …….	Wind River Reservation
WWNRT ……	Wyoming Wildlife and Natural Resource Trust Account
WY…….	Wyoming

INTRODUCTION

The Wind River Wetland Complex (WRWC) is a diverse landscape consisting of a central broad alluvial valley surrounded by rugged glaciated mountains located predominantly within Fremont County, WY. The watershed contains three distinct wetland areas, valley floor, extended foothills and glaciated montane regions connected by a corridor of riverine habitat. The complex serves as a winter stopover, seasonal migration route, and regionally important breeding habitat for waterfowl, waterbirds, and numerous other avian species. Fremont County is consistently one of the three counties sustaining the greatest abundance of wintering waterfowl in Wyoming (WGFD data). The WRWC also ranks third among the State's 10 priority complexes in terms of the area of palustrine wetlands (freshwater pond and freshwater emergent wetland), which total 40,684 acres. Federal, state, and tribal plans that address conservation needs at site-specific and population levels include the Wyoming Game and Fish Department's Wyoming Wetlands Conservation Strategy –Wind River Basin (WGFD 2010); U.S. Fish and Wildlife Service's PFW Strategic Plan – Wind River Priority Area (USDI/USFWS 2012); and Tribal Wildlife Plans including: The Status and Management of Waterfowl on the Wind River Reservation (WRR) (1982), A Plan for Wildlife Management on the WRR (1982) and Trumpeter Swan Re-introduction and Management WRR (2013). The purpose of this regional plan is to merge information from these prior planning efforts to characterize the wetland and riparian resources of the Wind River Basin and identify specific wetlands conservation strategies and objectives.

GENERAL DESCRIPTION AND LAND USE

The exterior boundary of the WRWC predominantly follows the outline of the Wind River watershed and encompasses 2.6 million acres. Topography is characterized as an uplifted mountain block and associated intermountain basin. Bailey (1995) divides the area into two provinces – the Middle Rocky Mountain and Wyoming Basin. A subordinate of the Wyoming Basin, the valley floor known as the Wind River Basin is a high arid plateau ringed by the Bridger, Rattlesnake, Owl Creek, and Wind River mountain ranges. The highest point in the watershed is Gannet Peak (elevation 13,785 ft) on the Continental Divide and the lowest elevation is 4,600 ft where the Wind River flows across the Fremont County line and into the Wind River Canyon.

The Wind River Basin is a semi-arid region with characteristically long, cold winters, and short, hot summers. Annual precipitation varies greatly as a result of dramatic elevation changes and rain shadowing effect of surrounding mountains. Precipitation ranges from 5-12 inches within the basin and is evenly distributed throughout the year. The foothills region receives 10 to 20 inches and up to 40 inches are common in the higher mountain elevations. Much of the mountain precipitation falls as snow during winter.

Soils are alkaline Aridisols (desert soils) with composition and texture dominated by parent material. Weathering and erosion rates are characteristically low. The foothills area contains extensive windblown features consisting of dune sand and loess deposits, as

well as numerous dry lake beds. Mountain soils occur as zones in response to precipitation and vegetation patterns. In the montane zone, soil is formed under grass (Mollisol) or forest (Alfisols) conditions, whereas the newest soils (Inceptisols) are located on steep slopes and recently glaciated areas. Glacial lakes, wetlands with accumulated organic soils, and beaver ponds are prevalent features through the Wind River Range (USDA –SCS and UW 1981).

Melt waters originating from the Wind River Mountains provide a perennial source of flow to more than 3,000 miles of low elevation streams, and a readily available supply of irrigation water. The Wind River Basin has more than 164,000 acres of irrigated crop and hay lands making it one of the leading agricultural regions of the state (USDA 2007). The majority of the area (1.7 million acres) is native rangeland and livestock production is the primary land use in the valley. The distribution of land ownership follows: Tribal lands of the Wind River Reservation total 1,327,000 acres (52%); public land primarily administered by the US Forest Service and Bureau of Land Management, and lands administered by the Wyoming Board of State Lands and Investments and the Wyoming Game and Fish Commission collectively total 832,000 acres (33%); and 401,000 acres (15%) are privately owned.

Ecological Cover Types

Native plant diversity is high within the WRWC due to wide variation in climate, geography, and habitats. The dominant ecological cover type is a contiguous expanse of sagebrush steppe broken only by lands modified for agriculture and municipalities. Typical plant associations (Artemisia-Agropyron; Artiplex-Sarcobatus) on undisturbed sites in good condition contain rhizomatous wheatgrasses (A*gropyron*/*Pascopyrum ssp*), Indian rice grass (*Achnatherum hymenoides),* prairie junegrass (*Koeleria macrantha*), Sandberg bluegrass (*Poa secunda*), plains prickly pear cactus (*Opuntia polyacantha*), and shrub components including greasewood (*Sarcobatus vermiculatus*), saltbush (*Artiplex ssp.*), rabbitbrush (*Chrysothamnus viscidiflorus*), and sagebrush (*Artemsia ssp*).

The mountains are characterized by distinct vegetation zones influenced by a combination of elevation, prevailing winds and slope exposure. Elevations of 11,000 ft and higher are treeless alpine tundra containing lush mats of low growing lush sedge (*carex ssp.*) and other herbaceous cover (*Agrostis ssp*, *Poa ssp*). The subalpine zone is dominated by Engelmann spruce (*Picea engelmannii),* subalpine fir (*Abies lasiocarpa*) and white-bark pine (*Pinus albicaulis*). The montane zone immediately below the subalpine is distinguished by presence of Douglas fir (*Pseudotsuga menziesii),* lodgepole pine (*Pinus contorta*), sagebrush (*Artemesia ssp.*) and quaking aspen (*Populus tremuloides*). The dryer rocky slopes of the foothill zone often contain mountain mahogany (*Cercocarpus Kunth*), bitterbrush (*Purshia tridentata*), sagebrush (*Artemesia ssp.*), limber pine (*Pinus flexilis*), and juniper (*Juniperus scopulorum*).

Numerous streams and associated riparian corridors connect the mountain and basin portions of the WRWC. Floodplains along the lower elevation rivers and streams commonly have a low terrace or active floodplain with a canopy of cottonwoods

(*Populus angustifolia*) and a shrub understory of willows (*Salix spp.*). Sedges (*Carex spp*) and non-native reed canary grass (*Phalaris arundinacea*) dominate the herbaceous layer especially on smaller perennial streams. Typical species growing on the dryer mid-terrace zone outside the active floodplain include alkali sacaton (*Sporobolus airoides*), basin big sagebrush (*Artemisia tridentata*), Silver buffaloberry (*Shepherdia argentea*), and scattered remnant cottonwoods along relic channels. Mountain stream channels are typically anchored in rock and often associated with dense willow stands, alders (*Alnus ssp*.) and aspen. Common plants in palustine wetlands at any elevation include sedges (*Carex ssp.*), spikerush (*Eleocharis ssp*.), hardstem and softstem bulrush (*Scirpus ssp.*) and cattail (*Typha ssp*.).

Hydrology

The Wind River flows west to east across a valley bracketed by mountains on the north and south, and is the major drainage. On the south side, the Wind River Mountains are a young landscape, recently sculpted by glaciers into deep, U-shaped valleys containing numerous lakes and ponds. These valleys are headwaters to several perennial sub-drainages including the Popo Agie River, Little Wind River, Bull Lake Creek, and Dinwoody Creeks. Streams draining from the Owl Creek Mountains on the opposite side are typically perennial at the headwaters, intermittent where they cross the valley, and then become perennial again after receiving return flows from irrigation or produced water from nearby energy developments.

Almost all rivers and streams within the WRWC are free flowing. The major exception is the lower Wind River. In 1951, a 200-ft earthen and rock dam was constructed at the upper end of Wind River Canyon, forming Boysen reservoir. However, flow is diverted from all rivers to supply water for irrigation. The largest diversion is the Wind River Diversion Dam with a hydraulic height of 19 feet (Fig. 1). This diversion enters the Wyoming Canal, which supplies water to the 71,000 acre Riverton Reclamation Project. The Wyoming Canal is 62.4 miles long and has a capacity of 2,200 cubic feet per second (cfs). The other major water conveyance within this project, Pilot Canal, is 38.2 miles long and has a capacity of 1,000 cfs. In 2001, irrigated crops included: alfalfa hay (35,404 acres), irrigated pasture (11,288 acres), other hay crops (6,896 acres), silage (3,447 acres), and sugar beets (2,650 acres). Irrigation water was first diverted from the Wind River in 1907. Since then, irrigation has been expanded to include the Riverton Reclamation, Riverton Valley, and Kinnear Valley projects through a series of in-stream diversions, off-channel storage dams, and canals. The Wind River Irrigation Project (WRIP) is located within the Wind River Reservation and delivers water to approximately 36,789 acres of irrigated lands. WRIP consists of three management units, the Upper Wind or Dinwoody Canal System (10,322 acres), Lower Big Wind (1,120 acres) and Little Wind (22,974 acres). Numerous small individual or private diversions are also located throughout the valleys natural waterways.

Fig. 1. Wind River Diversion Dam and associated canal systems.

These systems currently irrigate 59,685 acres within the 71,000-acre Riverton Reclamation Project.

Wetlands and Other Water Resources

Records from early trapper, missionary and government expeditions depicted a scene not much different than today. Jones (1873) along with others described the Popo Agie River between Lander and Riverton as about 60 yards wide and 3 feet deep with groves of large cottonwoods, willow thickets, and buffaloberry in the bottomlands. While crossing the Wind River at a point above current day Riverton, W.F. Raynolds (1859) wrote in his journal, "a valley being a mile or more in width and the immediate banks of the stream for 300-400 yards covered with a thick growth of cottonwood. The stream larger than the Popo Agie, the bed wider and more cut up by islands and bars…further up stream, ducks and geese were almost innumerable in the marshes along the banks of the river." Moving along the Popogia (Popo Agie) near Hudson in 1868, James Chisholm wrote, "it's not an easy task to approach the stream by reason of the thick groves of cottonwoods…swarms of wild ducks came scuttling round the bend every minute, so thick that I could bring them down with stones." As he followed the Popogia river farther into the high country, past a tremendous cavern in which the river disappears (the Sink) he made note of, "lakes that lie among the hollows one above the other, all fringed in living green."

Since the beginning of the 20th century, human activities have both eliminated and created wetlands in the region. Montane lakes and wetlands are least impacted, other than from possible effects of climate change and a few random irrigation/municipal reservoirs that overlay natural lakes at lower elevations. Based on early pioneers' descriptions, historic photos, and soil data, the extent of riverine wetlands and riparian habitat has been changed along the Wind River and tributaries, but not as dramatically as within adjacent upland areas that were converted to farmland. Even though floodplains have been physically modified to support agricultural production, most of the alteration has been on the mid-high terraces along the river systems. However, hydrology of river-associated (riverine) wetlands has been drastically altered in many instances. Historically these wetlands were fed by seasonal out-of-bank flows and high water tables (bank storage) from snowmelt and random storm events. Wetland hydrology has now been augmented and/or replaced by irrigation return flows and artificially elevated water tables resulting from long term flood irrigation practices within local watersheds.

In addition, water withdrawals and in-stream diversion structures directly impact stream stability by altering the natural flow regime and sediment transport. These modifications frequently accelerate channel movement (widening) and incision (down-cutting), which in turn impact local water tables and hydrology that support floodplain wetlands. High flows are more readily constrained within altered channels. As a result, natural overbank flooding becomes less frequent and extensive across the floodplain. Data from US Geological Survey (USGS) stream gauging stations on the Wind River at Riverton and Bull Lake Creek illustrate the reductions in mean peak discharge that occurred after construction of major irrigation infra-structure (Fig 2). Major installations of the Wind River Irrigation Project were initiated in the mid-1920's and continued to come on line well into the 1930's. Bull Lake Dam became fully serviceable in 1939.

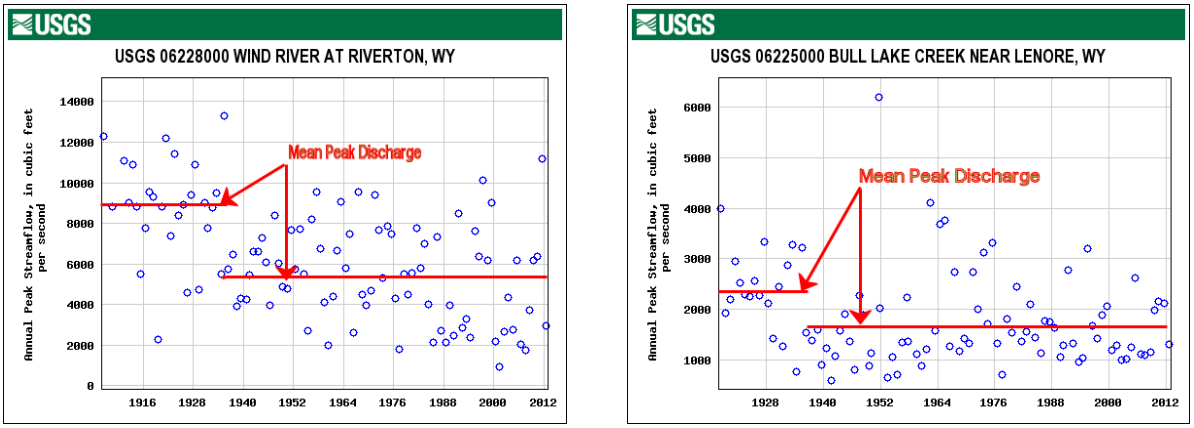

Fig. 2. Changes in mean peak stream discharge pre- and post-construction of major irrigation infrastructure.

There is a probable trade-off between the reduction of riverine wetlands due to irrigation withdrawals and creation of additional palustrine wetlands due to influence of irrigation. Traditional flood irrigation methods commonly increase the amount and duration of surface runoff as well as local water tables across the landscape. This often has the effect of creating new wetlands and/or enhancing existing wetlands. Wetlands commonly associated with irrigation include margins of storage reservoirs and delivery ditches, spring and seep areas below canals and ditches, and natural or constructed basins that capture return flows from flood-irrigation.

The composition of wetlands within the WRWC is summarized in Table 1. The summary is based on 1980 imagery (Figs. 3, 4) and does not include wetlands constructed on private lands after 1980. Since 2000, approximately 1,400 acres of wetland habitat have been restored through the efforts of conservation partners including, Ducks Unlimited, Inc. (DU), Natural Resource Conservation Service (NRCS), US Fish and Wildlife Service (USFWS) Partners for Fish and Wildlife Program (PFW), Eastern Shoshone and Northern Arapaho Tribes, numerous private landowners, Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), Wyoming Wildlife and Natural Resource Trust (WWNRT) and Wyoming Game and Fish Department (WGFD). The area also contains numerous natural

and man-made lakes (Table1). These larger water bodies provide important bird migration and reproduction habitat, especially during drought times (Table 2).

Table 1. Composition of wetlands within the Wind River Complex based on National Wetland Inventory (NWI) maps.

Wetland Type	Number	Total area
Palustrine		40,864 acres
Lacustrine	1,404	45,974 acres
Riverine		28,307 acres
TOTALS		115,145 acres

Table 2. Large reservoirs within the Wind River Complex.

Facility Name	Surface Area (at capacity)	Capacity	Uses
Boysen Reservoir	19,560 acres	892,000 acre-ft	irrigation storage, flood and municipal storage, recreation
Ocean Lake	6,000 acres	No storage Pool	fisheries, waterfowl refuge, recreation
Pilot Butte	832 acres	31,600 acre-ft	irrigation storage, fisheries, recreation
Bull Lake	2,943 acres	151,000 acre-ft	irrigation storage, fisheries
Ray Lake	490 acres	7,000 acre-ft	irrigation storage, fisheries
Dinwoody Lakes	200 acres	1,255 acre-ft	irrigation storage, fisheries
Washaki Lake	284 acres	8,000 acre-ft	irrigation storage, fisheries

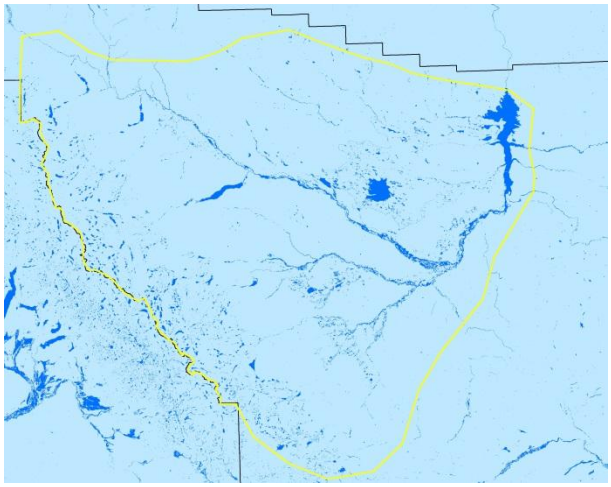

Fig. 3. National Wetland Inventory Overlay of the Wind River Wetland Complex.

Three distinct wetland areas are evident in the National Wetland Inventory. These include: montane lakes and wetlands; wetlands on the valley floor; and wetlands associated with irrigation and ribbons of interconnecting riverine wetlands. Montane lakes and wetlands are present at higher density, but have a shorter growing season. Numerous wetlands have also been constructed within the valley floor to provide fish and wildlife habitat. Examples of these various wetland types are depicted in Figs. 4-16.

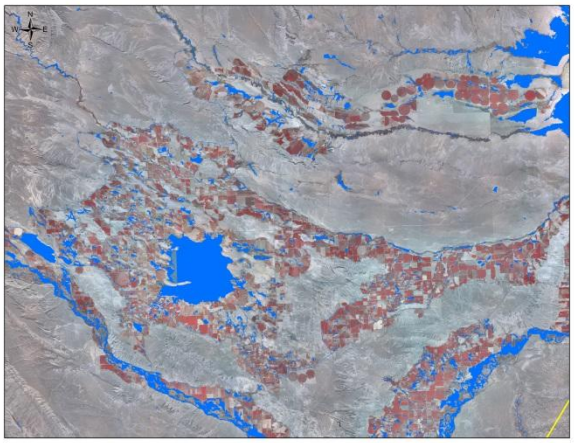

Fig. 4. Riverton Reclamation Project/Ocean Lake area

Fig. 5. Wetlands around the perimeter of Ocean Lake.

Fig. 6. Wetlands associated with the Wind River Floodplain.

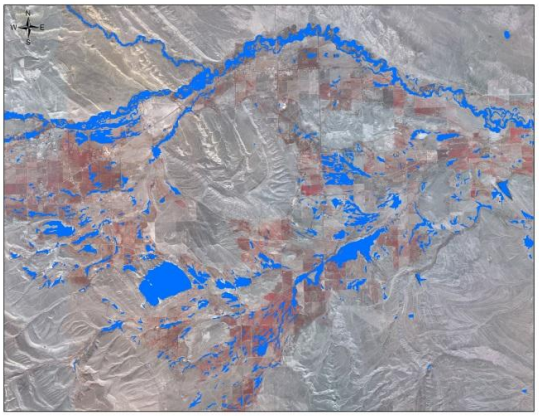

Fig. 7. Wetlands within the Little Wind River/ Ocean Lake.

Fig. 8. Foothills wetland associated with irrigation.

Fig. 6. Riverine/riparian wetlands along the lower Wind River.

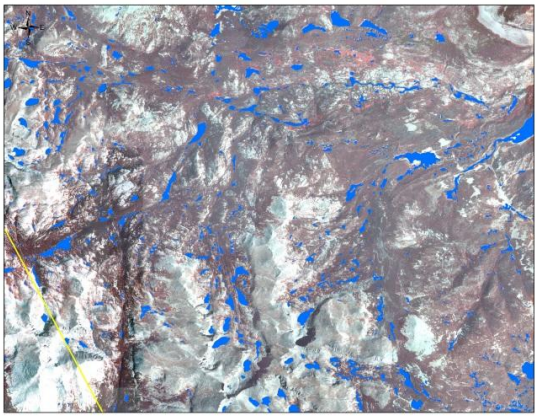

Fig. 7. Montane wetlands of the Wind River Range.

Fig. 8. Example of Wind River montane wetland.

Fig. 9. Wind River montane lake.

Examples of constructed and restored wetland projects within the Wind River Complex.

Fig. 10. Alkali Lake wetland.

Fig. 11. East Ray Lake wetland.

Fig. 12. Ray Lake wetland.

Fig. 13. Two constructed wildlife ponds.

Wetlands on Wyoming Game and Fish Department Managed Lands

Ocean Lake Wildlife Habitat Management Area

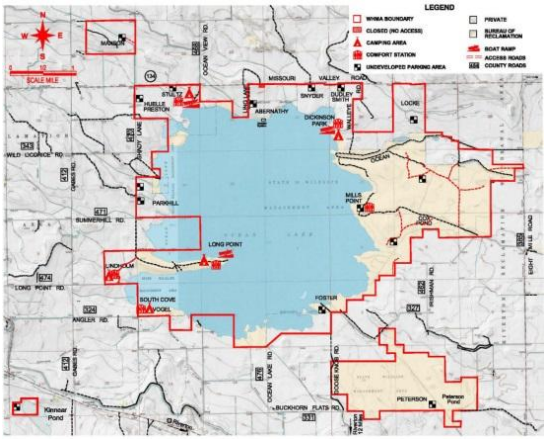

Fig. 14. Ocean Lake and Ocean Lake WHMA.

The 11,505-acre Ocean Lake Wildlife Habitat Management Area (WHMA – Fig. 17) was established in the 1940's through a cooperative agreement with the U.S. Bureau of Reclamation (BOR) and was completed in 1974. Several bodies of water including Ocean Lake were created by irrigation flows into a natural sump as a result of the Riverton Reclamation Project in the early 1920's.

This warm water lake has depths of up to 31 feet and is situated between the Owl Creek Mountains and the Wind River Range. Habitats throughout the WHMA are diverse, ranging from arid sagebrush grassland and cultivated cropland to permanently wet marsh and open water. Common game and furbearing species include geese, ducks, sandhill cranes, pheasants, mourning doves, cottontail rabbits, mule deer, muskrats, raccoons, red foxes, mink and skunks. Most of the area is important breeding and nesting habitat for Canada geese. The southeastern portion was historically considered migration habitat for endangered whooping cranes during a failed experimental restoration project. Whooping

crane eggs were fostered into sandhill crane nests, with the idea that sandhill crane parents would raise the chicks and teach them to migrate. However, the chicks, once grown, failed to identify as whooping cranes and successfully reproduce.

Habitat has been improved through the construction of dikes, creation of numerous ponds, and construction and placement of 200 Canada goose nesting structures. During migration, up to 3,000 geese, 400 sandhill cranes and 10,000 ducks may be present at any given time. Wetlands such as those at Ocean Lake are among the richest habitat types in our country. They provide suitable habitat for waterfowl, shore birds, upland game and many other species. Wildlife viewers and photographers can also observe grebes, terns, pelicans, snipe, avocets and other water birds and shorebirds in the areas on and surrounding Ocean Lake WHMA.

Sand Mesa Wildlife Habitat Management Area

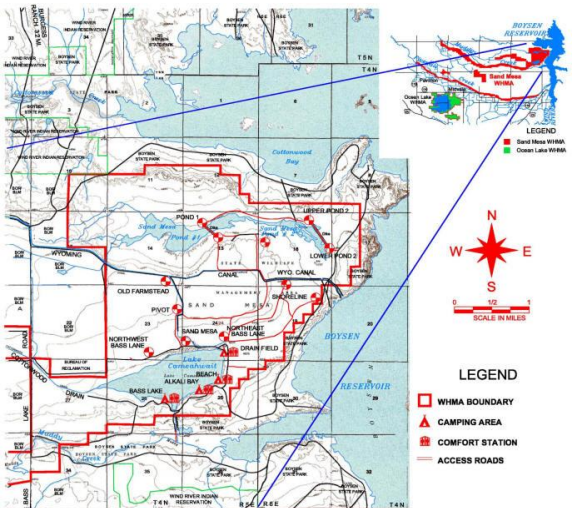

Fig. 15. Sand Mesa WHMA.

Sand Mesa Wildlife Habitat Management Area (Fig. 18) is approximately 25 miles northwest of Shoshoni. The area can be accessed by traveling west on U.S. Highway 26 and then north on Bass Lake Road. Sand Mesa is a good example of an area that has been enhanced by managing cropland to improve habitat for a variety of wildlife.

Farmlands are also being irrigated under a contract with the Wyoming Game and Fish Department to improve wildlife habitat. Wetlands totaling 350 acres on these managed farmlands not only serve as waterfowl habitat, but also filter sediment and impurities from runoff before it enters Boysen Reservoir.

Wetland-Associated Wildlife

Table 3. Species of greatest conservation need that use wetland, riverine, or riparian habitats in the WRWC based on WGFD (2017).

Bird Species	*Mammal Species*	*Amphibian Species*
American Bittern	Dwarf Shrew	Northern Leopard Frog
American White Pelican	Fringed Myotis	Plains Spadefoot
Bald Eagle	Long-eared Myotis	Western Tiger Salamander
Black-crowned Night-Heron	Long-legged Myotis	Western Toad
Black Tern	Little Brown Myotis	
Caspian Tern	Moose	*Fish Species*
Clark's Grebe	Northern River Otter	Burbot
Common Loon	Pallid Bat	Flathead Chub
Forster's Tern	Townsend's Big-eared Bat	Northern Plains Killifish
Franklin's Gull	Western Small-footed Myotis	
Great Blue Heron		*Other*
Harlequin Duck	*Reptile Species*	Dusky Fossaria
Lewis's Woodpecker	Northern Rubber Boa	Pewter Physa
Short-eared Owl	Eastern Yellow-bellied Racer	Tadpole Physa
Snowy Egret		Ash Gyro
Swainson's Hawk	*Plant Species*	Creeping Anclid
Trumpeter Swan	Ute' ladies-tresses	
Virginia Rail		
Western Grebe		
White-faced Ibis		
Willow Flycatcher		
Yellow-billed Cuckoo		

OTHER PLANS AND INITIATIVES

NRCS: Agricultural Conservation Easement Program, Wetland Reserve Easements

The Agricultural Conservation Easement Program (ACEP), administered through NRCS, provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. The Wetland Reserve Program (WRP) was replaced with Wetland Reserve Easements (WREs) in the 2014 Farm Bill. Similar to WRP, WREs are designed to provide a financial incentive to encourage restoration of wetlands previously degraded and/or drained on private agricultural lands. The WRP and WREs have been a very popular program. Approximately 2.6 million acres have been enrolled nationwide since the inception of WRP in 1990.

Website: http://www.nrcs.usda.gov/

North American Wetlands Conservation Act and Grant Program.

The North American Wetlands Conservation Act (NAWCA) was passed, in part, to support activities under the North American Waterfowl Management Plan (NAWMP). The NAWMP is an international agreement providing a strategy for long-term conservation of wetlands and associated upland habitats on which waterfowl and other migratory birds depend throughout North America. The companion grant program provides funding for on-the-ground projects that contribute to long term conservation of wetlands and wetland ecosystems. Conservation actions may include acquisition, enhancement and restoration of wetlands and associated habitats. Public or private entities or individuals establishing public/private sector partnerships are eligible to apply. NAWCA grants must be matched at least 1:1 with nonfederal matching funds. Higher nonfederal match ratios are usually needed for a grant application to successfully compete against other applications.

Website**:** http://www.fws.gov/birds/grants/north-american-wetland-conservation-act.php

The Nature Conservancy

The mission of The Nature Conservancy (TNC) is to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by conserving the lands and waters they need to survive. TNC does this primarily through acquisitions of lands and easements to protect important representative communities and habitats in their natural state. The Nature Conservancy has conserved more than one million acres and 1,500 miles of river and streams over the past 30years in Wyoming. TNC has been actively involved in landscape conservation within the Wind River Complex area. TNC projects have included the Winchester and Red Canyon Ranch acquisitions.

Website: http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/wyoming/

Partners for Fish and Wildlife Program.

Partners for Fish and Wildlife (PFW) is the USFW's primary program for conservation delivery on privately owned lands. The program provides technical and financial assistance to private landowners and tribes, on a voluntary basis, to help meet the habitat needs of federal trust species and species of interest designated by conservation partners. The program targets habitats in need of restoration or enhancement such as riparian areas, streams, wetlands and grasslands. Field biologists work one-on-one with landowners and partners to plan and implement a variety of projects including grazing lands management, sagebrush steppe enhancements, stream habitat and fish passage improvements, invasive species removal, and wetland restoration, enhancement, and establishment. The most recent strategic plan update identifies priority areas, focal species, and 5-year conservation targets in Wyoming (USDI/FWS 2017: 251-292) . The PFW WY strategic plan can be accessed at**:** https://www.fws.gov/mountain-prairie/refuges/partnersPDFs/WYPFW%20SP2017-2021.pdf

Wildlife and Sport Fish Restoration Program

The USFWS Wildlife and Sport Fish Restoration Program (WSFR) works with states, insular areas and the District of Columbia to conserve, protect, and enhance fish, wildlife, their habitats, and the hunting, sport fishing and recreational boating opportunities they provide. The Division of Wildlife and Sport Fish Restoration Program provides oversight and/or administrative support for the following grant programs: Wildlife Restoration Grant Program, Sport Fish Restoration Grant Program, Boating Infrastructure Grant Program, State Wildlife Grant Program, Tribal Wildlife Grant Program, and Tribal Landowner Incentive Grant Program. website: http://wsfrprograms.fws.gov/

Wind River Reservation (WRR): Eastern Shoshone and Northern Arapaho Tribes

Several tribal plans address conservation of federal trust species (waterfowl), tribally-designated significant species, and native species of concern. Specifically, "The Status and Management of Waterfowl on the WRR" and "A Plan for Wildlife Management on the WRR" identify the importance of waterfowl and provide recommendations to maintain and increase resident populations. The plans also identify broader conservation goals that include perpetuating and enhancing the distribution and abundance of target species (species important to tribal members; rare, threatened and endangered species; aesthetically unique or endemic species; species at the top of the food chain) within the limits of habitat carrying capacity. In addition, the Wind River Reservation Trumpeter Swan Restoration Project, Implementation and Evaluation Plan lay groundwork for swan re-introduction and management within the WRR.

Wyoming Partners in Flight (PIF): Wyoming Bird Conservation Plan: Version 2.0

Major purposes of the Wyoming Bird Conservation Plan are to identify priority species and habitats, and to establish conservation objectives. The plan describes conceptual objectives at statewide and landscape scales. However, goals and strategies are not stepped down to regional and local levels. A number of wetland "best management practices" (BMPs) described in the plan have applicability within the Wind River Complex to improve wetland conditions for priority species.

The Wyoming Bird Conservation Plan can be accessed at: http://www.blm.gov/wildlife/plan/WY/menu.htm. The wetland component can be downloaded from: http://www.blm.gov/wildlife/plan/WY/Wetlands.htm#wetlands.

Wyoming 2917 State Wildlife Action Plan

The State Wildlife Action Plan (SWAP) is a long-range plan to conserve Wyoming's Species of Greatest Conservation Need (SGCN) and was developed to meet the requirements of the Congressionally-authorized State Wildlife Grants (SWG) Program. The plan identifies SGCN, key habitats, and conservation challenges statewide.

The 2017 State Wildlife Action Plan can be downloaded from:
https://wgfd.wyo.gov/Habitat/Habitat-Plans/Wyoming-State-Wildlife-Action-Plan

Wyoming Wetlands Conservation Strategy

This statewide wetlands conservation strategy was developed to serve the following purposes: 1) delineate important wetland and riparian habitat areas throughout Wyoming and assess their existing condition; 2) identify factors or threats that may impair the functional integrity of wetlands and riparian habitats; 3) establish statewide and regional conservation goals and priorities; 4) formulate effective strategies to conserve and manage wetlands and riparian habitats; 5) bring together existing conservation programs and initiatives to build and expand upon partnerships; 6) assemble links to other resources and programs that can assist conservation planning, funding, and collaboration efforts; and 7) provide a technical foundation for the wetland component of the Wyoming State Wildlife Action Plan. Although wetlands are the focus of this strategy, riparian corridors and open water habitats are also considered. The Wind River Basin Regional Wetland Conservation Plan is a step-down plan under the afore-mentioned statewide strategy.

Accessed at: https://wgfd.wyo.gov/Habitat/Habitat-Information/Wyoming-Wetlands-Conservation-Strategy.

Wetland Program Development Grants: U.S. Environmental Protection Agency

Additional sources of funding for wetland monitoring, restoration and protection are available to states with EPA-approved wetland program plans. However, the current version of the Wyoming Wetlands Conservation Strategy lacks some of the "core elements" required by EPA. For additional information concerning state wetland program plans, refer to: http://www.epa.gov/wetlands/developing-wetland-program-plan.
In 2016, WY received an EPA Wetland Program Development Grant, in part, to support development of a wetland program plan. The plan is expected to be completed and submitted to EPA for approval in 2018.

Wyoming Wildlife and Natural Resources Trust

In 2005, the Wyoming Legislature created the Wyoming Wildlife and Natural Resource Trust (WWNRT). The WWNRT is funded by interest earned on a permanent account, donations, and legislative appropriations. Its purpose is to enhance and conserve wildlife habitat and natural resource values throughout the State. Any project designed to improve wildlife habitat or natural resource values is eligible for funding. WWNRT funds can also be used to meet the non-federal match requirements of other funding programs including NAWCA grants, WHIP, and SWG, provided the projects are consistent with WWNRT funding guidelines. Website: http://WWNRT.state.wy.us/

Wyoming Statewide Comprehensive Outdoor Recreation Plan

The Statewide Comprehensive Outdoor Recreation Plan (SCORP) is prepared and updated every 5 years to maintain state eligibility for Land and Water Conservation Fund (LWCF) grants. Under LWCF guidelines, the SCORP document must include a wetlands component, which the Wyoming Game and Fish Department has prepared during each plan update. To our knowledge, no LWCF grants have been expended to acquire or enhance wetlands in the Wind River Basin or the remainder of Wyoming. In 2009, the funding appropriation for the LWCF was increased substantially. The LWCF had been targeted to reach its full funding level of $900 million by 2014, but this is jeopardized by Congressional cutbacks to conservation programs. The potential utilization of LWCF funds for wetland acquisition and improvements to support wetland-based recreation needs to be investigated further.

Accessed at: http://wyoparks.state.wy.us/pdf/Planning/SCORPBook.pdf

Wyoming State Water Plan

The Wyoming Water Development Office is responsible for overseeing preparation and periodic updating of the Statewide Framework Water Plan and individual river basin plans. The Framework Plan provides a statewide perspective on water resources compiled from the results of a seven-basin planning process performed by the Wyoming Water Development Commission (WWDC). The Wind-Bighorn Basin Plan Update (2010) is a regional inventory and assessment of water-related resources and uses that covers a larger area encompassing the Wind River Basin Wetland Complex. The primary purposes of water plans are to inventory existing water resources and uses, to predict future water demand, and to identify related storage, conveyance, and other infrastructure needs for towns, agriculture, and other economic sectors. The plans provide a resource used by project planners, as well as guidance for the Wyoming Water Development Commission to consider in approving project funding from the Wyoming Water Development Account. While the statewide and basin water plans do not specifically address wetland conservation, they do contain information and data that can be useful for planning wetland projects and for identifying potential future impacts.

Accessed at: http://waterplan.state.wy.us/frameworkplan.html.

THREATS TO WETLANDS

Conditions that potentially threaten wetlands within the Wind River Complex, and the degree of risk they pose, are summarized in Table 4.

Table 4. Threats to wetlands in the Wind River Complex

	Low	Moderate	High	Extreme
Climate Change/Drought Short and Long Term			X	
Wetland Conversion			X	
Flood to Sprinkler Irrigation Conversion			X	
Irrigation Water Delivery Improvements				X
New Irrigation Projects (storage reservoirs, diversions, land conversion)				X
Local Aquifer Alterations		X		
Stream Degradation				X
Inadequate Management/ Maintenance of Existing Wetlands Projects		X		
Surrounding Land Use Changes			X	
Inconsistently Applied Regulatory Protections		X		
Invasive Species		X		
Water Quality	X			

Climate Change, Short and Long Term Drought

Wyoming is the 5th driest state and drought is a naturally recurring condition in our region. Periodic dry cycles are a normal climatic feature and nutrients released from exposed organic substrates increase wetland productivity when wet cycles return. Much of Wyoming was under moderate to severe drought from 1999-2009 and again in 2013-2014 (Fig 19).

The apparent trend toward increasing drought frequency and severity will adversely impact wetland hydrology. Many of the benefits wetlands provide to fish and wildlife species (vegetation for food or cover, nesting and resting habitat, breeding grounds and water) are dependent on precipitation and other surface and ground water sources impacted by drought.

Changes in water conditions (wetter, drier, more saline, etc.) resulting from climate change will potentially impact wetland-dependent wildlife. In particular, isolated wetlands are the most vulnerable and those with unique community assemblage and structure offer little chance for adaptation (Status and Trends Wetlands in conterminous United State 2004-2009). Montane wetlands are buffered somewhat by elevational precipitation patterns and will likely be least impacted. Valley wetlands, both natural and man-made, are most susceptible to precipitation variations.

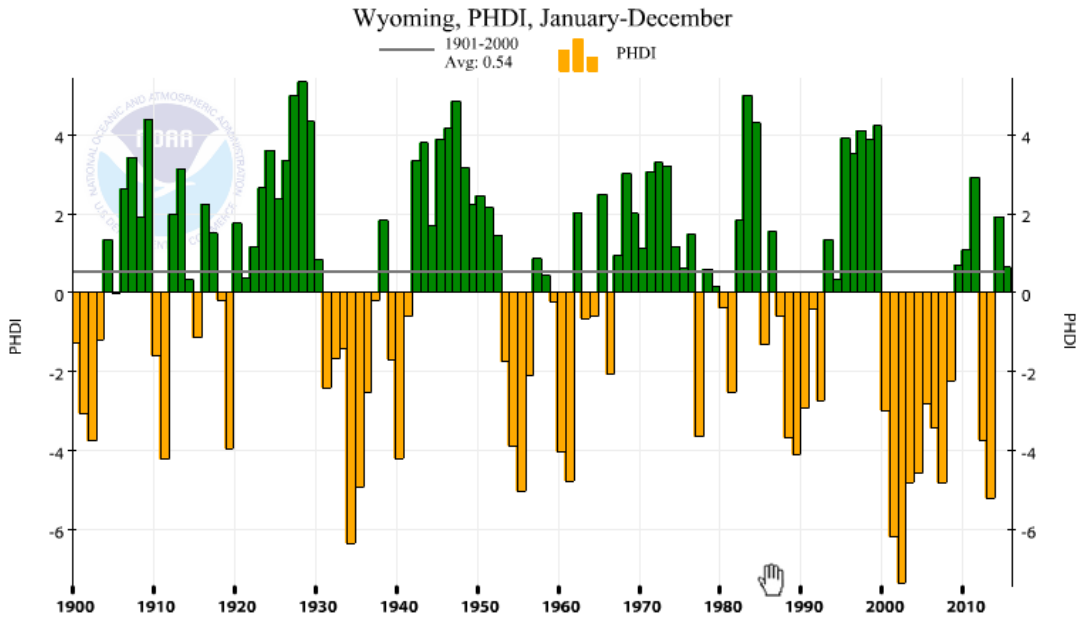

Fig. 16. Palmer Drought Hydrological Index.
Source: http://www.ncdc.noaa.gov/cag/

Annual and seasonal precipitation throughout most of Wyoming is generally insufficient to support dry land production of most crops. Supplemental irrigation is necessary to reliably produce crops in commercially viable quantities. Major retention structures have been built along larger rivers and streams in the Wind River Basin to store water for future use and help to mitigate some of the risk of drought (table 2). However, low mountain snowpack and retreating glaciers impact stream base flows and can have a negative effect on water storage when these conditions persist over a 2 or 3 year period,.

Glaciers serve as repositories for 75% of fresh water on earth. The Wind River Range contains 63 glaciers, the largest concentration in the American Rocky Mountains (Cheesbourgh 2009). Glaciers strongly affect the discharge of sediment and water downstream, and thereby influence the ecology of riparian and lacustrine habitats (Walsh et al. 2014). Glaciers also provide hydraulic buffering capacity, reducing inter-annual variability of water by storing water during cold years and releasing it during warm years (Jimenez Cisneros et al. 2014). However, the moderating influence of glaciers is weakened as glacial ice diminishes, likely resulting in higher stream flows earlier in the runoff season and possibly reduced summer flows (Jimenez Cisneros et al. 2014). Surface area and volume of the 42 primary glacier complexes in the Wind River Range declined from 1966 to 2005. About 25 percent of the glacial mass was lost from 1985 to 2005. The volume of Dinwoody Glacier alone decreased approximately 53,500 acre-ft from 1983-2001. In comparison, Pilot Butte Reservoir contains 31,660 acre-ft when full (Thompson et al. 2009).

Wetland Conversions

The reasons why wetlands are converted to other land uses are complex and often reflect local and regional economic conditions and land use trends. Approximately 38% of the natural wetlands that existed in Wyoming prior to settlement were lost by the mid-1980s (Dahl 1990:6). Current and recent wetland losses are not tracked at the state level. Wetlands currently occupy less than 2% of Wyoming's arid landscape. Nationally, losses of freshwater wetlands have been attributed primarily to urban and rural development and silviculture operations. Dahl (2011) estimated the annual rate of loss has averaged 42,000 acres in recent years (2004-2009). It is likely the potential magnitude of loss was not fully realized due to creation or enhancement of wetlands supported by surplus water from traditional irrigation practices. However, technologies to improve irrigation efficiencies including conversions from flood to sprinkler irrigation, improvements to water delivery systems, and construction of new irrigation projects (storage reservoirs, diversions, and land use conversions) will likely drive wetland losses in the future. Emerging challenges for water use and conservation include expanding water demands and agricultural production to support a growing population base, allocation of environmental flows (water within wetlands, rivers, and groundwater systems) needed to sustain natural ecosystems, energy-sector growth, Native American water-right claims, and supply/demand shifts expected with climate change (Schaible and Aillery 2012).

Local Aquifer Alterations

Changes in groundwater/surface water exchange can affect water quantity and quality. Reduced groundwater levels due to drought or increased pumping can result in decreased stream flows and decreased water levels in lakes and wetlands. On average, greater than 50 percent of stream flow is contributed by springs and alluvial aquifers. Decreased groundwater discharge can affect aquatic ecosystems sustained by, and dependent on a continuous supply of groundwater (USGS Groundwater 2014).

Throughout the Wind River Basin, groundwater occurs as unconfined aquifers in unconsolidated deposits and bedrock formations. Topography and drainage patterns primarily influence groundwater recharge, flow, and discharge. Shallow groundwater (less than 300-500 feet below the land surface) is recharged by precipitation, and often discharges to streams. Complex interactions can occur among bedrock aquifers, unconsolidated aquifers, and surface waters, especially along drainages lined with alluvial deposits. Groundwater discharge contributes to stream base flows and in some cases, constitutes the entire base flow (Wind/Bighorn River Basin 2010 Plan).

Stream Degradation

River form and fluvial processes evolve through mutual adjustments towards self-stabilization (Rosgen, 1994). Channel stability is defined as the ability of a stream to transport sediment and flows of a watershed in such a manner that channel geometry is maintained overtime without aggrading or degrading (Rosgen 1994). Changes in the watershed that affect the quantity or timing of stream flows can influence channel stability. The addition of in-stream diversions, channel alterations (i.e. straightening, dredging), water withdrawals, trans-basin water transfers, roads,

urbanization and bank vegetation removal have introduced instability into lower elevation rivers and streams within the Wind River watershed. These modifications often lead to accelerated channel movement and bank erosion, over widened channels, increased sediment loading, and channel incision leading to reduced frequency of out of bank flows, lowering of local water tables, and ultimately loss of aquatic and wetland habitat.

Management/Maintenance of Existing Wetlands Projects

Wetlands perform numerous functions including water retention and storage, nutrient transformation, and accumulation of organic substrates. Wetlands also sustain diverse, productive communities of plants, invertebrates, and wildlife. Not all wetlands perform all functions, nor do they perform functions to the same degree. Numerous attributes such as location, size, climatic variation, and hydrology determine the wetland type that develops and the functions it performs. Irrigated landscapes often provide supplemental water that maintains wetland water levels at or near full pool throughout the growing season. Under these conditions, wetland productivity may diminish. Absent fluctuating water levels, oxidation-reduction processes needed to cycle nutrients cannot occur. Maintaining static water levels reduces wetland diversity potential and can create a broader monotypic class of wetlands at the watershed scale. On the other hand, irrigation infrastructure and runoff sustain some wetlands in locations where wetlands did not previously exist, and also provide a water source for several created wetlands.

Water regimes within the majority of wetlands are influenced predominantly by variability in natural runoff events and/or irrigation inputs. However, most wetland projects on federal, state, tribal or private lands include water control features that provide land management agencies, tribes, and landowners the capability to actively manage water to obtain a desired response by vegetation and the wildlife community.

Surrounding Land Use Changes

Based on the most recent U.S. Census, Wyoming's population increased 14 percent from 2000-2010, far more than the national average. As of 2005, almost 51% of Wyoming residents lived in one of the State's 13 largest municipalities. Wyoming offers an increasingly attractive lifestyle alternative owing to its healthy economy, low taxes, and open space. Wyoming's current population estimate is 579,315 and expected to reach nearly 700,000 by 2025 (World Population Review2017). As population and industrial growth continue, added stresses will be placed on wetlands and associated watersheds. Additional support facilities and infrastructure must be built to accommodate population growth. These include housing developments, roads, shopping areas, and commercial and industrial facilities. Not only is land disturbed when development occurs, but additional demand will be placed on water resources to fulfill growing domestic and industrial needs.

Over the past two decades, energy development has intensified significantly throughout Wyoming. From 1990 to 2010, Wyoming's total energy production more than doubled from 4,644.4 to 10,532.2 trillion BTU's ranking the State second nationally in terms of gross

energy production and first in terms of net energy exported (USDOE 2015). The Bureau of Land Management (BLM) administers more than 17.5 million acres of public land in Wyoming, and 40.7 million acres of federal mineral estate underlying both public and private lands (USDI/BLM 2015). In 2012, BLM managed a total of 16,489 oil and gas leases encompassing more than 11.5 million surface acres – an area larger than Maryland and Massachusetts combined. The overall footprint of energy development including coal, oil and gas extraction, electric power generation, and related infrastructure development and population growth, will continue to impact wetlands directly and indirectly.

The NRCS's National Resources Inventory (NRI) tracks statewide changes in land cover and use on non-federal lands. Between 2002 and 2007 an estimated 129,300 acres of agricultural land (cropland, pasture, and rangeland) were converted to developed lands (urban, built-up areas and rural transportation land) in Wyoming. During that same period, the National Agricultural Statistical Service reported the number of farms increased from 9,422 to 11,069 whereas the average size of farms decreased from 3,651 to 2,587 acres. This represented a 5.8 million-acre loss of farmland. Coincidently, smaller operations (those generating less than $10,000 annually) increased from 3,700 to 5,200. The number of farms in Wyoming increased 17%, but it's likely the average size and revenue generation followed national trends. These data support a growing trend of habitat fragmentation and loss from urban expansion, rural subdivision and ranchette development, and energy production.

Effectiveness of Regulatory Programs

Numerous regulatory mechanisms are in place to conserve wetland resources in Wyoming. Among these are Section 404 of the Clean Water Act, the Wyoming Wetlands Act and Mitigation Bank, and federal land use planning and permitting processes. Effectiveness of wetland protection programs is directly related to how much value the public places on wetland resources and agency capacity available to carry out monitoring and compliance enforcement. Factors that limit success of the current model include the sheer vastness of Wyoming coupled with the concept of voluntary oversight and compliance. Reliance on the public to notify appropriate officials of possible wetland violations is hampered by a lack of understanding of what constitutes a wetland and/or willingness to get involved. More consistent implementation of wetland programs could be realized if a single oversight entity were provided with the resources needed to adequately monitor wetland activities and enforce wetland protection regulations.

Invasive Species

Three problem species are common in the Wind River Watershed: tamarisk or salt cedar (*Tamarix spp.*), Russian olive (*Elaeagnus angustifolia*), and reed canary grass *(Phalaris arundinacea L)*. All three can adversely affect stream stability by displacing deep rooted native sedges and shrubs, and tend to form monotypic stands that diminish habitat quality. Higher transpiration rates also impact stream base flows and wetland hydrology.

CONSERVATION OBJECTIVES

Objectives for conservation and management of wetlands and riparian habitats within the Wind River Wetland Complex include:

1) Work with conservation partners (including landowners) to reduce impacts that contribute to habitat fragmentation.
2) Protect the integrity of montane lake and wetland systems.
3) Restore, enhance and protect valley palustrine wetlands and associated uplands.
4) Restore, enhance and protect riverine systems and associated wetlands and riparian habitats.
5) Conserve and protect groundwater resources.

CONSERVATION STRATEGIES

1) Work with conservation partners to reduce impacts contributing to habitat fragmentation.
   - Identify and prioritize key areas necessary to maintain ecological integrity and connectivity across the landscape.
   - Work with federal, state, tribal and local conservation partners and landowners to conserve and protect priority habitats.
   - Work with conservation partners to manage impacts of rural housing development through county planning and zoning efforts.
   - Develop a GIS-based desktop screening tool to evaluate wetlands based on important functions. This information could track cumulative impacts and help empower local administrators making wetland decisions.
   - Collaborate with partners to develop additional strategies addressing wetland and riparian habitat degradation and loss from fragmentation.

2) Protect the integrity of montane lake and wetland systems.
   - Complete a comprehensive biological assessment of montane lakes and wetlands, including an assessment of hydrologic and biological connection to valley wetlands.
   - Work with federal, state, and tribal land managers to develop conservation strategies and policies applicable to the lands they administer.
   - Identify compatible activities and discourage incompatible activities based on appropriate internal agency processes.
   - Develop the necessary support network to assist agencies and tribes with implementing protection mechanisms on lands they administer, particularly regarding measures essential to assure long-term lake and wetland health.

3) Restore, enhance and protect valley palustrine wetlands and associated uplands.
   - Conduct biological and functional assessments to identify and prioritize important wetland areas for protection and restoration.
   - Identify biological and hydrologic linkages among montane, palustrine and riverine wetlands. For example, determine linkages based on local movement patterns of priority wetland bird species during winter, migration, and breeding periods.
   - Through existing programs and funding opportunities, work with conservation partners to restore and enhance priority wetlands and associated uplands.
   - Coordinate habitat management efforts between land management agencies and private landowners when possible.
   - Work with local irrigation districts and agricultural interests to address aging irrigation infrastructure while providing incentives to maintain priority wetlands.

4) Restore, enhance and protect riverine systems and associated wetlands and riparian habitats.
   - Conduct biological and functional assessments to identify and prioritize important wetland and riparian areas for protection and restoration.
   - Work with conservation partners to restore, enhance priority riverine systems through existing programs and funding opportunities.
   - Work with local irrigation districts and agricultural interests to rehabilitate aging irrigation infrastructure and provide incentives that maintain wetlands, promote sustainable agriculture, and restore stream health.

5) Conserve and protect groundwater resources.
   - Identify and prioritize important watershed and ground water sources that significantly influence hydrology of priority wetlands.
   - Review existing ground water protection measures and work with local administrators to ensure adequate protection measures are fully implemented.

6) Additional Recommendation.
   - Work with partners to develop appropriate local protection ordinances empowering a designated local entity (e.g., conservation district) to authorize actions and monitor activities potentially impacting wetland, stream and water resources.

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