Riparian Habitat Group

Wetlands

1) Describe the habitat (Frederickson and Laubhan 1994; Kusler et al. 1994; Mitsch and Gosselink 1993; Ogle 1997; Ringelman 1992; U.S. Fish and Wildlife Service 1955, 1990; USDA Forest Service 1980; Wyoming Department of Commerce 1995):

a) Historic conditions: Wetlands were abundant in North America when the Europeans first arrived and remained so into the mid 20th century, although Wyoming, an arid state, probably never contained as high a percentage of wetland acreage as the rest of the nation. Although the original types and extent of wetlands are not known in great detail, wetlands probably originally composed about 2 million acres (809,000 ha), or about 3.2%, of Wyoming's land area. Historically, floodwater and surface runoff regularly filled and inundated natural wetlands instead of being diverted for agricultural or urban uses. Although all wetlands were not flooded every year, some wetland habitats were available in most years. Montane wetland communities were probably in much the same condition as they are today, but the wetlands of the plains/basin regions were probably much more widespread and had a much greater supply of higher quality water. On the other hand, wetlands associated with irrigation systems, reservoirs, and stock ponds did not exist.

b) Present conditions: In the early to mid 20th century, wetland habitat suffered substantial losses in Wyoming. Although the magnitude is debatable, probably about 38% [750,000 acres (303,000 ha)] of Wyoming's wetlands have been lost. There are currently an estimated 1.25 million acres (506,000 ha) of wetlands remaining in Wyoming, about 2% of the state's surface. Montane wetland communities have remained relatively intact when compared with the widespread wetland loss and degradation typical of the intermountain basins and plains. The plains/basin regions are used intensively for agriculture, grazing, mining, and human settlement, and today, much of the rainfall in the West is diverted for agricultural or urban uses and never reaches wetland sites. Many former wetlands are now irrigated hayfields or croplands, although wetlands have been converted for a variety of other land uses, including mining and urban development. Shallow wetlands and wet meadows, which originally supported large populations of breeding birds, have suffered the greatest losses. Irrigation systems have created some wetlands from canal and dam seepage, and some wetlands are associated with stock ponds and reservoirs, but these wetlands are often maintained with little vegetation. The pace of wetland losses has slowed since the mid 1970s due to increased awareness, better protection measures, and increased federal regulations.

Wetlands encompass a large variety of ecosystems of large and small proportions, which are distributed throughout Wyoming. Wetlands form where there is a water supply at or near the land surface. The location and persistence of the supply depends on a number of factors, including precipitation, runoff, evaporation, topography, and groundwater discharge. Combinations of these factors create conditions that support wetlands in Wyoming in the mountain ranges, river drainages, closed basins, and in areas of human activity. Freshwater marshes are found mostly in the mountains and foothills, but also in the plains regions, depending on the hydrology and the soil; wet meadows are found along streams and around mountain lakes and ponds; semi-permanently and permanently flooded riverine wetlands are associated with river drainages throughout the state; playa wetlands exist in closed basins throughout Wyoming, including some of the driest areas in the state, and may be saline or fresh; shrub swamps are created by beaver activities along streams; wooded swamps occur in the coniferous mountain regions; and peatlands, or fens, are represented in small areas in the mountains.

2) Identify the issues:

a) Use: Although wetlands comprise only about 2% of the state's area, their ecologic and economic value is greater than their surface area might indicate. About 90% of Wyoming's wildlife use wetland habitats daily or seasonally during their life cycles, and 70% of Wyoming's birds are wetland obligates. Wetland habitats are essential spawning and young-rearing areas for many fishes in Wyoming. Wetlands are the focus of varied recreational and tourist activities such as hunting, fishing, trapping, bird watching, camping, and hiking; and are used for livestock grazing and hay production. Wetlands moderate the effects of floods by storing abundant moisture and releasing it during drier periods. In some areas of Wyoming, wetlands are important for recharging aquifers. This groundwater supply is used for irrigation, livestock watering, mining operations, and many other activities. Healthy wetlands maintain high water tables, making adjacent uplands more productive. Wetlands help maintain or improve water quality by removing, transforming, or retaining contaminants as water flows through the wetland. Wetland vegetation can also process chemical and organic wastes and pollutants and reduce sediment loads.

b) Access: Most plains/basin wetlands are in private ownership, which keeps large numbers of people from impacting the habitat. Most montane wetlands are in public ownership, where access and use have increased. High intensity impacts in accessible sites are a concern, and human disturbances in wetlands can severely affect some nesting birds, such as Franklin's Gulls, Forster's Terns, and Common Loons.

c) Problems: Agricultural practices still pose the greatest threat to Wyoming wetlands through dewatering, draining, clearing, stream channelization, and conversion from flood to sprinkler irrigation. Invasion by exotic species (e.g. bullfrogs, Russian olive, tamarisks, leafy spurge, purple loosestrife, pepperweed, and whitetop), reduced water quality (e.g. selenium in irrigation drainwater, organophosphate pesticides, pollution in storm drainages), ongoing and proposed flood control projects, residential and recreational development, predators that thrive on urbanization (e.g. raccoons, red foxes, and skunks), oil and gas exploration and other mineral development (coalbed methane production can cause problems by dewatering the surface or by discharging poor quality water), overgrazing, road and bridge construction, and competition for scarce water supplies pose additional threats to wetlands. The dependence of many wetlands on contiguous water systems makes them especially vulnerable to even minor human activity; development in watershed areas and the pumping of groundwater can disrupt or destroy them. The number of wetlands is growing, but native wetlands are declining. There is a lack of knowledge about the wetlands that are being created, and whether they are providing adequate habitat for birds and other wildlife.

d) What has been the cause of change to the habitat: The early history of wetland management, a history that still influences many people today, was driven by the misconception that wetlands were wastelands that should be avoided or, if possible, drained and filled. Until the late 20th century, wetland management usually meant wetland drainage to many policymakers, except for a few resource managers who maintained wetlands for hunting and fishing. Landowners were encouraged through government programs to tile and drain wetlands to make the land suitable for agriculture and other uses. From the 1950s to the mid 1970s, 87% of wetland losses in the U.S. were due to conversion to agriculture, and from the mid 1970s to the mid 1980s, 54% of wetland losses were attributed to agriculture. Because of the types of development in Wyoming, this is probably a reasonable assumption for the state as well. Losses have also been due to residential and commercial development, roads, water development projects, erosion and inundation, mining of mineral resources, livestock grazing, stream channelization, dredging, encroaching fill, and other land and water uses. Wetlands have been degraded by the invasion of exotic plant species, flood control has removed seasonally flooded areas, grazing by domestic livestock and native ungulates has removed vegetation and dried up wetlands, and pesticides and other contaminants have adversely affected bird species dependent on wetland habitat.

Montane wetlands are relatively intact compared with the widespread wetland degradation typical of the plains/basin regions. Nevertheless, logging activities may cause disturbance, reduce the amount of available nesting cover in the surrounding wetlands, and cause erosion and sediment deposition. Disturbance from recreationists can be a problem in some areas; grazing domestic livestock and native ungulates can have severe effects on wetland vegetation; and mining activities often alter or destroy wetlands, and can create acid runoff that drastically alters the water chemistry and devastates invertebrate communities.

While natural wetlands have been degraded or lost in many areas, irrigation systems have created some wetlands from canal and dam seepage, and many stock ponds have been constructed. Unfortunately, most stock ponds are poor quality wetlands due to a lack of submergent and emergent vegetation. Also, many constructed stock ponds in Wyoming are nonfunctional. For instance, in the Bighorn Basin, less than half of the 2,000 stock ponds constructed still contain water; the rest have breached or silted full. Nevertheless, some stock ponds do provide benefits to birds in otherwise arid areas.

In Wyoming, there are approximately 230,000 acres (93,100 ha) of deepwater reservoir habitat. Unfortunately, most of the reservoirs in Wyoming removed wetland habitat, and operation of these reservoirs for irrigation and power production causes such great water level fluctuation that wetland vegetation does not reestablish. Also, a common goal of reservoir management is to provide the smallest surface area of water to limit evaporation losses; this goal often creates steep shores that do not support wetland vegetation. Though significant increases in these large and small open water areas have occurred over the last 25 years, the importance of these newly created habitats is not as great as the wetlands lost.

3) Priority bird species in Wetlands habitat in Wyoming:

Level I:
American Bittern
Trumpeter Swan
Wilson's Phalarope
Franklin's Gull
Forster's Tern
Black Tern

Level II:
Common Loon
Snowy Plover
Marsh Wren

Level III:
Western Grebe
Clark's Grebe
Northern Harrier
American Avocet
Willet

Best Management Practices

Wyoming Partners In Flight Best Management Practices for Wetlands to Benefit Birds in Wyoming.

Introduction

Various bird species that use wetlands have a diversity of requirements. Some, like the Franklin's Gull, prefer sparse emergent vegetation. Others, like the Marsh Wren, prefer emergent vegetation of more moderate density. Some birds prefer marshes with patches of open water, some like wetlands that are bordered by mudflats, and some feed in the marsh but nest in grassy uplands nearby. A simple set of guidelines for wetland management in Wyoming will not work for all species of birds using those habitats. A variety of wetland types and conditions under different or rotating management schemes may be the best strategy within an ecological region, or ecoregion, that encompasses public lands and diverse private lands, and may even cross state boundaries. The efforts of land managers and private landowners are critical to the survival of these birds. Landowners and land managers can take a variety of simple and inexpensive actions to improve habitat for birds and help them nest successfully. By maintaining and restoring habitat for wetland birds, many other wildlife species will also benefit. Some management activities that improve the health of wetlands may also improve watershed health by recharging the aquifer, filtering pollutants from the water, and moderating the effects of floods.

As a landowner or land manager, the actions you take will depend on your goals, resources, and commitment, as well as the physical characteristics of your property, such as topography, hydrology, existing vegetation, and whether you have control over the water levels in your wetlands. The following Best Management Practices (BMPs) should provide some reasonable guidelines for managing wetland habitats to benefit a wide variety of resident and Neotropical migratory birds in Wyoming.

Many of the Best Management Practices for wetlands fall into major categories of land use such as Grazing, Farming, Engineering, Recreation, etc. The recommended BMPs are broken out into categories for convenience, although some are general enough to cross into other categories.

Wetlands Ecology

Wetlands are areas covered by water or that have waterlogged soils for long periods during the growing season. They are transition zones between terrestrial and aquatic systems where the water table is near, at, or just above the surface of the land. The location and persistence of the water supply that forms a wetland is a function of precipitation, runoff, evaporation, topography, and groundwater discharge. Wetlands are referred to by such names as marshes, swamps, bogs, wet meadows, potholes, sloughs, fens, playas, and river overflow lands. Shallow lakes and ponds, usually with emergent vegetation as a conspicuous feature, are considered wetlands, however, the permanent waters of streams, reservoirs, and portions of lakes too deep to support emergent vegetation are not. Neither are wet areas that are so temporary as to have little or no effect on the development of moist-soil vegetation.

Wetland boundaries are delineated using three basic parameters: the presence of plant species adapted to life in moist or saturated soils (hydrophytes); the presence of soils displaying characteristics that develop due to lack of oxygen; and evidence of hydrologic input from surface water and/or groundwater, creating conditions favorable to hydrophytes and to the development of wetland soils. Wetlands such as swamps and marshes are often obvious, but some wetlands are not easily recognized, often because they are dry during part of the year. The U.S. Army Corps of Engineers (1987) has developed the following vegetation, soil, and hydrology indicators to use when making wetland determinations. Unless an area has been altered or is a very rare natural situation, wetland indicators of all three characteristics must be present for an area to be a wetland.

1) Vegetation Indicators. Hydrophytes are plants that are capable of living in soils that lack oxygen for at least part of the growing season. You can usually determine if wetland vegetation is present by knowing a relatively few plant types that commonly occur in the area. For example, cattails, bulrushes, sphagnum moss, willows, sedges, and rushes usually occur in wetlands.
2) Soil Indicators. There are approximately 2,000 named soils in the U.S. that occur in wetlands. Such soils, called hydric soils, have characteristics that indicate they were developed in conditions where soil oxygen is limited by the presence of saturated soil for long periods of the growing season. There are several indicators of hydric soils that may be determined by examining the soil, including:
    - Soil consists predominantly of decomposed plant material (peats or mucks).
    - Soil has a thick layer [8 inches (20 cm) or more] of decomposing plant material on the surface.
    - Soil has a bluish gray or gray color at 10 to 12 inches (25 to 30 cm) below the surface, or the major color of the soil at this depth is dark (brownish black or black) and dull.
    - Soil has the odor of rotten eggs.
    - Soil is sandy and has a layer of 3 inches (8 cm) or more of decomposing plant material at the soil surface.
    - Soil is sandy and has dark stains or dark streaks of organic material in the upper layer 3 to 12 inches (8 to 30 cm) below the soil surface. These streaks are decomposed plant material attached to the soil particles.

When soil from these streaks is rubbed between the fingers, a dark stain is left on the fingers.

2) Hydrology Indicators. Wetland hydrology refers to the presence of water either above the soil surface or within the soil for a sufficient period of the year to significantly influence the plant types and soils that occur in the area. The following indicators provide evidence of the periodic presence of flooding or soil saturation:
    - Standing or flowing water is observed on the area for seven or more consecutive days during the growing season.
    - Soil is waterlogged. This can be determined by digging a hole to a depth of 12 inches (30 cm) and examining the soil. If water stands in the hole, if the soil glistens with water at any depth to 12 inches (30 cm), or if water can be squeezed from the soil, the soil is waterlogged.
    - Watermarks are present on trees or other erect objects. Such marks indicate that water periodically covers the area to the depth shown on the objects.
    - Drift lines, which are small piles of debris oriented in the direction of water movement through an area, are present. These often occur along contours and represent the approximate extent of flooding in an area.
    - Debris is lodged in trees or piled against other objects by water.
    - Thin layers of sediments are deposited on leaves or other objects. Sometimes, these become consolidated with small plant parts to form discernible crusts on the soil surface.

A wide variety of birds use wetland habitats for all or part of their life cycles. In fact, wetlands provide essential nesting, migratory, and wintering areas for more than 50% of the nation's migratory bird species. Birds are attracted to the abundant invertebrate food resources and the normally heterogeneous nature of wetlands. The watery environment also provides nesting, resting, and feeding sites that are protected from many ground predators. Physical characteristics that influence how birds use wetlands include wetland size; habitat structure, especially cover to water ratios; extent and type of open surface water; water depth; dominant vegetation type (e.g. sedges/rushes, shrubs, etc.); landscape setting and the surrounding upland habitat (e.g. grassland, shrubs, forest, etc.); annual water regimes (e.g. permanent stable, or temporary wetlands that usually dry up in late summer, etc.); and the presence of special physical features, such as islands or peninsulas. In general, wetlands increase in value to birds if they are part of a complex of wetlands on a landscape scale, offer a diversity of vegetation structure, are free of contaminants, and are protected from human disturbance.

General

1) Strive for no net loss of wetlands on a landscape scale. Limit activities that degrade or remove wetland habitats (e.g. conversion to cropland and roads, industrial developments such as oil wells, heavy recreational use, overgrazing, contaminated runoff, invasion by exotic plants).

2) Conserve unique representatives and/or large, ecologically functioning examples of wetland habitat.

3) Consider both long- and short-term impacts and/or benefits of any activities within or adjacent to wetland areas. Manage wetlands for sustainable use without abuse over the long-term.

4) Maintain and enhance the habitat of remaining wetlands. Identify and protect the ecological processes that support specific wetlands and their associated bird communities. Conservation activities in wetlands should emphasize the protection of natural wetland structure, composition, and the ecological processes that support them and the birds present. Avoid practices that degrade or destroy natural water flow or the vegetation in and around wetland habitats.

5) Where possible, restore or rehabilitate the hydrology, water quality, and native plant communities to degraded and disturbed wetlands. Methods vary for ecologically sound management of human-made or modified wetlands but should emphasize creating or restoring natural wetland functions. Because modification of the hydrologic cycle will change the characteristics of a wetland, great care should be taken in the design of wetlands and in water level manipulations on any site.

6) Where natural nesting opportunities are limited, intensive wetland management may involve the creation of nesting islands, earthen furrows, and perching or nesting platforms. Although construction costs are high, properly located artificial islands can be ideal nesting places for birds because they reduce predation. In some cases, nesting success on islands can be several times higher than on uplands or shorelines.

7) Manage wetland areas for good water quality. It is particularly important to monitor the water supply because declining water quality may lead to insidious deterioration of the wetland habitat. Wetlands should not simply become shunts for receiving irrigation drainwater that can adversely affect water quality.

8) Manage wetlands from a watershed perspective. Most precipitation that falls in a watershed eventually travels to and affects the wetland areas. Good wetland management also includes good upland management because wetlands are part of a system that includes the uplands. For example, many wetland birds use the

surrounding uplands for nesting. In addition, wetlands are usually interconnected with other wetlands through the water system, so manipulation of one wetland often influences others in the watershed.

9) Protect pristine wetlands, and manage those that have been modified by human activities to enhance their functional value for wildlife. Assess the condition of the wetland, conduct reconnaissance of bird populations, and identify limiting factors before initiating management actions to avoid trying to fix something that isn't broken. While, in many cases, management of wetlands is desirable, it is not always necessary. Protection itself is a form of management and, in some cases, may be the only management action necessary. Many montane wetlands, particularly those in the upper montane and subalpine zones, have been insulated sufficiently from human activities so that no management actions are warranted. In these pristine habitats, actions are best directed toward habitat preservation rather than improvement. Pristine wetlands that have retained their inherent hydrologic characteristics and functions should be protected and passively managed. Conversely, wetlands that have been modified or impacted often must be actively managed to provide consistent resources to wetland wildlife. A primary challenge in wetland management is to make hydrological modifications that transform wetlands into suitable habitats for wildlife. A successfully managed wetland contains the type, quality, and distribution of food and cover that are the same or functionally similar to those found in natural, unmanaged wetlands and that meet the goals for bird conservation.

10) Regularly monitor birds to see how the management plan is working, and redirect efforts if necessary (with special emphasis for species that seem to be declining). Implement wetland monitoring programs to establish baseline data and identify changes in habitat quality (both positive and negative) through time. Monitoring is essential for verifying the effects of manipulations and scheduling treatments to maintain high productivity. Use standardized methods to monitor the habitats and sensitive species in an area, before and at several-year intervals after treatments are applied, to aid in making proper land management decisions in the future. For example, conduct reconnaissance of bird populations and identify limiting factors before initiating management action. Collect qualitative samples of invertebrates (e.g. presence/absence, percent occurrence) with simplified sampling techniques such as sweep nets, emergence traps, or underwater traps to track water quality and habitat suitability. Monitor the presence of different wetland plants and their distribution, growth, and seed production to gain important insights into the hydrology of the site and observe cues for management activities.

11) Monitor soil salinities. In arid areas, soil salinities largely determine the composition of vegetation and provide warnings when certain management practices should be implemented or changed. Saline wetlands have benefits for certain foraging bird species, such as American Avocets, but consistent use of waters with high salinities

can eventually reduce productivity of the wetland, including the foods that attract target species. Monitoring soil salinities helps determine whether saline water can be used for fall flooding, whether units need to be flushed with fresh water, or if some type of soil treatment is necessary.

12) Manage for a variety of locally native plants. A variety of plant species provides a diversity of vegetation structure and hosts a diversity of invertebrate populations, which are preferred by different bird species. Encourage vertical interspersion of vegetation, as well as horizontal diversity. A mixture of trees and shrubs along marsh edges, low shallow emergents, tall robust emergents, and submerged plants will enhance the diversity of wetland birds. Refer to the U.S. Fish and Wildlife Service's "National List of Plant Species that Occur in Wetlands" online at www.nwi.fws.gov/bha/ for a list of plants that are suitable for growth in wetlands.

13) Prevent the invasion of exotic plants (e.g. purple loosestrife, Russian olive). To reduce the likelihood of weed invasion in wetlands that contain a community of native vegetation, maintain the vigor of native species, control livestock stocking levels, avoid large-scale soil disturbances, and minimize habitat fragmentation. Treatments to control exotic plants include hand removal, mowing, grazing, prescribed burning, biological agents, elevating water levels, herbicides, etc., or a combination of these, depending on the plant species. Minimize the dispersal of seed by timing the removal activity before seeds ripen. Follow weed control with reseeding and restoring native plant species to prevent reinvasion of weeds. In areas of widespread invasions where native trees and shrubs are scarce, removal of Russian olive and tamarisk (salt cedar) in sections, followed by replanting with natives, may be better than a onetime, wide-scale removal. This should allow any wildlife using these invaders to gradually switch to native vegetation.

14) Maintain wetland habitat with a combination of open water and vegetation. Provide a cover:water ratio of about 50:50 across an entire wetland, or a large portion of a wetland, with vegetation and open water well interspersed throughout the basin. In this condition (called hemi-marsh), a wetland has the potential for the greatest diversity and numbers of waterbirds, and invertebrate populations are usually high. Depending on the situation, cover:water ratios of 65:35 to 35:65 might be considered optimum as well, because a good interspersion of vegetation and open water is probably more important than the ratio of the two.

15) To benefit area-sensitive species such as the Black Tern, maintain wetlands in large, continuous areas and in complexes composed of a mosaic of wetland types and conditions. An area-sensitive species is one that requires a large block of unfragmented habitat to successfully breed and survive. When the number of area-sensitive species in semi-permanent wetlands is ≥4, a factor of 1.5 may be used to determine how much larger a wetland of X area must be to support another area-sensitive species. For

example, a 20-acre (8-ha) wetland containing 8 area-sensitive species would need to be 10 acres (4 ha) larger in area (20 acres x 1.5 = 30 acres) to contain one additional species, whereas a 40-acre (16-ha) wetland would need to be 20 acres (8 ha) larger (40 acres x 1.5 = 60 acres) for an additional species to be present (Shuford 1999).

16) Within extensive areas of wetland habitat, manage for a patchwork or mosaic of wetland types and conditions across the landscape. This may include seasonal, semi-permanent, and permanent wetlands; wetlands in different phases of water level management; and wetlands with different vegetation structure and composition. When a group of different wetland types is in close juxtaposition, it forms a wetland complex. While no single wetland or wetland type will provide all the resources needed by a single species during all of its life history stages or for all birds adapted to wetlands, complexes provide many different resources for different species and provide the resources required for successful completion of different stages in the life cycle of a species. Generally, provision and management of large, diverse wetlands and complexes of different wetland types increases habitat heterogeneity and often increases overall diversity and density of bird species. Also, because in most wetlands succession can naturally advance or be reversed much more rapidly than on uplands, it is crucial that a variety of wetland types be present simultaneously throughout a region. This is particularly true in arid regions that are subject to frequent drought, as providing a diversity of wetland types will help to ensure the presence of shallow water [6 to 10 inches (15 to 25 cm) deep] habitat under a variety of climatic conditions. A good mix of different wetland types within about a 10-mile (16-km) radius provides optimum conditions for most wetland birds and will meet the living requirements of a variety of species.

17) Provide different stages of wetland succession at one time to maximize habitat diversity over the entire wetland complex. When multiple small wetland management areas are in close proximity, stagger the management cycle, or use different management practices in each wetland, so the different areas are not all treated the same way at the same time.

18) Develop a basic understanding of invertebrate and plant ecology and an ability to identify plants at all stages of their life history. Invertebrate food resources are an important factor in bird use of wetlands, particularly during the breeding season. The presence of different wetland plants and their distributions, growth, and seed production provides important insights into the hydrology of a site and is also an important factor in bird use of wetlands. An understanding of invertebrates and plants can provide cues for ecological approaches and is essential for successful wetland management.

19) Identify the life requisites for target bird species in order to provide the needed resources in a timely manner. The availability of cover and foods must match the seasonal, social, and biological needs of many species.

20) Consider all the alternatives for vegetation management before taking action. A variety of management schemes can be used to alter the distribution, composition, or density of vegetation (e.g. trapping muskrats, water level manipulation, livestock grazing, prescribed burning, mowing, disking, crushing, excavating, herbiciding, and blasting with explosives). While artificial techniques are often more expensive and less aesthetically pleasing than biological techniques, they may sometimes be necessary in highly modified or degraded wetlands. Whatever management scheme is selected should be scheduled and implemented to mimic natural processes as closely as possible.

21) Implement prescribed burning to change the structure, composition, and distribution of vegetation where needed. Prescribed burning in wetlands can be used to clean out old vegetation; release nutrients bound in dead vegetation; create open water areas; expose the soil for new germination; create a mosaic of vegetation attractive to wildlife; control exotic plant species and woody vegetation; clean out impoundments after drawdown and prior to reflooding; accelerate spring green-up and forage availability; modify plant communities without the use of herbicides; and modify soil temperatures and soil moisture conditions. Early-spring burning is usually best, but timing depends on dry conditions, fuel availability, and the presence of wildlife within the wetland. Avoid burning during the nesting season when eggs and nestlings might be destroyed. At some locations, mowing or light disking can be used to create fuel loads sufficient for burning.

22) Although more restricted in its use than burning, use mowing to modify the distribution and density of wetland vegetation where needed. This technique is best used on wetlands that develop sufficiently thick ice to support a tractor. Because water levels normally are at their lowest level in late autumn when such sites freeze, and highest at about the time of the spring thaw during most years, robust emergent vegetation (e.g. cattails) can be clipped just above the ice so that spring flooding inundates the cut stems and restricts the oxygen supply to the root zone. Many of the plants do not resprout, thus the distribution and density of emergents are modified for up to several years.

23) Manage artificially created wetlands (e.g. reservoirs surrounded by extensive marshes, return flows from ditches and canals, etc.) that provide habitat for birds to protect the supported bird communities. This includes best management practices centered on water level management, recreation, agriculture, and grazing.

24) Manage for a wide variety of bird and other wildlife species by maintaining habitat diversity. Because wetlands tend to be mosaics of different vegetation types, conservation actions at most wetlands should favor a wide variety of birds.

25) Maintain or restore a buffer strip of native vegetation surrounding the wetland to provide food and critical nesting, escape, and winter cover for birds and other wildlife. Buffer strips also improve wetland water quality by trapping silt and contaminants before they reach the water's edge, preventing soil erosion, and increasing the life expectancy of the wetland by reducing sediment loading. Buffer strips should be 40 to 100 feet (12 to 30 m) wide, and consist of tall herbaceous cover or other dense native vegetation.

26) Minimize human disturbance at known nesting areas and colonies during the nesting season by creating refuge areas and limiting human use. Disturbance problems can be alleviated to some degree through public education, signing, or seasonal restrictions.

27) Protect those wetlands used by colonial waterbirds for nesting sites. Colonial nesting birds are particularly sensitive to changes in habitat conditions after establishing a nesting site, because factors that might lead to nesting failures affect entire colonies. Throughout the nesting season, maintain the isolation of colonies by restricting human access, sustaining water levels, and preventing access by grazing animals.

28) Do not expect consistent, maximum production from any wetland every year, as the productivity of wetlands varies among years.

<u>Water Level Management</u>

The best wetland management practices are those that enhance the natural processes of the wetland ecosystem. One way to accomplish this is to maintain conditions as close as possible to the natural hydrology of the wetland, including hydrologic connections with adjacent rivers and lakes. Pristine systems with unmodified hydrology should always be protected and maintained in their natural state. However, in highly impacted wetlands, water level manipulation may be necessary to enhance the value for wildlife and to improve other wetland functions. Opportunities to consistently create favorable habitat conditions are much greater when control of water supply, water levels, and water discharge is possible. Drawdowns can be scheduled to produce desired results regardless of natural precipitation or drought cycles.

1) Where appropriate, use water level control to enhance wetland habitat. The control of water levels is probably the wetland management technique that has the greatest

effect on wetland conditions. Water level manipulation may be used to increase or decrease salinity; stimulate germination and growth of hydrophytes (moist-soil plants); enhance the production of invertebrates; clear up turbidity; recycle nutrients; manipulate the density of vegetation; control exotic plants, carp, mosquitoes, muskrats, and disease; and make resources available for target species. Changing water depth has the most dramatic effect on plant production and growth. This production and growth, in turn, affects the production of aquatic invertebrates, which serve as a food source for birds. Water level control is achieved by dikes (impoundments), weirs (solid structures in marsh outflows that maintain a minimum water level), control gates, and pumps.

2) Determine type and location of water control structures best suited for each site. Because the hydroperiod of most wetlands is dynamic and can involve daily as well as seasonal and annual fluctuations in water levels, the ability to alter water levels slightly and completely remove water from a developed wetland is essential. Build permanent water control structures that allow precise water level manipulation and locate them in such a way that complete drainage of the basin is possible.

3) Take great care in water level manipulations on any site. Any modification of the hydrologic cycle will change the characteristics of a wetland.

4) Use water level manipulation to recreate natural short- and long-term fluctuations in water levels. Wetlands are highly dynamic within and among years. Water rises or falls in accordance with precipitation, runoff, evaporation, and the activities of animals. Constantly fluctuating water levels are central to wetlands ecology and are necessary to maintain desirable plant communities and associated wildlife. Wetland management practices that standardize water depths and fluctuations across wetland complexes generally preclude the very short-term wetland dynamics. Stabilization of water at high levels is undesirable, as it leads to lake-like conditions, promoting the growth of aquatic vegetation instead of semi-aquatic vegetation, and lowering invertebrate production and total nutrient availability. Toxic substances may build up under the anaerobic conditions of continuous flooding, and the return of nitrogen and phosphorus to the system may be slowed. At constantly low levels, however, wetlands become too densely vegetated, and resemble terrestrial rather than aquatic systems. Both of these conditions lead to a lack of productivity and thus a lack of wildlife species diversity. The goal of successful management must include a strategy to fluctuate the timing, depth, and duration of water level manipulations within and among years.

5) When a wetland is primarily open water with little emergent vegetation, initiate a spring drawdown to stimulate the germination of seedlings on the exposed mud surfaces. Reflood the wetland in subsequent seasons, so that less water-tolerant vegetation disappears, resulting in improved cover-water interspersion. The drawdown cycle may be repeated for a second year if necessary to establish a good stand of emergents.

6) Develop a cover:water ratio of about 50:50 across an entire wetland, or a large portion of a wetland, with vegetation and open water well interspersed throughout the basin. During this stage (called hemi-marsh), the wetland has the greatest diversity and number of birds, and invertebrate populations are often high.

7) Although natural seed banks remain viable for years and these natural supplies are usually adequate to revegetate a wetland during drawdown procedures, consider planting or seeding to enhance revegetation if the wetland is known to have been devoid of vegetation for a considerable period (i.e. decades). Use native plants and seeds, and avoid the introduction of exotic plants, either intentionally or unintentionally, at all costs. Refer to the U.S. Fish and Wildlife Service's "National List of Plant Species that Occur in Wetlands" online at www.nwi.fws.gov/bha/ for a list of plants that are suitable for growth in wetlands.

8) Use drawdown techniques to speed up the decomposition of dead vegetation. When dead vegetation is under water, there is usually not enough oxygen for it to rot. When exposed to the air, it breaks down into nutrients which enrich the soil and act as fertilizer.

9) When planning to use prescribed burning or mowing to manipulate wetland vegetation, use drawdown techniques to create conditions suitable for fire or to enable equipment access.

10) Give careful consideration to the timing of drawdowns; schedule drawdowns according to the management objectives. When the objective is to stimulate germination of emergent plants, drawdowns are usually scheduled for early spring so a moist seedbed can be maintained to give emergent plants a good start. If the drawdown is delayed, annual weeds can become established, and the new emergent plants won't survive the reflooding. Drawdowns in mid and late summer expose mudflats and provide feeding sites for migrating shorebirds. Winter drawdowns can help control undesirable vegetation by exposing rootstocks to freezing temperatures, but these same conditions can adversely affect muskrats, turtles, and fish. Fall drawdowns can potentially cause problems with avian botulism, and drawdowns should not be conducted during the bird nesting season.

11) Provide stable water levels throughout the bird nesting season. The need of wetlands for seasonal instability should not be interpreted as a need for erratic water level changes at any time of the year. Water level manipulation should be carefully conducted at the proper time of the year to ensure maximum benefits to birds. Water fluctuations during the nesting season can flood nests, can leave nests dry and exposed to mammalian predators, and can cause some birds to abandon their nests.

12) Postpone drawdown plans during drought conditions in the interest of retaining whatever water is available, as managed wetlands may receive very heavy use by birds displaced from natural wetlands that have dried up.

13) Allow the wetland to reflood slowly and naturally after a drawdown. This will maintain the growth of flood-tolerant seedlings without shading them out in turbid water.

14) Maintain different wetland areas in staggered cycles to provide all stages of wetland succession at once and maximize habitat diversity across the landscape.

15) Be aware that during the drawdown process, wildlife species may not use the area the same as before. However, in a situation where a wetland must be rejuvenated, immediate wildlife needs may be deferred so the wetland can recover. Once recovery is complete, the benefits to wildlife will be long lasting and worth the one to three seasons of less desirable conditions. This is particularly true if the wetland is part of a complex in which other wetlands are in optimum condition.

16) Use over-winter water levels to discourage or encourage muskrats, depending on the density of the vegetation. If vegetation densities are high, maintain freeze-proof depths to encourage muskrat use of the wetland. If vegetation densities are too low, maintain water depths below freeze-proof depths to discourage muskrats. Other alternatives are to regulate muskrat numbers by trapping, or to control undesirable vegetation by exposing rootstocks to freezing temperatures.

<u>Farming</u>

These recommendations for farming practices will benefit birds and other wildlife, and also help to protect water quality and wetland functions.

1) Provide a buffer of uncultivated vegetation from at least 40 to 100 feet (12 to 30 m) wide around wetlands. Cultivating up to the edge of a wetland removes important vegetative filters, increases sedimentation, and accelerates siltation. Reestablish vegetation through plantings and, if necessary, fencing.

2) Prevent chemical runoff into wetlands. Agricultural chemicals can harm wetland vegetation and wildlife.

3) Prevent soil from eroding into wetlands. Increased sedimentation reduces the quality of wetland habitat. Use contouring and minimum tillage, and maintain winter cover and buffer strips to reduce siltation and erosion, and to extend the life of the wetland.

4) While it is better for birds (and cats) if cats are kept indoors, have domestic "barn" cats spayed or neutered, keep pet food and food bowls indoors so predators like raccoons and feral cats do not have an additional food source, and never intentionally feed feral cats. Cats (even well fed domestic cats) can be devastating to local songbird populations. Natural predators, like owls and hawks, are very efficient at controlling rodent pests, even around human dwellings.

5) Avoid converting existing wetlands to cropland, as this is the greatest threat to birds in this habitat type. Permanent easements on important wetland areas could benefit both landowners and wildlife.

6) Use Integrated Pest Management (IPM) to control undesirable weeds and insects. IPM will reduce destruction of non-target insects that are food for many species of birds and minimize exposure of birds to harmful chemicals. Most species of grasshoppers require bare ground to lay and hatch eggs; using minimum or no-till practices will reduce the need for insecticides.

7) To benefit wetland birds that also nest in upland habitat, such as Willets and Northern Harriers, limit activity in the field during the breeding season (April 15th through July 15th), minimize the number of field operations that destroy nests, and where possible, use agricultural methods that destroy fewest nests, such as subsurface tillage or no-tillage. In hayfields, delay spring mowing as long as possible (preferably until nesting ends in late July), avoid night time mowing, and space mowings as widely as possible to allow the greatest probability of successful nesting.

8) If wetland plants are harvested for hay to help maintain plant diversity, carefully consider the timing to get the best palatability and to avoid harming nesting birds.

9) Develop conservation partnerships between landowners, land managers, and private organizations. While landowners need to derive income from the land, this can often be compatible with maintaining regional biological diversity, depending on how the land is used and what land management tools are employed. Identify the habitat needs of the birds in the area and the economic needs of the landowner so a baseline need is established. Also, important habitat on private land can be protected with conservation easements. In some cases, landowners can derive income from hunters, trappers, tourism (e.g. bed-and-breakfasts with a view, wildlife watchers and photographers), bait minnows, or wetland plants (for aquatic gardening).

Pesticides

Pesticides can harm bird populations if used incorrectly. Insecticides can negatively affect bird populations for the very reason they were created—to kill insects. Birds, even seed-eaters, depend on insects to feed their young. Loss of insect prey during the nesting season can be devastating, and can turn a habitat that regularly produces birds into one that does not. Also, many migrants rely on insects in wetlands to store up or replenish fat reserves for their journey. Improperly used pesticides can directly kill birds, or weaken them and make them more susceptible to disease or unable to produce young. Herbicides change the composition of the vegetation in the wetland, which causes loss of nesting sites and declines in prey abundance. If pesticides must be used, carefully follow the label directions.

1) Strictly limit pesticide application in wetland areas and adjacent sites to activities that improve or maintain wetland vegetation (e.g. elimination of competitive noxious weeds). Where pesticides are needed, use them as part of an Integrated Pest Management (IPM) program. IPM involves closely monitoring pest populations of both plants and animals, and using chemicals only when and where pests are likely to cause economically or ecologically important damage. This reduces exposure of wildlife to harmful chemicals and reduces the destruction of non-target insects and plants. Include birds in IPM plans for insect control, along with natural pathogens, suitable crop and grazing practices, pest-resistant crop strains, minimal use of pesticides, and using less toxic or persistent forms of pesticides.

2) Use only those pesticides that are approved by the U.S. Environmental Protection Agency specifically for use in and adjacent to wetlands.

3) If available, use biological control for specific noxious species, rather than chemical control.

4) When possible, apply pesticides and herbicides by hand to target weeds and other pests as specifically as possible.

5) Carefully plan aerial application of herbicides to prevent drift of chemicals into wetlands and employ drift retardants. Depending on the wind speed, provide a buffer zone of 1 to 4 miles (1.6 to 6.4 km) downwind of the aircraft, and 250 feet to 1 mile (0.08 to 1.6 km) upwind. Avoid spraying herbicides in winds exceeding 10 mph (16 kph), or during calm weather when temperature inversions may prevent sprays from reaching the ground. Pellet herbicides are less prone to wind drift and are preferred when applying near wetlands. Check with the Wyoming Department of Agriculture for more specific information.

6) Do not apply pesticides when there is a high probability of rain.

7) Limit pesticide use to periods in the life cycle of the pest when the chemical is likely to be most effective and least toxic to non-target species.

8) Consider other alternatives, besides herbicides, for vegetation management. These include regulation of muskrat populations, water level manipulation, livestock grazing, prescribed burning, mowing, disking, crushing, and excavating. Whatever management scheme is selected should mimic natural processes as closely as possible.

Grazing

There are many possibilities for harmonizing grazing practices with habitat management for birds. Although improper grazing practices can cause wetland degradation, proper stocking levels and grazing regimes can be effective habitat management tools and compatible with wetland maintenance and improvement. These Best Management Practices for grazing focus on protecting wetlands during crucial growing periods.

1) Grazing management plans should be developed and evaluated on a case-by-case basis by the managing agency or landowner because no single grazing strategy will fit all situations. Include wetland management as an integral part of each grazing management plan. Determine site-specific wetland objectives and tailor the grazing management plan to help meet the objectives. Consider the site's specific factors of concern, such as loss of emergent vegetation; the site's potential and capability; its suitability for grazing livestock and the type of stock best suited to the area; and the ideal grazing strategy, including the time, place, amount, duration, and intensity of grazing. Monitor the effects of each grazing strategy on the wetland area to check progress toward the objectives. Record how key wetland plant species, the overall wetland ecosystem, and key upland plant species respond to grazing management (annual photographs taken from the same point are helpful).

2) Maintain proper stocking rates and livestock distribution to protect wetland ecosystems. Incompatible grazing can have harmful long-term effects on survival and regeneration of plant seedlings; can negatively influence the species, structure, and health of wetland vegetation; and can cause soil compaction, trampling of the wetland edge, altered local hydrological conditions, and degraded water quality from waste materials and excessive soil in the water. Manage grazing intensity at a level that will maintain the composition, density, and vigor of desired plants and will not damage wetland soils, edges, or water quality.

3) Limit the amount of time livestock spend in pastures with wetland areas. This can be a significant factor in the condition of the wetland. Base the length of the grazing period within a wetland zone on the areas livestock are actually using, not the entire pasture. If needed, add more rest to grazing cycles to increase plant vigor or encourage more desirable plant species composition.

4) Manage pastures with wetland habitat as separate units in a rotation grazing system. Where feasible, use a deferred-rotation or rest-rotation system, whereby no pasture is grazed the same season (spring, summer, or fall) two years in a row. A year of rest for each wetland pasture every three to four years is beneficial for long-term habitat maintenance. In some areas, use of these pastures late in the grazing season by cows with calves will produce the best use of upland forage resources and reduce impacts on wetlands.

5) Ensure adequate residual vegetation cover is left after grazing; this is essential for maintaining wetland ecosystem health.

6) Allow time for plants to rest and regrow between grazing periods to ensure they remain vigorous and productive. Plants that are continuously grazed during the growth period will lose their vigor and stop producing seeds, and their roots will die back, eventually causing a change in the plant community from more productive, palatable species to less productive and less palatable plants. Limiting grazing to the plants' dormant season (November to March) can help prevent damage to wetlands.

7) Improve livestock distribution and forage use by using salt and mineral blocks, but avoid placing them within wetland areas [keep them at least ½ mile (0.8 km) from the wetland] or in immediately adjacent uplands.

8) Improve adjacent upland forage to lure livestock out of wetland areas.

9) If needed, add more pastures to increase management flexibility and rest for wetland vegetation.

10) Provide water (wells, windmills, or guzzlers) in upland areas to encourage livestock to move away from wetlands. If livestock is dependent on the wetland as a water source, construct a pipeline from the wetland to a stock tank. If none of these options are feasible, a "water gap" can be constructed. This involves constructing a fence into a small portion of the wetland so livestock can use this restricted area for watering. Keep in mind that small birds can drown when they fall into stock tanks and troughs while drinking. Provide escape ramps to prevent drowning (Figure 6).

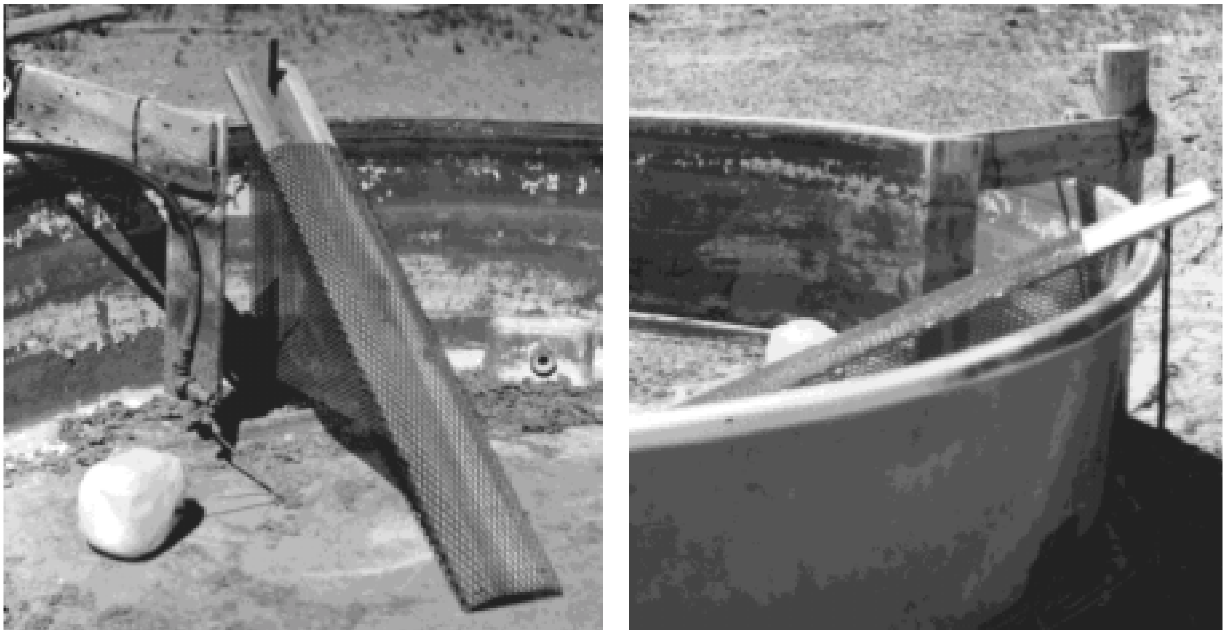

Figure 6. Escape ramps placed in stock tanks and troughs to prevent drowning of small birds and mammals (photographs courtesy of Mark Gorges, Bureau of Land Management).

11) Where possible, avoid keeping livestock in holding pastures (where livestock are held for prolonged periods for winter feeding or calving) with wetlands. If this is unavoidable, don't regard the vegetation in a holding pasture as forage; provide adequate supplemental feed. Provide ease of access for livestock to water, or provide supplemental water. Direct herd pressure to the most resistant areas of the field through placement of supplements.

12) Conversion to cropland is the greatest threat to wetlands. Efforts to maintain ranching and compatible grazing regimes as the dominant economic force and land use in wetland areas will benefit birds.

13) Defer livestock grazing until after the breeding season in pastures that contain wetlands important to breeding birds. Idle grasslands near wetlands and previously grazed areas provide habitat for nesting, but areas with cattle present during the breeding season are less suitable. Large numbers of livestock permitted to graze in wetlands during the breeding season may accidentally trample nests or young and significantly alter habitat.

14) Where feasible, fence livestock out of the wetland to avoid destruction of aquatic vegetation, increased water turbidity, and reduced water quality. Livestock can also destroy vegetation covering earthen retaining walls and dams, eventually leading to washout of these structures. Ideally, a 100-foot (30-m) perimeter fence should be

constructed around the wetland. However, fences can be hazardous to birds and mammals. Use smooth wires on top and bottom, and, where possible, do not string fences across water.

15) Prudent grazing of cattle in marsh habitats, after the nesting season, might be employed as one way to control vegetation density.

16) Develop conservation partnerships between landowners, land managers, and private organizations. While landowners need to derive income from the land, this can often be compatible with maintaining regional biological diversity, depending on how the land is used and what land management tools are employed. Identify the habitat needs of the birds in the area and the economic needs of the landowner so a baseline need is established. Also, important habitat on private land can be protected with conservation easements. In some cases, landowners can derive income from hunters, trappers, tourism (e.g. bed-and-breakfasts with a view, wildlife watchers and photographers), bait minnows, or wetland plants (for aquatic gardening).

Engineering

1) Avoid existing wetlands during construction projects. Ensure that wetland impacts are avoided wherever possible; impacts to wetlands are minimized to the extent possible, during both planning and construction phases; and unavoidable wetland impacts are mitigated.

2) If adverse impacts of projects cannot be avoided, reduced, or offset, then mitigation is a possibility. Mitigation should be designed to protect wetlands during development, enhance wetlands where appropriate, and replace wetlands that are destroyed. Mitigation at or near the project site is preferred and should at least be within the same watershed. Replacement habitat should be of the same quality and equal or greater in acreage than that eliminated. The focus should be on restoring the functions and values provided by the wetland to be lost. New or restored wetlands can be used for mitigation, although restoring previously degraded wetlands is usually more successful and less costly than trying to recreate what was lost.

3) Consider the wetland in the context of its watershed and the greater ecosystem.

4) Maintain buffer zones between wetland areas and mining, oil, gas, sand/gravel, and geothermal activities, including structures, roads, and support facilities. Establish buffer strips of land bordering wetlands that are wide, vegetated, and otherwise roughened enough to trap sediment that might otherwise enter the wetland.

5) During road and highway construction, create, preserve, or enhance wetlands through designed elevation controls and careful installation of culverts. Create wetland

conditions by raising culvert inlet elevations or lowering ditch bottoms to hold runoff in flat-bottomed drainage ditching.

6) Construct borrow pits with gently sloped sides combined with plantings. Taper the bottom contour so that the shallow end simulates a temporary basin, the middle a seasonal basin, and the deep end a semi-permanent basin with open water.

7) Enhance the value of wetlands along highways for birds by leaving the adjacent rights-of-way unmowed and unhayed until after July 15th. Mowing of wetland plants such as cattails and bulrush destroys important summer and winter cover unless done properly. Moreover, pesticides in runoff from adjunct croplands or from spray drift can adversely affect water quality and the wildlife that use the water.

8) Install temporary fencing (e.g. silt fences) around sensitive areas during construction.

9) Control erosion and runoff from construction sites. Construction activities in and around wetlands can result in significant erosion and sedimentation, severely reducing or eliminating the ability of a wetland to cleanse runoff. To minimize erosion, plan access on shallow grades, even though this may not be the most direct access.

10) Locate facilities; projects (e.g. maintenance areas, storage, and composts); and cleared, paved, and compacted surfaces away from wetlands. Developed facilities with hardened surfaces such as roads, trails, and parking lots may deliver runoff, sediments, and toxins to adjacent wetlands.

11) Minimize use of heavy machinery in wetland areas. Use the smallest equipment possible. Place heavy equipment on stabilization mats when working in wetlands.

12) Work when the ground is frozen and during low flow and low wind periods.

13) Design roads and trails so as not to impede the natural hydrology of the wetland, including the inflow and outflow of floodwaters.

14) Do not dump materials into wetlands. During construction and maintenance, establish routine carryout procedures to minimize pollution risks.

15) Restore disturbed areas with native vegetation, prevent grazing by livestock while plants recover, and eliminate the invasion of nonnative plants during the reclamation period.

16) Experiment with using less than recommended amounts of fertilizer, time-release fertilizer, or no fertilizer at all. Fertilizers are rarely necessary when establishing native plant species. Do not apply fertilizers when there is a high probability of rain.

17) Minimize the use of abrasives (e.g. sand and gravel), de-icing compounds (e.g. salt), and other traction-enhancing materials. Consider closing routes temporarily when conditions are hazardous. If using abrasives, select the coarsest material possible.

18) Transport topsoil from a site that is bound to be disturbed or from a wetland that has been drained to a new site where comparable vegetation is desired (a mitigation site, for example).

19) Minimize collisions between birds and power lines by avoiding constructing power lines in areas where birds concentrate during migration, breeding, or winter. However, if problems exist after construction, reduce the potential for collisions by using natural vegetation or human-made structures to shield power lines, modifying habitat near power lines to change its attractiveness to birds, and/or modifying land use to reduce disturbance (i.e. flushing birds near power lines). Some of the possibilities for line modification include enhancing the visibility of lines (e.g. flags or marker balls), burying the line, removing overhead groundwires, and removing small lightning shield wires in sensitive areas. Other possible mitigations include constructing lines parallel to the prevailing wind, constructing lines lower than flight corridors, and placing lines across rivers at oblique rather than right angles. To minimize avian mortality, power lines should be constructed to the most current standards using publications such as those from the Avian Power Line Interaction Committee (APLIC) (1994). For details on power line mitigation to benefit birds, please refer to these publications.

20) Minimize the electrocution of raptors on power lines by constructing and retrofitting power lines to the most current standards. Raptor electrocution can be addressed by a variety of mitigation measures, through design and retrofitting existing lines. Possible mitigation includes using insulating materials; gapping groundwires; adding pole-top extensions; lowering crossarms; and adding elevated perches, depending on the nature of the pole and the problem. Also, nest platforms may be installed on power line structures to enhance populations of raptors while minimizing the risk of electrocution and the risk to service. Nest platforms may be provided on the poles themselves or on "dummy" poles placed near those poles where nests have been built. To minimize avian mortality, power lines should be constructed and retrofitted to the most current standards using publications such as those from the Avian Power Line Interaction Committee (APLIC) (1996). For details on power line mitigation to benefit birds, please refer to these publications.

21) To minimize the effects of continuous noise on bird populations, reduce noise levels to 49 dBA or less, particularly during the bird nesting season. Constant noise generators should be located far enough away from sensitive habitats such as grouse leks and raptor nests that the noise that reaches those habitats is less than 49 dBA. For example, the noise impact from drill rigs is greater than 49 dBA when the rig is closer

than about 800 feet (250 m) to a receptor; impact from a 26,000 horsepower compressor station is greater than 49 dBA when located closer than about 2,500 feet (750 m) to a receptor. Near roads with 10,000 cars per day the population density of birds may be reduced up to 1 mile (1.5 km) from the road, while near very busy roads (up to 60,000 cars per day) the effect may be felt up to 2 miles (2.9 km) away. Avoid placing well pads, roads, and any other facilities requiring human presence within 825 feet (250 m) of raptor nests to prevent flushing adults from the nest. This buffer zone should be expanded in areas where prey are scarce, as raptors must spend more time searching for prey and may be less tolerant of disturbances. If necessary, implement mitigation measures to decrease continuous noise levels. For example, enclose compressor engines with buildings and install additional suppression around muffler exhausts. Noise barriers can be constructed at drilling and testing operations, and noise dampening around engines should be considered (including foam insulation around drilling rigs).

22) Where possible, avoid construction activities and other temporary disturbances during the breeding season in areas where priority bird species occur. Avoid noisy disturbances within ½ to 1 mile (0.8 to 1.6 km) of active or occupied raptor nests, depending on the species, during the period from February 1 through July 31 to prevent nest abandonment.

<u>Wildlife Management</u>

Wildlife can impact wetland areas. Managing for one species can sometimes have negative impacts on other species, such as birds. Wildlife management goals for each wetland should be well planned, and should complement the overall goals of the wetland community.

1) Consider wetland conditions and big game impacts on vegetation when setting herd objective levels. Do not exceed the carrying capacity of wetland habitats.

2) Be aware of the impacts that cowbird nest parasitism have on nesting birds. Increased nest parasitism often results when forests are fragmented or livestock grazing occurs near woody habitats during the nesting season. The cowbird is an open-habitat species that commonly associates with livestock because of the foraging opportunities livestock provide. Due to their nomadic behavior, cowbirds build no nest of their own. Instead, females lay their eggs in the nests of host species, often removing the host's eggs in the process. Cowbird eggs hatch sooner than the hosts' eggs, and cowbird young are larger and more aggressive; therefore, they crowd the hosts' young and receive the majority of food brought to the nest, at the expense and often demise of the hosts' young. In the West, expansion of livestock into forested areas has allowed cowbird populations to increase and expand their range. Cowbirds are highly mobile, commuting up to 4 miles (7 km) daily between breeding and feeding sites. Therefore, it

is necessary to take a landscape-scale approach to planning grazing regimes to benefit birds.

3) In situations where predators like raccoons, skunks, and crows have increased in number around human developments, manage predator issues where negative impacts to birds occur.

4) Maintain beaver populations in locations where they currently occur, encourage and promote reintroduction into areas that were historically occupied by beavers, and provide suitable habitat for reintroduced beavers. Before settlement of the Rocky Mountain region, beaver were one of the most influential natural forces shaping wetlands. Although they cut down trees, they also create suitable sites for establishing new growth of trees and shrubs. Where beaver populations are stable, their activities create new wetlands, buffer floods, raise water tables, and provide a diversity of habitats. Beaver activities are critical to the maintenance of uncommon peatland habitat. Restoring or maintaining beaver populations can be an effective habitat management tool, depending on habitat goals. Address damage and loss of mature trees where they occur, and control beaver populations where necessary by relocation or harvest. However, avoid removing beavers and destroying beaver dams where their activities do not affect irrigation, property developments, or habitat quality. Removing beavers and their dams can reduce water storage, lower water tables, increase soil erosion, and increase flood damage potential.

5) Monitor muskrat activity in wetland habitats, as they can dramatically affect plant production, distribution, and density. As muskrats increase in number, they use large amounts of vegetation for food and lodge-building materials. While the open water they create is desirable, too much open water can lead to homogeneous wildlife habitat and, ultimately, to reduced species richness in the wetland environment. In Wyoming, muskrat populations are rarely high enough to out-forage a wetland completely and, in fact, can be very effective at controlling the amount of emergent vegetation present. However, monitoring the muskrat population is advised, as muskrat populations can expand quickly and can rapidly remove vegetation from a wetland. Trapping can be an effective management tool for controlling muskrat numbers and for maintaining the wetland in a desirable condition. It is also possible to use over-winter water levels to discourage or encourage muskrats, depending on the density of the vegetation. If vegetation densities are high, maintain freeze-proof depths to encourage muskrat use of the wetland. If vegetation densities are too low, maintain water depths below freeze-proof depths to discourage muskrats.

6) Use sand, gravel, or wire screening to discourage beaver and muskrats from burrowing into dikes, creating obstructions to water flow, and removing vegetation.

7) Monitor carp numbers in wetland habitat, as they uproot wetland vegetation, compete with other wildlife for food, and create turbid water conditions. Unfortunately, controlling carp is very difficult, as either complete drawdown or chemical poisoning of the wetland are the only effective ways of eliminating them. If the wetland area is one in a series of linked wetlands, reintroduction of carp to the treated area is likely.

8) If available, use dams, levees, or other structures to control the water level and manage wildlife, such as carp, turtles, mink, and muskrats.

Recreation

Unfortunately for birds, people also like to use healthy wetland areas and some recreational uses are not compatible with bird conservation goals. Recreational use can affect birds by creating disturbances and habitat degradation, especially during the breeding season. The recommendations below can help minimize negative effects associated with recreation. Recreation activities, such as camping, off-road travel, and boating, can degrade wetland habitats. Humans may disrupt the breeding activities of birds, causing nest failures or decreased production of young.

1) Consider potential disturbances to birds and habitat (and other wildlife) when planning or locating camping sites, picnic areas, and other sites of human activity within or near wetlands.

2) Locate new recreation sites outside of wetland areas whenever possible. If sites must be within wetland zones, concentrate them in one area, rather than spreading them throughout the wetland area, to limit negative impacts on breeding birds and habitat. Keep disturbance to soils and vegetation to less than 15% of the area within the developed site.

3) Keep pets under control in recreation areas. Free-roaming dogs and cats can be devastating to birds that nest on or just above the ground.

4) Promote "Tread Lightly" recreation ethics. Educate recreationists about problems humans can cause in wetland habitat and how they can avoid damaging these areas.

5) Reduce recreational disturbances, including bird watching, in wetland areas during the bird nesting season, especially where rare, sensitive, or endangered species nest.

6) Avoid using foggers for mosquito control in wetlands, especially during the nesting season, so a food source remains available for birds.

Mining and Oil/Gas Development

Mining activities often physically alter or destroy wetlands, and can create acid runoff that drastically alters water chemistry and devastates invertebrate communities. Reclamation of wetlands despoiled by mining activities, although often difficult and costly, is possible. When initiated concurrently with mining operations, reclamation can restore wetland habitat for birds.

1) Avoid placing mines, oil and gas drill sites, sand or gravel pits, geothermal sites, and roads in or next to wetlands.

2) Reduce the impact of construction and operations on raptor nest sites through buffers and timing restrictions. Contact state or federal wildlife agencies for local advice on appropriate buffers and timing.

3) Ensure that ponds containing mining wastes are netted to exclude birds and bats, and fenced off to exclude other wildlife that may be attracted to water. Flagging, reflectors, and strobes, are not effective because animals become habituated to these deterrents. It is necessary to employ a technique, such as complete covering with metal or polypropylene mesh or eliminating ponds, that will reduce or eliminate the possibility of wildlife entering disposal pits.

4) Reclaim areas as soon as possible after activities are completed. This reduces the amount of habitat converted at any one time and speeds up the recovery of the wetland.

Forestry

Timber harvesting, including firewood cutting, can negatively affect wetlands by removing nesting trees and foraging sites from the wetland zone. Standing dead and live trees also trap sediments and nutrients, moderate water temperatures, and provide large organic debris. These recommendations can help reduce the impacts of forestry practices on wetlands.

1) Reseed and stabilize the surrounding uplands where necessary to promote the timely regrowth of vegetation. In montane wetland areas, logging activities may cause disturbance, reduce the amount of available nesting cover surrounding wetlands, and cause erosion and sediment deposition.

2) Forest management should maintain a mosaic of young, mature, and old trees; this is better for birds and usually enhances other wetland attributes, such as erosion control.

3) To protect the wetland and provide habitat for birds that depend on mature trees, retain a buffer zone in timber harvest and firewood cutting areas where no cutting is

allowed. Other activities within these zones should be modified to protect natural resources. Biologists with the Wyoming Game and Fish Department, U.S. Forest Service, or Bureau of Land Management can give advice on the appropriate buffer width for the area.

4) Maintain snags (standing dead trees) and dead-topped trees along perimeters of wetlands. These provide nesting cavities for birds and enhance the number of insects available for food. Snags eventually topple and become organic debris, so retain an abundance of mature trees to replace them over time.

5) Avoid locating landings, log decks, or skid trails in or through wetlands.

6) Route helicopter flight paths away from wetlands and locate helicopter landing sites more than ¼ mile (0.4 km) from wetlands, especially from May through July. Helicopters and other loud noises interfere with songbird breeding activity, which relies on singing and being heard.

7) Avoid operating heavy equipment through, along, or across wetlands. If equipment operation is necessary, use tracked equipment rather than wheeled vehicles, and only during winter when the ground is frozen and less vulnerable to damage.

8) During fire activities, locate incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities outside of wetlands. Design fuel treatment and fire suppression strategies, practices, and actions to reduce disturbance of riparian vegetation. Keep chemical retardant, foam, or additives out of surface waters.

Wetland Restoration and Creation

The creation of wetlands in previously dry and/or nonvegetated areas or the restoration of wetlands are exciting possibilities for reversing the trend of decreasing wetland resources. In Wyoming, created and restored wetlands may have a greater positive effect on wetland losses than in most parts of the country simply because in an arid environment any water is valuable. Wetland creation and restoration can range from the relatively simple building of farmland freshwater marshes by plugging existing drainage systems to the construction of more extensive wetlands. Wetland restoration usually refers to the rehabilitation of wetlands that are degraded or hydrologically altered and often involves reestablishing the vegetation. Wetland creation refers to the construction of wetlands where they did not exist before and can involve much more engineering of hydrology and soils.

1) In constructing and reclaiming wetlands, managers must resist the temptation to over-engineer by attempting to channel natural energies that cannot be channeled and by introducing species that the design does not support. Design the system simply, for

minimum maintenance, and without reliance on complex technological approaches that invite failure. Simple systems tend to be self-regulating and self-maintaining.

2) Methods for wetland restoration and creation should emphasize creating or restoring natural wetland functions. Because the hydrology of most regions of the continent has been dramatically altered, restoration of functioning wetland ecosystems will usually not succeed under a passive, set-it-aside and leave-it-alone philosophy. Protection must be accompanied by the identification and manipulation of other factors in the environment that will make them into functioning ecosystems (e.g. hydrology). This may require the construction and installation of physical structures (e.g. levees, water control structures, water supply and discharge systems, pumping systems) that enable more exact control of water inflow, distribution, and discharge.

3) Always identify and address the causes of wetland degradation or loss before starting restoration.

4) Determine specific objectives for each wetland, and develop a monitoring program to track whether the objectives are being met. Monitoring programs of three to five years are generally sufficient.

5) Where possible, design a system that utilizes natural energies such as the potential energy of streams. Flooding rivers transport great quantities of water and nutrients in relatively short periods, subsidizing wetlands open to these flows.

6) Design the system with the hydrologic landscape and climate. Floods, droughts, and storms are to be expected, not feared.

7) Design the system to fulfill multiple goals, but identify at least one major objective and several secondary objectives.

8) Give the system time. Wetlands do not become functional overnight. Several years may pass before plant establishment, nutrient retention, and wildlife enhancement can become optimal. Strategies that try to short-circuit ecological succession or over-manage it are doomed to failure.

9) Design the system for function, not form. If initial plantings and animal introductions fail but the overall function of the wetland, based on the fulfillment of objectives, is being carried out, then the wetland has not failed.

10) Carefully consider wetland site selection. The optimum site for wetland restoration or creation will allow for the maximum probability that the objectives can be met, that construction can be completed at a reasonable cost, that the system will perform in a generally predictable way, and that the long-term maintenance costs of the system will

not be excessive. Mitsch and Gosselink (1993) developed the following guidelines for site selection.

- Find a site where wetlands previously existed or where nearby wetlands still exist. In an area such as this, the proper substrate may be present, seed sources may be on site or nearby, and the appropriate hydrologic conditions may exist. Historical meanders of streams that have been abandoned or channelized, gravel and placer mines on floodplains, and barren reservoir and lake margins make excellent potential sites for restoring wetlands.
- Undertake a detailed hydrologic study of the site, including a determination of the potential interaction of groundwater with the wetland. Hydrologic conditions are paramount. Without flooding or saturated soils for at least part of the growing season, a wetland is impossible to maintain. Areas with a water table within 4 inches (10 cm) of the soil surface make good potential sites for restoring wetlands.
- Find a site where natural inundation is frequent. Sites should be inspected during flood season and heavy rains, and the annual and extreme event flooding history of the site should be determined as closely as possible.
- Inspect and characterize the soils in some detail. Highly permeable soils are not likely to support a wetland unless water-inflow rates are excessive.
- Determine the quality of groundwater, surface flows, and flooding streams and rivers that may influence the site water quality. Chemicals in the water may be significant either to wetland productivity or to the bioaccumulation of toxic materials.
- Evaluate on-site and nearby seed banks to ascertain their viability and response to hydrologic conditions.
- Ascertain the availability of necessary fill material, seed and plant stocks, and access to infrastructure (e.g. roads and electricity). This is particularly important for the construction phase.
- Assess site access. Public access to the site may eventually need to be controlled so breeding birds are not disturbed. A remote site that offers possibilities of fewer disturbances, fewer mosquito complaints, lower property values, and less drastic kinds of social impact is often preferable to an urban one. Urban wetlands, on the other hand, offer intriguing possibilities for programs on wetland education for school groups and the public.
- Evaluate the position of the proposed wetland in the landscape. Landscapes have natural patterns that maximize the value and function of individual habitats. For example, an isolated wetland pothole functions in ways that are quite different from a wetland adjacent to a river. A forested wetland island created in an otherwise grassy or agricultural landscape will support far different species from those that inhabit a similar wetland created as part of a large forest tract.

11) Wetlands that have not been effectively drained and already reflood frequently should be targeted for restoration. Such basins are typically used for pasture or hayfields in which pressure for complete drainage is lower. Frequent reflooding of

these basins may allow a seed bank to persist and, thus, allow a quick vegetative response.

12) Tailor specific restoration efforts to each wetland. Physical factors such as hydrology, geology, climate, and elevation will influence the project's success.

13) New or restored wetlands can be used to mitigate adverse impacts of construction projects. Mitigation at or near the project site is preferred and should at least be within the same watershed. Replacement habitat should be of the same quality and equal or greater in acreage than that eliminated. Restoring previously degraded wetlands is usually more successful and less costly than trying to recreate what was lost.

14) To slow the flow of water off site, crush or remove drain tile and restore ditches and swales to original grade. If material is not accessible, block ditches at intermittent locations with fill or metal sheets, and provide small diversions to spread impounded water on the site.

15) Wetlands are generally fully restorable in form and function if the hydrological regime that created them in the first place is restored. In most instances, portions of the seed bank of native wetland plant species survive for many decades and germinate when conditions are again suitable. However, the longer the wetland has been dry, the less viable the seeds lying dormant in the soil prove to be. Vegetation can be reintroduced by natural mechanisms, such as transportation by wind or wildlife, although this can be a slow process, allowing erosion to occur in the meantime. Also, the manager has little control of species composition, and the site could become a monotypic stand (e.g. cattail). Even though it is more expensive and time consuming, it may be necessary to reintroduce vegetation by artificial mechanisms, such as reseeding, transplanting plants, or transporting soil from more complete seed banks.

16) Plant only native species to increase nesting cover and foraging opportunities for birds. Refer to the U.S. Fish and Wildlife Service's "National List of Plant Species that Occur in Wetlands" online at www.nwi.fws.gov/bha/ for a list of plants that are suitable for growth in wetlands.

17) Introduce plants to the wetland by transplanting roots, rhizomes, tubers, seedlings, or mature plants; by broadcasting seeds obtained commercially or from other sites; by importing substrate and its seed bank from nearby wetlands; or by relying completely on the seed bank of the original site. If planting stocks rather than site seed banks are used, choose plants from wild stock rather than nurseries because the former are generally better adapted to the environmental conditions that they will face in the constructed wetland. The plants should come from nearby, if possible, and should be planted within 36 hours of collection. If nursery plants are used, they should be from the same general climatic conditions and should be shipped by express service to

minimize losses. For emergent plants, use plants with at least 8 to 12 inches (20 to 30 cm) of stem; whole plants, rhizomes, or tubers rather than seeds have been most successful. Both fall and spring planting times are possible for certain species, but spring plantings are generally more successful; spring planting minimizes the destructive grazing of plants in the winter and avoids the uprooting of the new plants by ice. Transplanting plugs or cores [3 to 4 inches (8 to 10 cm) in diameter] from existing wetlands is another successful technique; it brings seeds, shoots, and roots of a variety of wetland plants to the newly constructed wetland. Seed banks from nearby sites can be used to develop wetland plants in a constructed wetland if the hydrologic conditions in the new wetland are similar, but they should be evaluated for seed viability and species present. Seed bank transplants can be successful for many different species, including sedges, arrowleaf, bulrushes, and cattails. The disruption of the wetland site where the seed bank is obtained must also be considered. When seeds are used directly to vegetate a wetland, they should be collected when they are ripe. If commercial stocks are used, the purity of the seedstock should be determined. The seeds can be added with commercial drills or by broadcasting from the ground, watercraft, or aircraft. Seed broadcasting is most effective when there is little to no standing water in the wetland.

18) Fertilizers are not necessary, as wetland plant species do not usually require high nutrient levels.

19) Remove livestock to allow vegetation to establish. Install fencing or provide other water sources to draw livestock away from the wetland.

20) Remove exotic plants, like Russian olive and purple loosestrife, that compete with native plant species and do not provide foraging or nesting opportunities for wildlife. Eliminate the invasion of nonnative plants during the rehabilitation period.

21) The most crucial aspect of restoration is getting the elevation of the land right, which, in turn, ensures proper hydrology. A matter of a few inches or centimeters in elevation can cause drastic differences in the wetland.

22) Provide beaches with gentle inclines.

23) Provide nesting islands. Properly located islands can be ideal nesting places for birds because predation is reduced, and reproductive success on islands can be several times higher than that in upland or shoreline nests.

24) Maintain or restore a buffer strip of native vegetation surrounding the wetland to provide food and critical nesting, escape, and winter cover for birds and other wildlife. Buffer strips also improve wetland water quality by trapping silt and contaminants before they reach the water's edge, prevent soil erosion, and increase the life expectancy

of the wetland by reducing sediment loading. Buffer strips should be 40 to 100 feet (12 to 30 m) wide, and consist of tall herbaceous cover or other dense native vegetation.

25) It may be beneficial to dredge silted-in wetlands to remove sediment, create areas of different water depths, increase water storage, and allow a diversity of plant and animal communities to develop. This practice is not recommended for healthy wetlands that are contributing to management objectives.

<u>Information and Education</u>

1) Establish public education goals and implement programs to inform users of public lands and owners of private lands of the value, sensitivity, and importance of wetlands to resident and Neotropical migratory birds and other species. This could range anywhere from interpretive signs on public lands, to distribution of Best Management Practices to landowners, to presentations at local grade schools, etc.

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