Blitzen Valley
Management Plan

Malheur National Wildlife Refuge,
Oregon

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U. S. Fish & Wildlife Service
BLITZEN VALLEY MANAGEMENT PLAN

Malheur National Wildlife Refuge
Princeton, Oregon

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The 64,000 acre Blitzen Valley unit of Malheur National Wildlife Refuge is not producing enough wildlife to meet the refuge's migratory bird objectives. The area suffers from four major problems (water management, carp, predators, vegetation management) which are limiting its potential as wildlife habitat. This document recommends progressive actions that can be taken to help correct problems and enhance wildlife production.

Water management is hindered by a deteriorated delivery system which currently allows only 40 percent of the potential wildlife habitat to be properly irrigated.

Carp, an exotic fish species, currently inhabit most wetlands associated with the Blitzen River. This fish is a great detriment to waterfowl and waterbirds as it competes aggressively for food resources and degrades aquatic habitat quality.

In the recent past predators have severely limited migratory bird production in the valley by taking nests and young. A predator control program, targeted at improving greater sandhill crane production is currently in effect. This program is covered by an Environmental Assessment released in 1989.

The vegetation management program is directed at uplands, meadows, marshes and riparian habitat types which will be managed to meet the varied needs of wildlife. Uplands should be managed to provide optimum nesting habitat for cover-dependent species. Marshes require management to provide nest cover as well as open-water feeding areas for waterfowl and marsh birds. About 40 percent of the meadows should be managed to provide quality nesting cover while the remaining 60 percent needs to be managed to provide choice feeding, breeding and brooding habitat. Management of riparian habitats demands that emphasis be placed on maintaining proper structure, size and density of woody vegetation as habitat for a great variety of songbirds and other wildlife.

This 5-year plan identifies needed repairs for the water management system, outlines a carp interdiction program and provides specific vegetation management prescriptions for each field in the valley. These proposals are based on the need to provide improved habitat conditions for key wildlife species.

Planned management actions will focus on the habitat needs of the sandhill crane, trumpeter swan, willow flycatcher, mallard, gadwall, cinnamon teal and redhead with the perception that "if the needs of these 7 species can be met, the needs of most other migratory birds and associated wildlife species will be served". Habitat needs of key species have been clearly defined and recorded in a Key Species Document. This manuscript provides information needed to develop "management rules of thumb", rules which dictate the specific actions that can be taken for habitat alterations. The intent of
these specific actions, called prescriptions in the plan, is to create optimum habitat conditions within fields. The prescriptions outline selective treatments to be applied to individual habitat types.

Implementation of this plan will result in significant improvement of wildlife habitats in the valley. High quality upland nesting cover will increase by an estimated 33 percent. Meadow habitats will receive approximately 22 to 44 percent more hay-only type treatments to furnish attractive wildlife feeding areas while protecting associated upland and riparian habitats. Rake-bunch-graze treatments will decrease by 12 to 19 percent. Management strategies for meadow habitat types will yield additional nesting cover within fields while providing an interspersion of hayed, grazed and burned areas. About 1 percent of the meadows will receive spring grazing to provide improved feeding opportunities for birds using adjacent ponds. Meadows and marsh habitats will be flooded earlier in the season and some fall flooding will be done to ensure adequate habitat is available for early-nesting species. The quantity of marsh habitats flooded all year will substantially increase, and more diverse treatment strategies will be applied to marshes to improve the interspersion ratio of open water to marsh vegetation. Desired woody riparian habitats will be excluded from treatments to allow for improvement of habitat quality. Fish management structures, coupled with water management strategies will be implemented to minimize carp problems in Blitzen Valley wetlands. Noxious weeds will be controlled where it is compatible with refuge objectives. Grain farming will receive more emphasis to produce enough grain for migrating cranes.

When the identified repairs to Blitzen Valley water management facilities and construction projects are completed, water management and habitat quality will be greatly enhanced.

Some significant changes will occur to the economic use programs as a result of the plan. Overall, animal-unit-months (AUMs) of grazing will decrease by nine percent, while tons of hay taken from the refuge will almost double. Total AUMs (grazing AUMs + hay converted to AUMs) will increase by five percent. The dominant season of use for cattle grazing will continue to be winter with a minimum spring grazing program.

The most costly items to implementing the plan will involve the replacement of water diversion dams, construction of new ponds, repair of water control facilities and fabrication of carp barriers. Some of these projects can be accomplished through normal budgeting, but additional funds will be needed to fully implement these changes. However, changes to the vegetation management program can be implemented with minimal additional funding since the most costly items include the construction, removal and realignment of fences.

In conclusion, the Blitzen Valley Management Plan is designed to benefit migratory birds and other wildlife. Implementation of this plan will improve habitat conditions and should permit the refuge to realize its wildlife production objectives in the Blitzen Valley.
CREDITS:

The Blitzen Valley Management Plan is a product of the efforts of both the professional refuge staff and the many public and private individuals who provided comments and advice during the public involvement process.

Refuge Manager George Constantino supervised the planning process and coordinated public involvement until he transferred to Alaska in May 1989. As acting refuge manager from May through October 1989, Assistant Refuge Manager Richard Voss directed the final fine-tuning of the plan. Forrest Cameron took over George's role in October 1989 and supervised the plan's completion. David Johnson, Assistant Refuge Manager, was the lead planner until he transferred to Finley Refuge in March 1990.

The body of the plan was written and edited by David Johnson and Mike Rule, refuge habitat management specialist, with Mike doing the final editing. The Key Species Appendix was written by wildlife biologists Gary Ivey and David Paulin, with Gary as the editor. The Habitat Guidelines Appendix was written by Gary Ivey, David Johnson, and David Paulin, with Gary as the editor. The Wildlife Inventory Plan was updated by Gary Ivey and David Paulin, with Gary as the editor. The Habitat Inventory and Monitoring Plan was designed and written by Mike Rule and David Johnson, with Mike as the final editor. The Biological Unit Action Plans were developed and written by Mike Rule and Dave Johnson with input from the refuge staff. Mike also developed and maintained data files in the Geographic Information System which were invaluable in the planning process. George Constantino and Richard Voss played key roles in reviewing and editing all sections of the plan.

Tony Faast of the Oregon Department of Fish and Wildlife and Susan Saul, Regional Outdoor Recreation Planner, deserve special recognition for their roles in assisting refuge staff in organizing and facilitating our public involvement workshops.
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I. Introduction
Blitzen Valley Management Plan
I. Introduction

The purpose of this Blitzen Valley Management Plan is to provide guidance to resolve resource problems that limit the achievement of wildlife objectives identified in the Malheur National Wildlife Refuge Master Plan (USFWS 1985). This will involve the development of site specific management strategies which are guided by themes emphasized in the Master Plan and current biological knowledge.

Scientific names of plants and animals referred to in this document are listed in Appendix I.

A. Area/Location

Malheur Refuge is located in Harney County in southeast Oregon (Figure 1). Burns, the nearest town, is located approximately 30 miles north of the refuge, and is served by a number of highways and the Union Pacific Railroad. Boise, Idaho, the nearest large city, is 200 miles east.

Malheur provides valuable breeding, resting and feeding areas for waterfowl and other waterbirds. This 185,000 acre refuge is located within the Harney Basin, 300 miles north of the Central Valley of California, a major wintering ground for ducks and geese. The basin provides a major and essential feeding and resting location for Pacific Flyway birds migrating between northern breeding grounds and their wintering grounds to the south.

This plan deals with the Blitzen Valley portion of Malheur Refuge, which encompasses about one-third of the refuge, and spans from Page Springs Dam on the south, to Sodhouse Lane on the north. Approximately 63,735 acres, are included in this 40-mile section of the valley. This area contains the greatest diversity of wildlife and vegetation on the refuge, and is the most intensely managed portion of the refuge.

B. Climate

Precipitation averages 9" annually. Summers are warm and dry, with temperatures rarely reaching 100 degrees. Freezing conditions generally prevail from late November to March. During this period, water areas are usually frozen. Snowfall averages 23" annually. Winds occur regularly, contributing to low humidity and a high surface evaporation rate.

C. Physical Description

The width of Blitzen River floodplain varies from several hundred feet to a mile. Much of the river was channelized during an earlier period of agricultural development by private interests. Many
marsh and upland areas were converted to meadows. Additional acres of wetlands were created in the valley by projects of the Civilian Conservation Corps Program during the 1930's and 40's. Irrigation of meadow and croplands is accomplished on refuge lands mainly during the spring runoff period. The flood irrigation system along the entire length of the Blitzen Valley gives it the greatest potential of any refuge area for improvement of migratory bird habitat.

D. Mission and Direction

The mission of the National Wildlife Refuge System is "to provide, preserve, restore and manage a national network of lands and waters sufficient in size, diversity and location to meet society's need for areas where the widest possible spectrum of benefits associated with wildlife and wildlands is enhanced and made available."

The mission for the Blitzen Valley portion of Malheur Refuge was clearly stated in 1935 by President Franklin Roosevelt. His executive order stated the 65,000 acre Blitzen Valley shall be managed "to serve as a refuge and breeding ground for migratory birds and other wildlife."


Section 1 of the Refuge Manual (USFWS 1982) lists the following goals for the National Wildlife Refuge System:

"1. To preserve, restore, and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered.

2. To perpetuate the migratory bird resource.

3. To preserve a natural diversity and abundance of fauna and flora on refuge lands."

Section 6 of the Refuge Manual (Habitat Management) outlines the policies and guidelines to be used in habitat management on refuges. The following is a summary of these policies and guidelines:

1. Whatever level of habitat management is required to meet objectives will be applied.

2. No habitat management activity should occur until management planning for that activity has been completed and approved.

3. Planning will consider the full range of alternatives available and the impacts each has on the wildlife and habitat resources of the refuge and surrounding ecosystem.
4. The attainment and maintenance of naturalness and natural diversity should be considered in all management activities. The least intensive management measures to obtain objectives should be used. If the objective cannot be met with more "natural" systems, managers must consider the use of more intensive management measures. To maintain maximum diversity and be responsible to the habitat needs of wildlife, managers must intervene with practices such as grazing, water management, prescribed burning, and selective cutting.

5. Habitat management planning must clearly document the need for those practices involving intensive management.

6. If practical and economically feasible, practices will be designed and implemented so that the appearance of naturalness is maintained.

7. Habitat management practices will, to the extent possible, contribute to the widest diversity of indigenous wildlife species and habitat types.

8. Economic uses of refuge resources that do not contribute to refuge objectives will not be considered as part of a habitat management program.

The Malheur National Wildlife Refuge Master Plan (USFWS 1985) outlined the long range management strategies that would be used in fulfilling refuge objectives. The Master Plan serves as the principal guide for developing detailed short-term refuge management and operational plans such as the Blitzen Valley Management Plan.

The Master Plan reviewed the environmental and historical setting of the refuge. It established legal mandates and policy direction. It inventoried and analyzed resource capabilities. It established objectives and studied and weighed alternative management themes and strategies. It also established priorities for migratory bird management on the refuge. Specific priorities and objectives for the Blitzen Valley portion of the refuge were defined by Ivey and Paullin (1985).

The preferred alternative of the Master Plan proposed a comprehensive management approach which states that "the use of livestock grazing, haying, prescribed burning and other necessary management tools will be made, as appropriate, to meet the needs of refuge habitats and animal population management programs. Habitat management will emphasize, where practical, the use of natural ecological processes such a drought-flood cycles, prescribed fire, and grazing rather than intensive management through manipulative practices such as storage reservoirs, irrigation wells, and pesticides. Refuges in general, and Malheur in particular should be the premiere showcases of
wildlife management and good land stewardship on public land."

E. Public Involvement

The following list summarizes the efforts taken to date to insure participation and review by citizens:

1. A three page letter containing a mission statement, problem statement and a request for peoples' concerns was mailed to over 450 citizens in February 1988. About 180 responses were received from organizations and individuals.

2. More than 30 individuals expressed a desire to work with the refuge staff to identify concerns, questions, problems and potential solutions that should be addressed in preparing the plan. This group became the Blitzen Valley Management Planning Committee and was organized on March 18, 1988 when a workshop was held at Malheur Field Station. This group worked for three days to develop an understanding of the problem, review facts, and identify possible solutions. A second workshop was held in June 1988, to allow people to observe habitat conditions during the critical wildlife production period.

The Committee has continued to be involved in planning to date.

3. Displays were developed and used to keep citizens informed at the Harney County Fair, John Scharff Waterfowl Festival, and the High Desert Conference in 1988. This traveling exhibit, which illustrated the key components of the plan, remained on display at Malheur Field Station during the summer of 1988.

4. Refuge personnel gave presentations to a variety of local private and civic organizations (e.g. Lions Club, Chamber of Commerce, The Wildlife Society, the Oregon Field Ornithologists, and Isaac Walton League).

5. A working draft was presented to the Blitzen Valley Management Planning Committee at a workshop in Bend, Oregon on February 10, 1989. The comments and concerns expressed by this group were reviewed and addressed in the final draft of the plan.

6. All refuge livestock grazing permittees were officially informed of the plan in May, 1989. Individual meetings were held with each permittee to give an overview of the objectives, changes, implications and strategies proposed in the plan. Comments were considered and appropriate changes made where primary refuge objectives were not compromised.

7. One hundred individuals and/or groups received the complete final draft of this plan, and 250 individuals or groups received
only the executive summary. The public comment period was originally set for February 15 to March 16, but was extended by request to April 16, 1990. Forty-three comment letters were received by the end of the comment period. These comments and the refuge response are provided in Appendix II.

See Appendix III for a comprehensive list of the groups and individuals involved in the development of this plan.
II. Identifying the Problem

Blitzen Valley Management Plan
II. Identifying the Problem

The Blitzen Valley is producing wildlife at far below objective levels identified in the Master Plan. Four major factors limiting wildlife production have been addressed in the Blitzen Valley Management Plan. In order of importance, they are:

A. Water

Water is key to meeting established migratory bird production goals. In order to meet wildlife production objectives for the Blitzen Valley, it is necessary to have at least three permanent ponds, 20 acres or larger per square mile of breeding habitat. Currently, there is only about one pond per 2 square miles of breeding habitat ranging in size from 1 to 300 acres.

The water system is 50 years old, badly deteriorated, and was severely damaged by the floods of 1982-85. The current condition of the Blitzen Valley water management system allows for only 40% of the wetlands to be properly irrigated for wildlife.

Additional ponds need to be constructed, the water management system must receive major repairs, and irrigation schedules must be changed if optimum water conditions are to be provided for wildlife.

B. Carp

The production of Blitzen Valley wetlands is reduced by carp. This introduced fish competes with native fish and birds for aquatic insects and vegetation. Its feeding activities destroy aquatic plant beds and increase water turbidity, which prevents light from reaching the plants and therefore inhibits plant growth.

A major carp interdiction and control program must be implemented if the Blitzen Valley wetlands are to be productive enough to meet wildlife objectives. Actions already taken include construction of fish barriers on major river diversions and periodic winter drawdown of key ponds to kill carp. Recently, there has been an attempt on a national basis to elevate the awareness of the carp problem to develop more support for research on control actions.

C. Vegetation

There are five basic vegetation types in the Blitzen Valley: upland, meadow, marsh, riparian, and cropland. Each habitat must be maintained within a specific range of conditions to be optimum for migratory birds. Uplands are important to nesting birds. Meadows and marshes are needed for feeding, pairing, nesting, and rearing young. Fragile riparian areas are important songbird habitat. Croplands are essential for fall maintenance of greater sandhill...
cranes and other migratory wildlife. Noxious weeds are a problem which affects management of all habitats in the Blitzen Valley.

1. Uplands

In 1972, probably less than 5% of the 8,100 acres of potentially good nesting upland areas in the Blitzen Valley were in good condition. In 1989, 30% are at their potential for providing nesting cover. While this is a significant improvement, cattle were still having a serious impact on upland nesting cover in some areas. The goal for the Blitzen Valley is to have 80% of these uplands at their potential.

2. Meadows

During the peak of cattle grazing in the early 1970's on Malheur Refuge, less than 10% of the 20,000 acres of meadow in the Blitzen Valley were in non-use to provide nesting cover. In recent years, the amount of idle meadow has increased to nearly 40% of the total, greatly improving the amount and quality of meadow nesting cover. Recognizing that treated (grazed, hayed, and burned) meadows provide habitat for wildlife pairing and feeding needs, it is important to achieve the necessary abundance, distribution, and interspersion of idle and treated meadows. Additional acres and improved distribution of idle meadow are still needed to achieve the desired conditions for wildlife.

3. Marsh

Of the 9,000 acres of marsh in the Blitzen Valley in 1989, only 20% were in the open, productive condition needed to raise waterfowl and waterbirds. These marshes were overgrown with closed stands of emergent vegetation. The timing, intensity, and frequency of past management strategies involving grazing, prescribed burning, and water management have not been successful in maintaining the dispersed open water areas needed by wildlife in these marshes.

4. Woody Riparian

Past grazing practices and eradication of willows and other woody riparian vegetation to create hay meadows has resulted in the loss and degradation of much of this habitat in the Blitzen Valley. In recent years, livestock grazing and other impacts to this habitat have been greatly reduced in many parts of the valley. The result has been an increase in both the quantity and quality of woody riparian zones on the refuge. In order to continue this upward trend, it will be necessary to protect these and additional areas from future impacts from livestock activity and other sources.

5. Croplands

Grain farming in the Blitzen Valley is essential to meeting refuge
objectives for fall maintenance of greater sandhill cranes. Analysis
has determined that 190 tons of grain are required to meet the refuge
objective of 225,000 crane use days. The average yield per acre in
the Blitzen Valley is 1 ton per acre. Currently, the refuge farming
program is operated under a cooperative agreement where the farmer
receives an 80 percent share of the crop and the remaining 20 percent
is left in the field for wildlife. In order to meet refuge objectives
under this program, approximately 950 acres of grain are needed.
There are approximately 1300 acres of potential farm fields in the
Blitzen Valley.

Over the past several years, the refuge farming program has seldom
produced the necessary grain crop needed for wildlife. There has
been a large discrepancy in potential farm acres versus actual acres
farmed and the potential refuge share versus the actual refuge share.
This recurring problem has been the result of both climatological and
management factors. Improvements to water delivery systems in each
farm field and better compliance to conditions of the cooperative
agreements by the refuge farmer are necessary to meet refuge
objectives for grain production. Another alternative may be for the
refuge to operate the farming program without a cooperator.

6. Noxious Weeds

There are nine species of plants found adjacent to or on the refuge
(Table 1) which are classified by the Oregon Department of
Agriculture as "B" designated noxious weeds. Under this rating
system, a "B" plant is identified as " a weed of economic importance
which is regionally abundant, but of limited distribution in other
counties." Recommended action under the 1989 Oregon Department of
Agriculture Noxious Weed Control Policy is "moderate to intensive
control at the state or county level".

<table>
<thead>
<tr>
<th>COMMON NAME</th>
<th>RELATIVE ABUNDANCE</th>
<th>THREAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bull Thistle</td>
<td>common, widespread</td>
<td>low</td>
</tr>
<tr>
<td>Canada Thistle</td>
<td>abundant, widespread</td>
<td>high</td>
</tr>
<tr>
<td>Italian Thistle</td>
<td>isolated patches</td>
<td>low</td>
</tr>
<tr>
<td>Perennial Pepperweed</td>
<td>common, widespread</td>
<td>high</td>
</tr>
<tr>
<td>Poison Hemlock</td>
<td>infrequent, widespread</td>
<td>moderate</td>
</tr>
<tr>
<td>Puncturevine</td>
<td>isolated Frenchglen</td>
<td>low</td>
</tr>
<tr>
<td>Scotch Thistle</td>
<td>infrequent, isolated patches</td>
<td>low</td>
</tr>
<tr>
<td>Western Horsetail</td>
<td>common, widespread</td>
<td>low</td>
</tr>
<tr>
<td>Whitetop</td>
<td>common, farm fields</td>
<td>high</td>
</tr>
</tbody>
</table>
D. Predation

Predators must be kept from destroying more than 60% of the waterfowl nests and 25% of the greater sandhill crane nests and young in the Blitzen Valley if production objectives are to be met. This issue is currently being addressed according to the preferred alternative identified in the 1989 Environmental Assessment Plan on Alternatives to Enhance the Production of Greater Sandhill Cranes on Malheur National Wildlife Refuge, and is not specifically addressed in this plan.
III. Resolving the Problem
Blitzen Valley Management Plan
III. Resolving the Problem

A. Resource Inventory and Biological Guidance

1. Key Species Management

Because wildlife's needs are so varied, (and often conflicting) and information is lacking on specific habitat needs for many species, it is not possible to provide optimum habitat conditions for all species at the same time and place. Therefore, an effort will be made to provide optimum habitat conditions for migratory birds in need of emphasis. This process is simplified by selecting 'key species' of wildlife for management emphasis based upon the concept that if high quality habitat is provided for these species, associated wildlife species will benefit as well.

Seven key species have been selected for the Blitzen Valley: the GREATER SANDHILL CRANE, TRUMPETER SWAN, WILLOW FLYCATCHER, REDHEAD, MALLARD, GADWALL, AND CINNAMON TEAL. These particular birds were chosen because they are high priority management species for the U.S. Fish and Wildlife Service, and their habitat needs represent the needs of broad guilds of closely associated species. For example, providing treated (hayed or grazed) meadow as feeding habitat for sandhill cranes will enhance habitat conditions for other meadow species such as common snipe, Wilson's phalaropes, and bobolinks. However, idle meadow maintained as nesting cover for cinnamon teal will also provide cover for other ground nesting species such as short-eared owls and western meadowlarks. Providing brood habitat for the gadwall will benefit other species which need late season brood water such as pied-billed and western grebes (Table 2).

Table 3 summarizes key wildlife species, their habitat needs, and the rationale for including them as key species in this plan.

Production objectives for key species were established in the Master Plan and have been divided for each biological unit in the Blitzen Valley (Table 4). Since the Master Plan was completed, the greater sandhill crane objective for the Blitzen Valley has been re-evaluated and reduced. The reduction reflects a more realistic number because of the low number of crane pairs in the area in recent years and the decades it takes to build up a crane population. Duck production objectives were divided among the major dabbling duck species nesting at Malheur, based on historical duck pair distribution in the Blitzen Valley.

A formal objective for willow flycatchers has not been established, because of lack of specific population data. Management guidelines call for increasing populations in eastern Oregon by at least 50%
<table>
<thead>
<tr>
<th>KEY SPECIES</th>
<th>MANAGEMENT NEEDS</th>
<th>EXAMPLES OF ASSOCIATED SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trumpeter Swan</td>
<td>Semipermanent marshes for nesting, with abundance of submergent vegetation for feeding.</td>
<td>Canada Goose, Ruddy Duck, American Bittern, White-faced Ibis.</td>
</tr>
<tr>
<td>Willow Flycatcher</td>
<td>High quality woody riparian habitats.</td>
<td>Great Horned and Long-eared Owls, Yellow Warbler, Eastern Kingbird.</td>
</tr>
<tr>
<td>Mallard</td>
<td>Dense residual upland vegetation for early spring nesting.</td>
<td>Short-eared Owl, Ring-necked Pheasant American Wigeon.</td>
</tr>
<tr>
<td>Cinnamon Teal</td>
<td>Residual meadow vegetation for nesting.</td>
<td>Northern Harrier, Northern Pintail, Northern Shoveler.</td>
</tr>
<tr>
<td>Gadwall</td>
<td>Late season marsh brood water.</td>
<td>Pied-billed and Western Grebes, Forster's and Black Terns, Ruddy Duck.</td>
</tr>
<tr>
<td>Redhead</td>
<td>High quality marshes with abundant submergent vegetation, late season marsh brood water.</td>
<td>Red-winged Blackbird American Coot, Black and Forster's Terns, Pied-billed, Eared, Western Grebes, and Virginia and Sora Rails.</td>
</tr>
</tbody>
</table>
Table 3. Key wildlife outputs/habitat requirements and rationale for inclusion in the habitat management planning process.

<table>
<thead>
<tr>
<th>Wildlife Output</th>
<th>Habitat Needs Primary</th>
<th>Secondary</th>
<th>Breeding Chronology</th>
<th>Rationale</th>
<th>Limiting Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandhill Crane</td>
<td>Marsh</td>
<td>Meadow</td>
<td>Very Early</td>
<td>High profile, declining population, good indicator of early habitat conditions.</td>
<td>Predation, late season brood water.</td>
</tr>
<tr>
<td>Trumpeter Swan</td>
<td>Marsh</td>
<td>Marsh</td>
<td>Mid</td>
<td>High profile, good indicator of quality and quantity of permanent ponds.</td>
<td>Carp, predation, late season brood water, winter mortality (limited food).</td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willow Flycatcher</td>
<td>Riparian</td>
<td>Riparian</td>
<td>Mid-late</td>
<td>Good indicator of quality and abundance of willow habitats.</td>
<td>Distribution, patch size, spacing, and age structure of willow communities.</td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Redhead Production</td>
<td>Marsh</td>
<td>Meadow</td>
<td>Late</td>
<td>Good indicator of high quality marshes and late season brood water.</td>
<td>Emergent encroachment, carp, late season brood water, predation.</td>
</tr>
<tr>
<td>Mallard Production</td>
<td>Upland</td>
<td>Marsh/Meadow</td>
<td>Early</td>
<td>Good indicator of early season habitat conditions, particularly residual cover in uplands.</td>
<td>Predation, residual nesting cover, carp.</td>
</tr>
<tr>
<td>Cinnamon Teal</td>
<td>Meadow</td>
<td>Upland</td>
<td>Mid</td>
<td>No. 1 nester on Malheur NWR, Good indicator of meadow habitats, particularly residual cover.</td>
<td>Predation, residual nesting cover, carp.</td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gadwall Production</td>
<td>Upland/Meadow</td>
<td></td>
<td>Late</td>
<td>Good indicator of late season habitat conditions, particularly late season brood water.</td>
<td>Predation, late season brood water.</td>
</tr>
</tbody>
</table>
Table 4. Production objectives for key species in the Blitzen Valley, Malheur National Wildlife Refuge.

<table>
<thead>
<tr>
<th>Bio Unit</th>
<th>Production Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sandhill Crane</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
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<tr>
<td>9</td>
<td>11</td>
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<td>10</td>
<td>5</td>
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<tr>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>Blitzen Valley Total</td>
<td>65²</td>
</tr>
</tbody>
</table>

¹There are no quantified objectives for Willow Flycatchers.
²This objective was changed from the Master Plan, based on current low crane population.

(Sharp 1987). An on-going study in the Blitzen Valley should provide better information on population numbers for use in the future; however, preliminary information suggests that a flourishing population of willow flycatchers currently exists and most available habitat on the refuge is occupied. Significant increases may only be achieved by either reinvigorating decadent willow stands or developing additional woody riparian habitat.

Appendix IV was compiled that includes an in-depth literature review, research findings, and personal observations and professional judgement of the refuge staff on the life histories, habitat needs, and factors limiting the attainment of refuge objectives for the seven key species. This document was developed to provide biological guidance for the development of management strategies.

2. Resource Inventory

"Actual" conditions are the result of the current management program, while "potential" conditions refer to the ability to provide conditions optimum for wildlife. "Actual" conditions were determined and "potential" conditions estimated for the Blitzen Valley by using the following five-step inventory process:
Step 1. **Assimilate Existing Information.**

The information gleaned as background material included: (1) the 1958-60 range vegetation and forage inventory by Rouse (1960); (2) the 1985 Master Plan; (3) historic vegetation monitoring photographs and data; and (4) historic annual water management plans.

Step 2. **Develop a Geographic Information System (GIS).**

A computerized mapping and analysis system was established using National Wetland Inventory (NWI) maps as base maps. Overlay themes were established for **habitat types** (upland, meadow, marsh, riparian and open water), **land ownership** (USFWS, BLM, Private, etc.), **management units** (fenced fields, firebreaks, etc.), **water delivery system** (canals, ponds, dikes, river, creeks, etc.), **greater sandhill crane territories** and **physical developments** (structures, wells, dams, roads, corrals, etc.).

Step 3. **Design a Vegetation Classification and Monitoring System**

In the refuge Habitat Inventory and Monitoring Plan (Appendix VI), a classification procedure based on expected wildlife benefits was developed to document how different management actions impact five basic habitat types in the Blitzen Valley (upland, meadow, marsh, riparian, open water). This has allowed evaluation of different management strategies to focus on vegetation and key species' needs. Field observations are made in spring (February through May) for the entire Blitzen Valley. Each acre is classified into one of several different categories based upon (1) vegetation type, (2) intensity of management applied during the past season, and (3) actual condition and potential of the site to provide key wildlife benefits. This information was computer-analyzed using a spreadsheet program and was then summarized into indices to establish current versus desired conditions and habitat trends.

Step 4. **Conduct Extensive Inventory of the Water Delivery System.**

Natural and man-made water courses were evaluated for their condition, value, and efficiency in providing water delivery for wildlife benefits. In addition, estimates were made to determine how much it would cost to bring each delivery system back into working order.

Step 5. **Establish Long-Term Monitoring System.**

Procedures were developed to obtain long-term trend information on uplands, meadows, marshes, riparian areas, pond vigor (submergent vegetation), carp populations, predator populations, key species populations and maintenance programs. More detail on actual monitoring methods is available in the refuge Habitat Inventory and Monitoring Plan and Wildlife Inventory Plan (Appendices VI and VII).
3. Management Guidelines

Vegetation Management Guidelines

Management guidelines were written for upland, meadow, marsh and riparian habitat types (Appendix V). This document includes an in-depth literature review, research findings, personal observation and professional judgement of the refuge staff on how different management strategies should be applied to provide optimum conditions for meeting key wildlife species' needs. The document provides a discussion of each habitat type, its values to wildlife, associated wildlife outputs, and the effects of different management strategies. In addition, strategies were developed to manage different vegetation types to provide the optimum conditions for wildlife. The following is a summary of the vegetation management guidelines.

Overall

- A diversity of vegetative conditions within a habitat type will provide greater diversity for wildlife benefits.

- A diversity of treatments within a field is more desirable than diversity between fields.

Uplands

- Uplands are most valuable when managed to provide nesting cover for ground nesting birds.

- The most important attribute of uplands for providing optimum nesting cover is the accumulation of grasses and forbs.

- Maintaining uplands in idle status improves nesting cover and increases bird nest densities.

- Long term (10 or more years) idle status in uplands can lead to decreased vigor, structure, and overall production of the grass/forb species and a corresponding decrease in dabbling duck nest densities.

- Periodic burning and grazing treatments will remove upland nesting cover in direct proportion to the intensity of the treatment. These treatments have short term, negative impacts on duck nest densities that are offset by longer term benefits to improved nesting cover and duck nest densities if the uplands
are put in idle status following the treatment.

Meadows

- Meadows provide habitat for the widest array of wildlife needs on the refuge.

- The primary importance of idle meadows is to provide nesting cover for ground nesting birds. The most important nesting species in idle meadows is the cinnamon teal, followed by the northern shoveler and the northern pintail. Secondary nesting species are numerous (e.g. mallard, gadwall, short-eared owl, ring-necked pheasant).

- A 60:40 mix of treated to untreated meadows will provide optimum conditions for the greatest diversity of key wildlife species.

- Treated meadows fulfill important requirements (feeding, pairing, resting) for birds in the fall and spring, when flooded. The dominant use of treated meadows is by feeding geese and cranes, followed by other waterfowl, marsh and water birds.

- Mowing, grazing, and burning decrease the attractiveness of meadows for nesting, particularly for early to mid-season nesting species such as mallard and cinnamon teal, in proportion to the intensity of the treatment.

- Early nesting species like mallards are more negatively impacted by treatment of meadows than late nesting species like gadwall.

- When properly irrigated, vegetation in treated meadows can provide ample nesting cover after the accumulation of one year's growth.

- Wet meadows are important brooding areas, particularly for sandhill cranes and mallards.

Marshes

- Emergent vegetation in marshes provides nesting cover for over-water nesters (e.g., sandhill crane, trumpeter swan, diving ducks) and escape cover for broods of numerous species, particularly late season nesters such as gadwall, redhead, and grebes.

- A 50:50 mix of emergent vegetation to open water provides optimum conditions for the greatest diversity of key wildlife species. Divergence from this ratio in either direction
decreases overall wildlife diversity and abundance. Treatments (mowing, grazing, burning, deep flooding, prescribed drought, plowing, herbicides, etc.) can generally reduce the density of emergent vegetation in direct relation to the intensity of the treatment.

Riparian

- The major objective regarding riparian habitat is to maintain a high level of wildlife diversity (native species) on the refuge, with emphasis on willow flycatchers (a sensitive species).
- Riparian zones are important to almost all wildlife species and are of primary importance to willow flycatchers.
- Healthy riparian zones provide good fish habitat and enhance fish populations.
- Willow flycatchers generally prefer untreated riparian areas.
- Livestock grazing should be excluded from refuge rivers and streams to promote riparian habitat improvement. A 400 foot ungrazed corridor for the Blitzen River and a 200 foot corridor for other streams will be the standard.
- Primary canals must be periodically cleaned to achieve important water delivery requirements for the entire Blitzen Valley.
- Haying tends to limit expansion of shrub-willow communities in meadows.
- Selective burning, grazing, haying, or mechanical disturbance may be used to re-invigorate decadent riparian stands.
Water Management Guidelines

The water management guidelines were written to provide direction on how water should be managed to provide optimum conditions for wildlife. Water is the most important manageable habitat variable at Malheur. The ability to produce quality brooding, nesting, pairing, and feeding habitat for wetland birds is directly associated with water management. Water is an important habitat component both directly, as a basic requirement and indirectly, because it so strongly affects vegetation growth, soil erosion, and serves as medium for life forms to survive. Therefore, water provides the central theme for habitat management and is a major factor in all aspects of management at the refuge. Most other refuge programs are planned and executed around the water management program.

Wildlife species at Malheur Refuge are dependent upon water to meet their basic needs as follows:

- Protection from ground dwelling predators, such as coyotes, is greatly enhanced when water is provided as a barrier during the nesting period. Species such as greater sandhill cranes, white-faced ibis, egrets, herons, and waterfowl need this barrier.

- Waterfowl broods depend on water for safe movement from nesting to brooding areas.

- Open water is essential for pairing habitat when birds first arrive in the spring.

- Brooding habitat requirements for some waterfowl and waterbirds include the quantity and quality of open water areas.

- Feeding opportunities are strongly associated with water since most species of wildlife feed on vegetation and invertebrates which are produced in the shallow, flooded marshes and meadows.

- Providing quality late season brood water is a critical factor in meeting wildlife production objectives.

The following is a summary of water management guidelines for optimum wildlife conditions:

Meadows

- During the irrigation period wet meadows should be sheet flooded (1 to 5 inches deep).

- To provide habitat for breeding sandhill cranes, Canada geese,
and early nesting mallards, at least 60% of the meadow habitat should be irrigated by March 15. All meadow habitat should be irrigated by late April. Fall irrigation of some meadow areas may be necessary to achieve this goal.

- Irrigation water should be maintained in meadows through early August for crane broods, except when drawdowns are necessary to repair facilities or accomplish other habitat management projects (e.g. mowing).

**Seasonal Marshes**

- Seasonal marshes should be irrigated simultaneously with meadows since the two are generally associated.
- Water should be maintained through August in these areas to provide habitat for the broods of late-nesting waterfowl and waterbirds.

**Semi-Permanent Marshes**

- These areas should be maintained all year except for periodic drawdowns to control carp, aerate bottom soils, control emergent vegetation, etc.
- Reflooding of drawn down marshes should be completed by early March to provide habitat for early nesting Canada geese and other waterfowl pairs.
- Water levels in managed ponds should be maintained at stable levels if possible through the waterfowl and waterbird nesting period, which is mid March through July.
- Semi-permanent marshes (ponds) should constitute at least 10 percent of each square mile of habitat in the Blitzen Valley for optimum waterfowl and waterbird brooding habitat.
- Brood ponds should contain excellent aquatic plant beds (greater than 50% canopy coverage of good food plants) and should be hemi-marsh condition (50/50 emergent to open water ratio).
- Carp populations need to be reduced or eliminated to prevent negative impacts to food resources.

4. Habitat Complex Rules of Thumb

If ideal management could be applied, it would be preferable to manage one habitat type without impacting adjacent types. That is, it would be desirable to apply grazing to a specific part of a meadow
without trampling the adjacent upland. However, this is not possible in most cases. The proximity and interspersion of habitat types complicates management, and often reduces or eliminates many options.

In the Blitzen Valley Management Plan a strategy has been developed for dealing with this problem by identifying common habitat associations, or "complexes", that have similar management goals and strategies. Each field in the Blitzen Valley is classified into one of the following five habitat complexes: (1) Upland/Riparian; (2) Meadow/Marsh; (3) Rangeland; (4) Brooding/Maintenance; (5) Management. The management strategies (rules of thumb), which are defined for each of these complexes provide guidance to develop prescriptions for each field. For example, fields which have significant areas of high potential uplands are managed to protect the uplands while providing treatment to the meadows. A similar management strategy is applied in fields which have significant areas of riparian habitat. Therefore, any fields which have significant areas of high potential uplands and/or riparian habitat are managed under the "rules of thumb" for the upland/riparian complex.

Table 5 is a matrix which provides comparison of each habitat management complex.
Table 5. Comparison between habitat complexes of the management strategies or “Rules of Thumb” for each of the four habitat types.

<table>
<thead>
<tr>
<th>HABITAT COMPLEX</th>
<th>UPLANDS/TERRAIN</th>
<th>HEADWATERS</th>
<th>RANGELAND</th>
<th>MOOING/Maintenance</th>
<th>MANAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>OVERALL DESCRIPTION OF COMPLEX</td>
<td>-Contains significant areas of high potential uplands and woody riparian habitat. -Management emphasizes maintaining these areas in optimum condition.</td>
<td>-High potential uplands and/or woody riparian areas are not a significant part of the composition. -Management will emphasize optimum meadow and/or marsh conditions.</td>
<td>-Composed primarily of low potential uplands. -Native uplands will be managed to emphasize &quot;WATER&quot; conditions. -Created weathgrass seedings will be managed to promote winter goose browse or return to native species.</td>
<td>-Contains ponds and/or farm fields -Management emphasizes on providing quality feeding areas for duck broods, cranes, and swans. -Ponds will be managed to produce optimum emergent vegetation. -Drawdowns will be done as needed. -Management will emphasize maintenance of open water.</td>
<td>-Restricted to small areas such as corrals, holding pens, stock yards, living quarters, etc. -all of which are needed/used to enhance proper management. -Impacts will be mitigated by restricting number and size of these areas. -These areas will be located (as much as possible) to minimize impacts to sensitive habitats.</td>
</tr>
<tr>
<td>MANAGEMENT STRATEGIES FOR UPLANDS</td>
<td>- Idle strategy will dominate. - Treatment frequency will be determined by monitoring of structure and vigor. - Prescribed burning will be the primary management tool used.</td>
<td>- High potential uplands will be excluded from grazing by fencing where possible. - Where fencing is not feasible, grazing impacts on uplands will be accepted</td>
<td>- Native uplands will be excluded to promote recovery of native species. - Some created weathgrass seedings will be managed for winter goose browse using fall/winter grazing. - A few areas will be seeded to big game winter browse.</td>
<td>- Primarily site tops, these areas will be excluded from grazing where feasible.</td>
<td></td>
</tr>
<tr>
<td>MANAGEMENT STRATEGIES FOR HEADWATERS</td>
<td>- Treatment of 40-60% of meadows using selective tools (hay only and spot burning) - A buffer of idle vegetation 10-20 yards will be maintained between uplands and meadows. - Periodic treatment of the buffer zone with hay only or prescribed burning.</td>
<td>- Frequent, high intensity treatment of wet meadows using grazing, moving, and burning will be prescribed. - Areas of sub-irrigated, &quot;dry&quot; meadows should be left intact but may be treated with rake/bunchgraze strategy.</td>
<td>- No significant acreage of marsh are found in fields of this complex.</td>
<td>- Spring grazing associated with shallow flooding, provides feeding/loafing areas for Canada geese, white-faced ibis, and molting ducks.</td>
<td></td>
</tr>
<tr>
<td>MANAGEMENT STRATEGIES FOR RANGELAND</td>
<td>- Chemical, mechanical, or fire used in conjunction with water management will be used to up rank emergents for semi-marsh. - Mowing along wet meadow and marsh ecotone will be promoted to improve pairing habitat.</td>
<td>- Semi-marsh will be provided by using grazing, moving, burning, hoing, and/or herbicides. - The ultimate goal is to provide long term &quot;Semi-marsh&quot; conditions. - Sandhill crane nest sites will be protected from impacts.</td>
<td>- No significant acreage of marsh are found in fields of this complex.</td>
<td>- Semi-marsh conditions through periodic drawdown, burning, deep browsing, and wetland management. -Carp control achieved thru winter drawdown and placement of carp barriers.</td>
<td></td>
</tr>
<tr>
<td>MANAGEMENT STRATEGIES FOR RIPARIAN</td>
<td>- Idle treatment strategy will dominate to prevent damage to community structure. - Investigate &amp; apply treatment strategies that will regenerate decadent willow stands.</td>
<td>- The low acreage of willow communities associated with the complex does not require special management consideration.</td>
<td>- Limited fencing may be required.</td>
<td>- No significant acreage of riparian habitat occurs in this complex.</td>
<td>- No significant acreage of riparian habitat occurs in this complex.</td>
</tr>
</tbody>
</table>
B. Management Actions

All the analyses, biological guidelines, and strategies described above were used to prepare a prescription or set of management actions to achieve habitat objectives in each field of the Blitzen Valley. The process began by reviewing the condition and history of each field to gain an understanding of what actions, if any, would be necessary to improve habitat conditions for key wildlife species. The resulting prescriptions are very specific concerning treatment strategies (i.e. seasonality, intensity, and frequency of each action), and what success would look like every step of the way. Prescriptions are made for a five-year period. Any period shorter than this is an inadequate amount of time to measure response. A period much longer than five years would prevent the refuge staff from making needed mid-course corrections.

The completed prescriptions are organized and incorporated into biological unit plans. There are six biological units delineated in the Blitzen Valley (Figure 2). Each of these units contains a diversity of habitat zones and is equivalent in management complexity to many refuges in the National Wildlife Refuge System.

It is at the biological unit level that water management schedules are defined, maintenance needs are prioritized, and overall changes to vegetation management programs are scheduled. This is done by summarizing the field prescriptions and working out schedules which will allow for implementation of all the prescriptions with minimum conflict among irrigation, maintenance, burning, haying and grazing schedules, etc.

A five-year action plan has been developed for each biological unit and is designed to provide a five-year schedule for implementation (Appendices VIII-XIII). This is when the balancing of fiscal constraints, required management actions, and timing of events becomes critical.

Each biological unit has one year when it is scheduled to be "emphasized" for maintenance, construction and physical upgrading. The composite of all these biological unit plans constitutes the management recommendations of the Blitzen Valley Management Plan.
Figure 2 Biological Unit Map

MALHEUR NATIONAL WILDLIFE REFUGE

- Biological Unit Boundary
1. Water and Carp Management

Refuge and regional office staff are in the process of realigning the current and future use of irrigation and storage water for wildlife habitat with federal and state water rights laws. Changes to water management strategies, repair of the existing water delivery system, and construction of brood ponds are designed to meet the desired conditions for early season wetland habitat and late season brooding habitat. Construction of carp barriers and use of winter drawdowns and rotenone to kill carp is necessary to improve the quality of late season brood habitat. These actions are summarized in Table 6. Implementation of these actions within a biological unit have been scheduled to provide better coordination of maintenance and construction projects (Table 6).

Table 6. Implementation schedule for construction and maintenance projects in the BLitzen Valley

<table>
<thead>
<tr>
<th>Biological Unit</th>
<th>Year of Major Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>89/90</td>
</tr>
<tr>
<td>7</td>
<td>90/91</td>
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<tr>
<td>8</td>
<td>91/92</td>
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<td>11</td>
<td>92/93</td>
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<td>10</td>
<td>93/94</td>
</tr>
<tr>
<td>9</td>
<td>94/95</td>
</tr>
</tbody>
</table>
Table 7. Proposed changes to water management strategies, and repair and improvement to water delivery systems of each biological unit in the Blitzen Valley, Malheur National Wildlife Refuge.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WATER MANAGEMENT STRATEGIC CHANGES</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>- Manage Scharff and John Ponds as late season brood water (through Sept 30).</td>
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<tr>
<td>- Use fall reflooding to improve early spring pairing habitat for waterfowl and other waterbirds and feeding habitat for cranes.</td>
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<tr>
<td>- Manage 200 acres of seasonal wetlands in Little Soapbrush and Unit 8 Duck Pond Fields as late season brood water.</td>
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<tr>
<td>- No change</td>
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<tr>
<td>- Few changes necessary to adjust for farming program in breeding/maintenance habitat complex.</td>
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<tr>
<td>- Maintain 200 acres of emergent marsh on the westside of unit in West South Meadow, Baker, and Peay fields flooded yearround if possible.</td>
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<tr>
<td>- Use fall reflooding to improve early spring pairing and feeding habitat.</td>
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<tr>
<td><strong>WATER MANAGEMENT SYSTEM REPAIRS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>- Canal cleaning and rehabilitation</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>- Spreaders &amp; pond dike repairs</td>
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<td></td>
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<tr>
<td>- Water control structure repair or replacement</td>
<td></td>
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<td></td>
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<tr>
<td>- One replacement and/or relocation</td>
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<tr>
<td>- Repair Sodhouse Dike.</td>
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<tr>
<td>- Replace and relocate Sodhouse Dam.</td>
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<tr>
<td>- Replace Sedan Dam.</td>
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<tr>
<td>- Bridge Blitzen River.</td>
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<tr>
<td>- Repair pond and spreader dike washouts.</td>
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<tr>
<td>- Replace water control structures.</td>
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<tr>
<td>- Repair 200 acre State Corral Pond and develop primary delivery ditch from RNA Vista Canal. Manage as late season brood water.</td>
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<tr>
<td>- No improvements planned.</td>
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<tr>
<td>- Clean and rehab all major canals and ditches.</td>
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<tr>
<td>- Repair S. Horse Pond dike and develop new pond inlet off Diamond Canal.</td>
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<tr>
<td>- Replace Lake Honda Pond dike.</td>
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<tr>
<td>- Replace Arks Farm Pond from Diamond Drain.</td>
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<tr>
<td>- Replace water control structures.</td>
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<tr>
<td>- Bridge Blitzen River channel.</td>
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<tr>
<td>- Repair dike separating Blitzen Pond and Boca Lake Outlet.</td>
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<tr>
<td>- Clean and rehab, approximately 3 miles of infill delivery ditches.</td>
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<tr>
<td>- Repair spreader and pond dike washouts.</td>
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<tr>
<td>- Replace deteriorated water control structures.</td>
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<tr>
<td><strong>WATER MANAGEMENT SYSTEM IMPROVEMENTS</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>- Pond construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Canal construction</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>- Change system design</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>- Construct six 20+ acre brood ponds and manage as late season brood water.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>- Construct 2, 3 acre dugouts in the northern end of Larson Field.</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>- Construct 2, 3 acre dugouts in the northern end of Larson Field.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- No improvements planned.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Construct 4 carp barriers on East Canal – Bridger Creek System.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Construct 4 carp barriers at Great Eagle Farm diversions and major river outlets.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Winter drawdown of entire system following completion of barriers to kill carp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CARP MANAGEMENT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Carp barriers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Drawdowns</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Pre-treatment</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>- Construct carp barriers at:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Raw Ditch (1)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>- Stubblefield Canal (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Sodhouse Dam (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Sodhouse Lane (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Drawdown Stubblefield system after completion of barriers.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Overturn 300 acre feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>- Winter drawdown of entire system to kill carp following placement of barriers.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Construct 4 carp barriers on East Canal – Bridger Creek System.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Winter drawdown of entire system following completion of barriers to kill carp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Maintain 200 acres of emergent marsh on the westside of unit in West South Meadow, Baker, and Peay fields flooded yearround if possible.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Winter drawdown of as much of system as possible after completion of barriers to kill carp.</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

26
2. Vegetation Management

a. High Potential Nesting Uplands

The 33% increase in the quantity of idle, high potential uplands (Table 8) will be the direct result of removal of grazing in fields of the upland/riparian complex to allow an accumulation of residual cover for early nesting species. Although 1,874 acres, or 20%, of the high potential uplands will continue to receive winter grazing, the intensity of grazing in these fields has been reduced to insure that less than 10% of the standing biomass is removed from the uplands. The result is minimal impact to upland nesting cover, while providing a diversity of treatments to meadow and marsh habitat.

b. Meadows

The major difference between 1989/90 and this plan involves the treatment of meadows. Hay-only treatments will be emphasized over rake-bunch grazing. During the five-year plan, there will be a 22-44% increase in the acreage of hayed meadows (depending on the year), while rake/bunch/graze meadow acreage will decrease by 12-19%. This is primarily the result of shifting treatment of meadows in upland/riparian fields to hay-only, non-use, or low intensity rake-bunch grazing programs to minimize livestock impacts to woody riparian zones and high potential nesting uplands.

There is a slight increase in the quantity of meadows receiving treatment by livestock in the spring and summer. In 1989, no spring or summer grazing occurred on the refuge. During the course of the plan, 134 acres, or less than 1%, of the meadows in the Blitzen Valley will be treated with spring/summer grazing to provide open, shallow, flooded meadows for feeding waterfowl and waterbirds during mid-summer.

c. Marsh

In 1990, 9,397 acres (91%) of the emergent marsh will be flooded between March 15 and August 1 if water is available. In 1989/90, 63% of these seasonally flooded marshes received winter grazing, the predominant marsh treatment during this period. There are two major changes associated with the Blitzen Valley Plan. The first change to occur is the substantial increase in the quantity of marsh that will be flooded all year. The second is the more diverse use of treatment strategies that provide long term openings in the dense, monotypic stands of emergent cover.
Table 8. Summary by acres of vegetation treatments for upland, meadow and riparian habitats for each year of the plan and 1990, a pre-plan year.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HIGH POTENTIAL UPLANDS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDLE</td>
<td>5,698</td>
<td>7,330</td>
<td>7,566</td>
<td>7,566</td>
<td>7,566</td>
<td>7,566</td>
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<tr>
<td>PRESCRIBED BURN</td>
<td>324</td>
<td>146</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>GRAZE ONLY (WINTER)</td>
<td>3,737</td>
<td>1,954</td>
<td>1,874</td>
<td>1,874</td>
<td>1,874</td>
<td>1,874</td>
</tr>
<tr>
<td><strong>TOTAL ACRES:</strong></td>
<td>9,759</td>
<td>9,440</td>
<td>9,440</td>
<td>9,440</td>
<td>9,440</td>
<td>9,440</td>
</tr>
<tr>
<td><strong>MEADOWS (FLOODED MARCH 15 THROUGH AUGUST 1)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>IDLE</td>
<td>7,217</td>
<td>7,867</td>
<td>9,204</td>
<td>8,364</td>
<td>8,027</td>
<td>8,204</td>
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<tr>
<td>PRESCRIBED BURN</td>
<td>1,152</td>
<td>1,275</td>
<td>48</td>
<td>340</td>
<td>670</td>
<td>491</td>
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<tr>
<td>MOWED</td>
<td>2,735</td>
<td>3,339</td>
<td>3,893</td>
<td>3,913</td>
<td>3,993</td>
<td>4,033</td>
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<tr>
<td>RAKE/BUNCH/GRAZE</td>
<td>7,524</td>
<td>6,061</td>
<td>6,197</td>
<td>6,430</td>
<td>6,446</td>
<td>6,587</td>
</tr>
<tr>
<td>GRAZE ONLY (WINTER)</td>
<td>1,561</td>
<td>1,454</td>
<td>834</td>
<td>806</td>
<td>906</td>
<td>690</td>
</tr>
<tr>
<td>GRAZE ONLY (SPRING/SUMMER)</td>
<td>0</td>
<td>134</td>
<td>134</td>
<td>134</td>
<td>134</td>
<td>134</td>
</tr>
<tr>
<td><strong>TOTAL ACRES:</strong></td>
<td>20,139</td>
<td>20,139</td>
<td>20,139</td>
<td>20,139</td>
<td>20,139</td>
<td>20,139</td>
</tr>
<tr>
<td><strong>WOODY RIPARIAN</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDLE</td>
<td>655</td>
<td>692</td>
<td>780</td>
<td>748</td>
<td>779</td>
<td>783</td>
</tr>
<tr>
<td>GRAZE ONLY (WINTER)</td>
<td>144</td>
<td>66</td>
<td>50</td>
<td>87</td>
<td>56</td>
<td>52</td>
</tr>
<tr>
<td>PRESCRIBED BURN</td>
<td>36</td>
<td>77</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(FALL/WINTER)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL ACRES:</strong></td>
<td>835</td>
<td>835</td>
<td>835</td>
<td>835</td>
<td>835</td>
<td>835</td>
</tr>
</tbody>
</table>
Table 8. Summary by acres of vegetation treatments for marsh habitats for each year of the Blitzen Valley Plan and 1990, a pre-plan year.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SEASONAL EMERGENT MARSH (FLOODED MAR. 15 THROUGH AUG. 1)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDLE</td>
<td>2,639</td>
<td>4,447</td>
<td>5,124</td>
<td>5,166</td>
<td>4,679</td>
<td>4,454</td>
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<tr>
<td>PRESCRIBED BURN (FALL/WINTER)</td>
<td>821</td>
<td>1,453</td>
<td>559</td>
<td>488</td>
<td>1,087</td>
<td>1,125</td>
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<tr>
<td>GRAZE ONLY (WINTER)</td>
<td>5,915</td>
<td>2,460</td>
<td>2,821</td>
<td>2,840</td>
<td>2,743</td>
<td>2,869</td>
</tr>
<tr>
<td>GRAZE ONLY (SPRING/SUMMER)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>RODEO (HERBICIDE)</td>
<td>22</td>
<td>45</td>
<td>5</td>
<td>15</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td><strong>TOTAL ACRES:</strong></td>
<td>9,397</td>
<td>8,405</td>
<td>8,509</td>
<td>8,509</td>
<td>8,509</td>
<td>8,347</td>
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<tr>
<td><strong>PERMANENT EMERGENT MARSH (FLOODED YEAR ROUND IF POSSIBLE)</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>IDLE</td>
<td>655</td>
<td>1,025</td>
<td>1,349</td>
<td>1,469</td>
<td>1,499</td>
<td>1,249</td>
</tr>
<tr>
<td>GRAZE ONLY (WINTER)</td>
<td>45</td>
<td>127</td>
<td>110</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>GRAZE ONLY (SPRING/SUMMER)</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>RODEO (HERBICIDE)</td>
<td>0</td>
<td>120</td>
<td>40</td>
<td>10</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td><strong>TOTAL ACRES:</strong></td>
<td>803</td>
<td>1,319</td>
<td>1,601</td>
<td>1,601</td>
<td>1,601</td>
<td>1,601</td>
</tr>
<tr>
<td><strong>MARBSES AFFECTED BY DRAWDOWN (LATE SUMMER/WINTER REFLOOD)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDLE</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PRESCRIBED BURN (LATE SUMMER/FALL)</td>
<td>0</td>
<td>231</td>
<td>115</td>
<td>115</td>
<td>115</td>
<td>115</td>
</tr>
<tr>
<td>MOWED</td>
<td>0</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>PLOWED</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL ACRES:</strong></td>
<td>0</td>
<td>257</td>
<td>135</td>
<td>135</td>
<td>135</td>
<td>135</td>
</tr>
<tr>
<td><strong>MARBSES AFFECTED BY PRESCRIBED DROUGHT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDLE</td>
<td>29</td>
<td>68</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PLOWED/FARMED</td>
<td>10</td>
<td>120</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>PRESCRIBED BURN (FALL/WINTER)</td>
<td>0</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>RODEO (HERBICIDE)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL ACRES:</strong></td>
<td>49</td>
<td>238</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td><strong>GRAND TOTAL ACRES:</strong></td>
<td>10,245</td>
<td>10,245</td>
<td>10,245</td>
<td>10,245</td>
<td>10,245</td>
<td>10,245</td>
</tr>
</tbody>
</table>
Treatments will include the use of winter flooding over intensively treated marsh (burned, mowed, or plowed) to promote rootstock mortality. Herbicides, prolonged drought, and spring/summer grazing will also be used to improve marsh interspersion.

d. Woody Riparian

In 1989/90, 17% of the woody riparian habitat received use by livestock. There will be a 64% reduction in grazing in this habitat type. The acreage that will continue to receive use by livestock is a relatively small component (less than 1%) of meadow/marsh complex fields where impacts would be accepted to achieve desired conditions of meadow and marsh habitats.

e. Noxious Weeds

Guidance and direction for control of noxious weeds is provided by a plan titled "Integrated Pest Management of Noxious Weeds at Malheur National Wildlife Refuge, Burns, Oregon". The preferred alternative in this plan and environmental assessment, stresses "ecologically sound land management practices based on long-term effectiveness, minimal ecological disturbance, and a minimum hazard to non-target organisms". Land management practices will utilize physical, cultural, and chemical control to manipulate the environment to the pest organism's disadvantage. The decision to control or not control will be based upon conflicts with refuge objectives and legal obligations.

Italian thistle, puncturevine, and Scotch thistle are currently restricted to small, isolated patches, and control will be directed at individual plants using manual removal or hand application of selective herbicides. However, perennial pepperweed, whitetop, and Canada thistle populations pose a more serious threat. Efforts must be more extensive and intensive if control is to be accomplished. Control strategies will include: water management (eg. deep flooding), reseeding, prescribed burning, mowing, improved farming practices, selective herbicide application, high intensity, short duration grazing by sheep, and biological control agents.

Bull thistle, poison hemlock and western horsetail are widely distributed, but do not normally dominate areas to pose a serious threat or problem. Control of these species is proposed only if a problem develops.

Coordination with the Harney County Weed Control Supervisor and the Harney County Extension Agent will continue. Adjustments
will be made as needed to insure that this program is used in a means that is consistent with refuge objectives.

f. Grain Farming

In order to meet the objective of 190 tons of grain for fall maintenance of greater sandhill cranes, approximately 1,300 acres are slated for grain farming in the Blitzen Valley (Table 9).

Table 9. Farm fields and tillable acres in the Blitzen Valley.

<table>
<thead>
<tr>
<th>Biological Unit</th>
<th>Field Name</th>
<th>Tillable Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>East River</td>
<td>72</td>
</tr>
<tr>
<td>9</td>
<td>Lava Beds</td>
<td>300</td>
</tr>
<tr>
<td>10</td>
<td>East Grain Camp</td>
<td>300</td>
</tr>
<tr>
<td>10</td>
<td>West Upper Grain Camp</td>
<td>70</td>
</tr>
<tr>
<td>10</td>
<td>South Krumbo #1</td>
<td>100</td>
</tr>
<tr>
<td>11</td>
<td>West Swamp #1</td>
<td>100</td>
</tr>
<tr>
<td>11</td>
<td>West Boca Lake</td>
<td>150</td>
</tr>
<tr>
<td>12</td>
<td>West Knox Pond</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td></td>
<td><strong>1,292</strong></td>
</tr>
</tbody>
</table>

The current program relies almost exclusively on a cooperative farming agreement. Under this agreement the cooperator receives 80% of the grain crop in exchange for use of refuge lands and water. The refuge's 20% is left standing in the field for wildlife. The cooperator assumes responsibility for soil preparation, weed control, in-field irrigation, and harvesting. The refuge is responsible for maintenance of the water delivery system and water delivery to the field during the irrigation season. Maintenance projects necessary to improve irrigation of farm fields are summarized in Table 9.

Approximately 70 acres of refuge land in the East River Field near refuge headquarters in Biological Unit 7 will be farmed using refuge personnel and equipment. This is an experimental program using winter wheat to determine the viability of this type of program as an alternative to the current cooperative farming program.

An alternative being explored is the possible use of sprinkler irrigation in the Lava Beds Field.
Table 10. Farm field maintenance projects.

<table>
<thead>
<tr>
<th>Biological Unit</th>
<th>Field Name</th>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Lava Beds</td>
<td>Ditch cleaning</td>
</tr>
<tr>
<td>10</td>
<td>East Grain Camp</td>
<td>Land leveling and ditching</td>
</tr>
<tr>
<td>10</td>
<td>West Upper Grain Camp</td>
<td>Ditch cleaning</td>
</tr>
<tr>
<td>10</td>
<td>South Krumbo #1</td>
<td>Ditch cleaning</td>
</tr>
<tr>
<td>11</td>
<td>West Swamp #1</td>
<td>Ditch cleaning</td>
</tr>
<tr>
<td>11</td>
<td>West Boca Lake</td>
<td>Ditch cleaning</td>
</tr>
<tr>
<td>12</td>
<td>West Knox Pond</td>
<td>Terracing and ditching</td>
</tr>
</tbody>
</table>

C. Predicted Results

The habitat conditions resulting from implementation of the Blitzen Valley management program were predicted by applying assumptions on the effectiveness of various vegetation treatments outlined in Appendix V. The relationship of the predicted outcomes to the desired range of conditions for high potential uplands, meadows, marsh interspersion, and the quantity of late season brood water is depicted in Figure 3. Although desired conditions have been established for the quantity of late season brood water and condition of woody riparian areas, no attempt has been made to quantify the predicted results of prescribed treatments for these types. When possible, a probability trend has been reported in the text.

1. Water and Carp Management

a. Quantity of Early Season Wetland Habitat

The desired range in the Blitzen Valley falls between 12,132 and 18,199 acres of meadow and marsh habitat flooded by March 15. In many years, this objective is difficult to reach due to the current deteriorated condition of the water management system, drought and the risk of damage to diversion dams during freezing periods in early spring. Damage occurs when the dams are frozen down and cannot be raised to accommodate high runoff. The use of fall flooding, prior to freeze up in fields where no conflict exists with other vegetation management strategies, should result in significant increases in the quantity of this habitat. In addition, renovation of the water management system will greatly improve the ability to flood areas quickly in the spring, when weather conditions allow. Implementation of the above strategies should result in flooded acreage within the desired range.
Figure 3. Relation of predicted outcomes to desired range of conditions for high potential uplands, meadows, marsh interspersion, and quality late-season brood habitat, resulting from implementation of the Blitzen Valley Management Plan.
b. Quantity of Late Season Brood Habitat

Changes to water management strategies in Biological Units 7, 8, and 12 involve the maintenance of wetland habitat by keeping it flooded all year. This strategy, coupled with repairs to existing ponds and the construction of 10 new ponds, will result in 2,882 acres of late season brood water by 1995. However, the desired quantity and density of brood ponds will not be met during the course of this plan. To meet the desired quantity of 4,060 acres of late season brood water, an additional 1,178 acres of late season brood water distributed at a density of 3 ponds of 20 acres or more per section of breeding habitat are needed. This would amount to about 55 additional brood ponds. These ponds could be developed by rehabilitation of existing ponds and sloughs and the construction of new impoundments.

c. Quality of Late Season Brood Habitat

Fish barriers to prevent carp from reinvading wetlands after prescribed drawdowns, and rotenone applications should significantly increase the quality and productivity of ponds.

2. Vegetation Management

a. High Potential Nesting Uplands

Exclusion of grazing in the majority of the high potential nesting uplands and removal of less than 10% of the biomass in the remainder of this habitat type should provide desired conditions by 1992.

b. Meadows

Overall, the desired ratio of 60% treated to 40% idle meadows will be met. Total acres of idle meadow will increase by 1,000 acres (14%). Increased acreage of idle meadow is the result of more selective treatment of meadows using hay-only and conversion of previously treated areas to non-use to minimize conflicts with water management. However, the amount of treated meadow will increase in biological units with a high proportion of meadow/marsh fields. The annual treatment of these meadow and marsh areas will provide open vigorous wetland habitat for feeding cranes, and pairing and feeding of waterfowl and other migratory birds.

c. Marsh

Vegetation treatments aimed at providing long term openings (greater than five years) will be implemented to bring the
marshes of the Blitzen Valley close to the desired interspersion of open water and emergent vegetation by 1994/95. This will include haying, grazing, and burning in association with herbicide application and changes in water management programs.

d. Woody Riparian

Currently, the condition of woody riparian habitat in the Blitzen Valley is at desired levels. The removal of grazing along riverbanks and large areas of infield willow stringers will insure that these areas are maintained in optimum condition for riparian dependent species. An overall increase in the amount and quality of willow riparian habitat is expected, especially in the south end of the Blitzen Valley.

e. Noxious Weeds

At the end of this 5 year planning period, Italian thistle, Scotch thistle, and puncture vine should be almost eliminated from the refuge. However, it would be overly optimistic to predict the same results for perennial pepperweed, Canada thistle, and whitetop. The use of water management, burning, mowing, rehabilitation of excavations, grazing by sheep, and/or biological control should provide increased control of these species along roadsides and dike tops, but progress beyond this should not be expected.

f. Grain Farming

The annual cooperative farming of 1,300 acres of refuge cropland under optimum growing conditions should result in approximately 260 tons of grain. Realizing that climatic conditions are extremely variable in this region, it is difficult to predict what the success of this program will be from year to year. However, planned improvements to water delivery systems and better communication between the refuge and the cooperative farmer should result in a substantial increase in the refuge share of grain. The continuation of this program hinges on a better return on the cooperative farmer's investment. If this is not realized in the near future, other alternatives will have to be explored and implemented.

D. Economic Impacts

Some will occur to the economic use programs as a result of the habitat management actions in this plan. Changes will occur in the type, amount, and the season of use permitted.

1. Changes in Type of Use

35
a. Minor or No Change

Seventy-six fields, or 33,121 acres (52%), in the Blitzen Valley will continue with the current program with only minor adjustments made.

b. Idle to Active Management

Fourteen fields (13%), which are currently idle, will be converted into active treatment strategies as follows:

- North Meadow Field (414.1 acres) will be converted from idle to a program alternating rake/bunch/graze and hay-only to increase in-field diversity of habitat conditions.
- Two fields (962 acres) in the Sodhouse Unit created by fence realignments will be converted from a predominately idle strategy to rake/bunch/graze (South and North Sodhouse Fields).
- Six fields (4,630 acres) will have hay-only treatments initiated (Skunk Farm, West Swamp #2, Big Deer Park, South Little Juniper, Big Dry, and West Wright).
- Two fields (400 acres) will be converted from idle to farm fields (Lava Beds and West Swamp #1).
- The Bailey Field (382 acres) will have a 200 acre enclosure constructed on the south end to allow a stacking and feeding operation to open marsh and reed canary grass areas.
- Both the North and South Knox #4 Fields (68 acres) will be converted to spring/summer grazing to create open feeding areas for wildlife.

c. Hay-Only to Other Use

- The Suicide Field (371 acres) will be converted to a rake/bunch/graze strategy after fences are constructed to protect uplands.
- The West Boca Lake Field (332 acres) will be converted to a farm field for crane maintenance.

d. Rake/Bunch/Graze to Other
Five fields (4,366 acres: Rockford Lane, Little Sagebrush, West Grain Camp, East Hamilton, and the western half of Baker Field) will be converted to long term idle to minimize water management conflicts.

Lower Krumbo #2 Field (101 acres) will be converted from rake/bunch/graze to graze-only (summer) to set back canary grass and provide summer brood areas.

The Center Sagebrush (2,718 acres) and North Meadow A (757 acres) Fields will have a reduction in the current rake/bunch/graze program to encourage recovery of uplands and riparian areas.

Four fields (5,199 acres: Northwest Big Sagebrush, House, East Upper Grain Camp, and eastern portion of Baker Field) will be converted from rake/bunch/graze to hay-only strategies to encourage recovery of uplands and riparian areas.

e. Graze-Only to Other

The northern third of the South Swamp Field (1,320 acres) and the South Krumbo #2 Field (178 acres) will be converted to a rake/bunch/graze strategy. The remainder of the South Swamp Field will be converted to idle to minimize conflicts with water management.

2. Changes in Amount of Use

Overall total AUMS including hay, grazing, rake/bunch/grazing will increase by 5% from 32,333 AUMS in 1989/90 to 34,060 AUMS in 1994/95 (Table 11). The types of AUMS will change as follows:

- **Graze-only (summer)** AUMS will increase from 0 in 1989/90 to 540 AUMS.
- **Graze-only (winter)** AUMS will decrease by 59% from 1,720 to 700 AUMS.
- **Rake/bunch/graze** AUMS will decrease to 8% from 25,325 to 23,275 AUMS.
- **Hay tons (stack & feed)** will increase by 30% from 540 tons to 700 tons. This change will increase grazing by 400 AUMS from 1350 to 1750 AUMS on selected fields in the Blitzen Valley.
- **Total hay tons** cut on the refuge will nearly double from 1,575 to 3,118 tons, an increase of 3857 AUMS.

3. Changes in Season of Use
Historically, the dominant season of use has been fall and winter. This season will continue to be the dominant use period on the refuge. However, a slight increase is planned for spring and summer grazing to set back problem areas of canary grass. Summer grazing will also be used in selected areas to provide summer green growth for brooding geese and other water birds.
Table 11. Summary of economic use program, by year for the Blitzen Valley Management Plan.

<table>
<thead>
<tr>
<th>TYPE OF USE:</th>
<th>89/90</th>
<th>90/91</th>
<th>91/92</th>
<th>92/93</th>
<th>93/94</th>
<th>94/95</th>
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</thead>
<tbody>
<tr>
<td>GRAZE-ONLY AUMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUMMER</td>
<td>0</td>
<td>540</td>
<td>540</td>
<td>540</td>
<td>540</td>
<td>540</td>
</tr>
<tr>
<td>WINTER</td>
<td>1,720</td>
<td>1,300</td>
<td>700</td>
<td>700</td>
<td>700</td>
<td>700</td>
</tr>
<tr>
<td>RAKE/BUNCH/GRAZE AUMS</td>
<td>25,325</td>
<td>21,825</td>
<td>21,625</td>
<td>22,375</td>
<td>22,625</td>
<td>23,275</td>
</tr>
<tr>
<td>STACK &amp; FEED HAY</td>
<td>1,350</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
<td>1,750</td>
<td>1,750</td>
</tr>
<tr>
<td>(HAY TONS/SAF)</td>
<td>(540)</td>
<td>(600)</td>
<td>(600)</td>
<td>(600)</td>
<td>(700)</td>
<td>(700)</td>
</tr>
</tbody>
</table>

SUBTOTAL AUMS OF GRAZING TO OCCUR ON THE REFUGE

| HAY TONS/OFF | 1,575 | 1,918 | 2,998 | 2,948 | 2,948 | 3,118 |

SUBTOTAL EQUIVALENT AUM VALUE

| 3,938 | 4,795 | 7,495 | 7,370 | 7,370 | 7,795 |

TOTAL EQUIVALENT AUMS PROVIDED BY THE REFUGE

| 32,333 | 29,960 | 31,860 | 32,485 | 32,985 | 34,060 |

1Hay cut and baled in one field, but stacked and fed off in another.
2Hay cut, baled and hauled off the refuge.
3Hay tons converted at a rate of 2.5 AUMS/ton to grazing AUMS equivalent.
4Grazing AUMS, plus AUMS value of hay hauled off refuge.
E. Cost of Implementation

A summary of the total cost to implement the recommended actions in each biological unit is given in Table 12. These expenditures are necessary to: (1) improve and rehabilitate the water management system; (2) implement a carp management program; (3) treat vegetation using fencing, prescribed burning, and chemical treatment; and (4) conduct the associated habitat and wildlife monitoring effort. Cost of construction items are for government contracted services.

**TABLE 12.** Cost analysis for water system rehabilitation, habitat treatments and wildlife & habitat monitoring for each biological unit and the Blitzen Valley as a whole.

<table>
<thead>
<tr>
<th>ITEMS</th>
<th>COST BY BIOLOGICAL UNITS (000)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>TOTAL BLITZEN VALLEY</th>
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<tbody>
<tr>
<td>CANAL REHABILITATION/CLEANING</td>
<td>204.0</td>
<td>40.0</td>
<td>160.0</td>
<td>70.0</td>
<td>287.0</td>
<td>165.0</td>
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<tr>
<td>POND CONSTRUCTION/REPAIR</td>
<td>350.0</td>
<td>35.0</td>
<td>120.0</td>
<td>40.0</td>
<td>230.0</td>
<td>340.0</td>
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<td>DAM REPLACEMENT</td>
<td>400.0</td>
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<td>0.0</td>
<td>20.0</td>
<td>0.0</td>
<td>40.0</td>
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<tr>
<td>STRUCTURES</td>
<td>45.0</td>
<td>13.0</td>
<td>20.0</td>
<td>20.0</td>
<td>68.0</td>
<td>90.0</td>
</tr>
<tr>
<td>CARP BARRIERS</td>
<td>35.0</td>
<td>0.0</td>
<td>20.0</td>
<td>25.0</td>
<td>25.0</td>
<td>25.0</td>
</tr>
<tr>
<td>FENCING (BUILD AND REMOVE)</td>
<td>10.2</td>
<td>11.2</td>
<td>6.0</td>
<td>2.9</td>
<td>5.0</td>
<td>14.6</td>
</tr>
<tr>
<td>CHEMICAL TREATMENTS (CARP AND EMERGENT CONTROL)</td>
<td>7.2</td>
<td>4.2</td>
<td>6.0</td>
<td>2.4</td>
<td>4.1</td>
<td>15.6</td>
</tr>
<tr>
<td>PRESCRIBED BURNING</td>
<td>1.3</td>
<td>2.8</td>
<td>2.6</td>
<td>1.0</td>
<td>3.4</td>
<td>5.9</td>
</tr>
<tr>
<td>WILDLIFE MONITORING</td>
<td>8.0</td>
<td>7.2</td>
<td>9.0</td>
<td>4.0</td>
<td>7.2</td>
<td>25.5</td>
</tr>
<tr>
<td>HABITAT MONITORING</td>
<td>8.0</td>
<td>8.0</td>
<td>6.0</td>
<td>4.0</td>
<td>3.2</td>
<td>12.0</td>
</tr>
<tr>
<td>TOTAL:</td>
<td>1068.7</td>
<td>141.4</td>
<td>349.6</td>
<td>189.3</td>
<td>632.9</td>
<td>733.6</td>
</tr>
</tbody>
</table>
IV. Follow-Up
Blitzen Valley Management Plan
IV. Follow Up

A. Monitoring

1. Habitat

The success of the prescribed management actions in meeting habitat objectives outlined in the Blitzen Valley Management Plan has been predicted based on certain assumptions regarding the effectiveness of various vegetation management tools. The validity of these assumptions will be evaluated by annual monitoring of the actual condition of high potential nesting uplands, meadows, emergent marshes, woody riparian habitat, and early and late season aquatic habitat under the various prescribed treatments. The monitoring procedures to be used are outlined in the refuge Habitat Inventory and Monitoring Plan.

2. Wildlife

The performance of the Blitzen Valley Management Plan will be evaluated in terms of responses of key wildlife species through data collected as directed by the refuge Wildlife Inventory Plan. This plan prescribes procedures for monitoring production of sandhill cranes, trumpeter swans, Canada geese, and ducks by census of pairs, nests and broods. For the most part, procedures of the Inventory Plan have remained unchanged since they were standardized for Malheur in 1968. Census techniques for adequately monitoring willow flycatchers have yet to be developed.

B. Course Correction

A commitment will be made to maintain as much stability as possible in the vegetation management program for the five year period covered by this plan. Noxious weed control, farming, and prescribed burning programs will be adjusted on an annual basis to reflect fiscal constraints, cooperator performance, climatic fluctuations, and policy changes.

Refuge grazing and haying permits will be issued to livestock operators on an annual basis with a commitment to maintain as stable program as possible for the first five years of the program. This is the minimum time needed to comprehensively evaluate the proposed level of livestock grazing as a vegetation management strategy. Forage allocations have been established at a conservative level to compensate for normal fluctuations in weather. This allocation is based on the assumption that in a wet year some forage will be left unharvested, but in a dry year the permittee can harvest the authorized number of AUMs without negative impacts to refuge objectives.
Efforts to enhance the water management system will be adjusted during this five year period to reflect changes in water rights, funding, maintenance priorities, and other management constraints.

Carp interdiction and predator management programs will be evaluated on an annual basis to identify problems. Adjustments will be dictated by program effectiveness, funding, water conditions, wildlife response, and policy changes.

The annual habitat monitoring program is designed to identify short term problems. If a problem arises during the five year period that interferes with refuge objectives, then solutions will be implemented on a case by case basis. However, at the end of the five year period an overall evaluation will be done to determine successes and shortcomings. Longer term changes will be proposed at that time.
V. Conclusion
Blitzen Valley Management Plan
V. Conclusion

In conclusion, the Blitzen Valley Management Plan is designed to benefit migratory birds using the area. When the plan is implemented, the refuge should be capable of achieving its wildlife objectives, resulting in great benefits to the public.
VI. Appendices
Blitzen Valley Management Plan
Appendix I. List of common and scientific names used in the Blitzen Valley Management Plan.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birds:</strong></td>
<td></td>
</tr>
<tr>
<td>Eared grebe</td>
<td>Podiceps nigricollis</td>
</tr>
<tr>
<td>Pied-billed grebe</td>
<td>Podilymbus podiceps</td>
</tr>
<tr>
<td>Western grebe</td>
<td>Aechmophorus occidentalis</td>
</tr>
<tr>
<td>American bittern</td>
<td>Botaurus lentiginosus</td>
</tr>
<tr>
<td>White-faced ibis</td>
<td>Plegadis chichi</td>
</tr>
<tr>
<td>Trumpeter swan</td>
<td>Cygnus buccinator</td>
</tr>
<tr>
<td>Canada goose</td>
<td>Branta canadensis</td>
</tr>
<tr>
<td>American wigeon</td>
<td>Anas americana</td>
</tr>
<tr>
<td>Cinnamon teal</td>
<td>Anas cyanoptera</td>
</tr>
<tr>
<td>Gadwall</td>
<td>Anas strepera</td>
</tr>
<tr>
<td>Mallard</td>
<td>Anas platyrhynchos</td>
</tr>
<tr>
<td>Northern pintail</td>
<td>Anas acuta</td>
</tr>
<tr>
<td>Northern shoveler</td>
<td>Anas clypeata</td>
</tr>
<tr>
<td>Redhead</td>
<td>Aythya americana</td>
</tr>
<tr>
<td>Ruddy duck</td>
<td>Oxyura jamaicensis</td>
</tr>
<tr>
<td>Northern harrier</td>
<td>Circus cyaneus</td>
</tr>
<tr>
<td>Ring-necked pheasant</td>
<td>Phasianus colchicus</td>
</tr>
<tr>
<td>American coot</td>
<td>Grus canadensis tabida</td>
</tr>
<tr>
<td>Greater sandhill crane</td>
<td>Numenius americanus</td>
</tr>
<tr>
<td>Long-billed curlew</td>
<td>Gallinago gallinago</td>
</tr>
<tr>
<td>Common snipe</td>
<td>Phalaropus tricolor</td>
</tr>
<tr>
<td>Wilson's phalarope</td>
<td>Bubo virginianus</td>
</tr>
<tr>
<td>Great horned owl</td>
<td>Asio otus</td>
</tr>
<tr>
<td>Long-eared owl</td>
<td>Tyrannus tyrannus</td>
</tr>
<tr>
<td>Eastern kingbird</td>
<td>Empidonax traillii</td>
</tr>
<tr>
<td>Willow flycatcher</td>
<td>Corvus corax</td>
</tr>
<tr>
<td>Common raven</td>
<td>Dendroica petechia</td>
</tr>
<tr>
<td>Yellow warbler</td>
<td>Agelaius phoeniceus</td>
</tr>
<tr>
<td>Red-winged blackbird</td>
<td>Dolichonyx oryzivorus</td>
</tr>
<tr>
<td>Bobolink</td>
<td></td>
</tr>
</tbody>
</table>

| **Mammals:**         |                          |
| Coyote               | Canis latrans            |
| Raccoon              | Procyon lotor             |
| Muskrat              | Ondatra zibethica         |
| Beaver               | Castor canadensis        |
| Mule deer            | Odocoileus hemionus      |

| **Fish:**            |                          |
| Red-banded trout     | Salmo sp.                |
| Carp                 | Cyprinus carpio          |
Appendix I. continued

Plants:

- Hardstem bulrush: Scirpus acuta
- Cattail: Typha spp.
- Burreed: Sparganium eurycarpum
- Bull Thistle: Cirsium vulgare
- Canada Thistle: Cirsium arvense
- Italian Thistle: Carduus pynocephalus
- Per. Pepperweed: Lepidium latifolium
- Poison Hemlock: Conium maculatum
- Puncturevine: Tribulus terrestris
- Scotch Thistle: Onopordum acanthum
- Western Horsetail: Equisetum arvense
- Whitetop: Cardaria spp.
Appendix II. Comments on draft plan and responses.

The following is a compilation of comments received on the Blitzen Valley Management Plan during the 60 day public comment period. Comments are summarized under major headings including: Plan content, key species, water management, vegetation management (general), livestock grazing, haying, prescribed burning, grain farming, noxious weeds, predator control, habitat monitoring, and fisheries management. Since some comments were shared by more than one individual or group, a list of commentors is provided for each comment. A reply by the refuge is provided for each comment that opposes or questions some aspect of the plan.

Plan Content

1. Good outline of a proposed action program, but need appendices to make complete comments on the plan.

Commentors: Ray Erickson

Reply: Unfortunately, the appendices were not updated at the time the draft was released for review. The appendices are nearing completion and will be available November 1.

2. Good plan. Would like to see inclusion of historic site preservation in the plan.

Commentors: William Cramer

Reply: The Blitzen Valley Management Plan is primarily a habitat management plan and does not specifically address historic site preservation. This facet of refuge management is dealt with in the Master Plan. Site specific plans are being developed by the refuge outdoor recreation planner and archaeologist.

3. Flexibility and the ability to change should be part of the plan. Must recognize the past in terms of water availability.

Respondents: Russ Pengelly
David Marshall
National Wildlife Refuge Association, Charles Hughett

Reply: Although the proposed actions in the plan are specific in the timing and level of treatment, they are not so rigid that changes cannot be made if necessary. The monitoring system that has been established will identify any short term problems that may arise, and adjustments will be made to assure that habitat objectives are not compromised.
4. Would like to assure access for tribal members to areas of "Wada Brush". Wishes to be advised of any Indian burials found during the construction of ponds or other activities.

Respondent: Kenton Dick, Burns Paiute Reservation

Reply: Wada harvest areas have not as yet been established. According to the agreement now being developed, the Burns Paiute Tribe will be notified of burials found during any refuge activities.

5. Needs to be assurance that the ranching aspects of refuge management do not compromise wildlife production goals.

Commentors: Ronald Schlorff, California Department of Fish and Game

Reply: The only planned use of grazing and haying on the refuge is to achieve stated wildlife habitat objectives. The use of these management tools will be strictly controlled and closely monitored to assure that they are used in a manner consistent with established objectives.

6. Agriculture and other economic uses should be used only when they have a positive influence on the refuge.

Commentors: Russ Pengelly
National Wildlife Federation
Oregon Waterfowl and Wetlands Association

Reply: During the planning process, the past use of grazing and haying on the refuge was scrutinized and the positive and negative aspects of these tools were identified. Habitat management guidelines were then developed that identified the effectiveness of each management tool in achieving desired habitat conditions for wildlife under a variety of conditions. The resulting management prescriptions contain the necessary controls to minimize the negative impacts of the various management tools while maximizing the benefits.

7. Would like to see priority listing of critical and non-critical elements of the plan for implementation in regard to dollars available for the Blitzen Valley Management Plan.

Commentors: Ranchers for Conservation

Reply: All the proposed actions in the plan are based on a thorough analysis of habitat problems in the Blitzen Valley and what is
required to solve them. The wildlife objectives in the valley will not be met unless all elements of the plan are implemented. Several elements of the plan can be completed with normal operational dollars and will be implemented on schedule. Those plan elements that exceed normal funding levels will require special funding or appropriations to meet the planned schedule of implementation. These special funds are usually earmarked for a specific purpose regardless of our refuge priorities, so a priority listing would likely be of little value. These special funding arrangements may include a challenge grant to be matched with funds from various conservation organizations, redistribution of funds within the region or special allocation of funds from Congress. A challenge grant has already been approved to do work in the Blitzen Valley with Oregon Trout. If funding needs are not met, the time schedule for implementation will probably not be met. This does not mean the plan is a failure. The time schedule will have to be expanded and new sources of funding explored.

8. Reestablishment of water management system, predator control and carp control along with a well planned noxious weed program, and continuance of cattle grazing on the refuge will result in an abundance of wildlife on the refuge.

Commentors: Darrel Otley  
Ranchers for Conservation  
Buck Taylor

Reply: We couldn't agree more. All these elements are included in the plan, and are necessary to meeting stated wildlife habitat objectives.

9. Why isn't more historic background information concerning economic outputs provided in the plan?

Commentors: Ranchers for Conservation

Reply: A thorough analysis of historical factors has already been accomplished and was used in both the development of the problem statements and proposed actions in the plan. Refuge biologists, Gary Ivey and Dave Paullin, completed an extensive analysis of factors affecting the achievement of migratory bird objectives at Malheur in 1985. This report is available at refuge headquarters for review and it is cited in the plan.

To specifically address the lack of information on historical economic outputs, whether or not the refuge is producing more or less economic outputs is not a basis for making decisions concerning wildlife habitat. It is the relationship of these outputs to wildlife that is important. Attempting to draw a correlation between one particular output such as grazing AUMs and
some quantity of wildlife produced ignores the bigger picture. Several factors have influenced historical wildlife outputs at Malheur. The four key problems contributing to declining wildlife numbers at Malheur have been identified. Ignoring even one of these factors will result in fewer wildlife outputs than the Blitzen Valley is capable of producing.

10. Important to recognize that past management practices involving reduction in grazing, poor water management, lack of maintenance on water delivery system and discontinuance of predator control has resulted in continued declines in bird and wildlife numbers. Returning to past management practices under John Scharff will result in increased birds and wildlife.

Commentors: Ranchers for Conservation
Hank Vogler IV
Buck Taylor

Reply: Past problems with water management and predator control have been recognized in the plan and actions have been proposed to correct them. However, returning to the high levels of grazing that occurred on the refuge in the past will not benefit wildlife. The controlled and well planned use of grazing and haying called for in the plan will provide the diversity and interspersion of habitat conditions required to meet the needs of a vast array of wildlife using Malheur throughout the year.

11. Except for the section on vegetation management, the rest of the plan was well written and acceptable.

Commentors: William Pearcy

Reply: Because there is so much difference of opinion on which tool should be used to treat vegetation or even if vegetation should be manipulated at all on refuges, the assumptions used to develop vegetation management prescriptions are frequently questioned. Given the state of knowledge regarding the habitat needs of the key species selected for management and the ability of various treatment tools to create the necessary habitat conditions, the assumptions made regarding habitat management necessarily incorporate a considerable amount of professional judgment. Although the draft plan may inadequately justify these assumptions, the information upon which they were based is available in appendices that are now attached to this plan. These appendices were, unfortunately, not available for review at the same time as the draft plan. It is important to remember that as these management guidelines are applied they will be closely monitored to test whether the assumptions upon which they were based are valid.
12. Implement water management, control carp and predators. Then evaluate response of wildlife before you implement any further reduction or change in livestock use on the refuge.

Commentors: Dale White, County Court, Harney County, Mr. and Mrs. Buck Taylor

Reply: The recent grazing program in the Blitzen Valley has caused damage to upland and riparian habitat as well as interfered with the management of critical late season brooding habitat in some areas. Documented harmful economic uses cannot be allowed to continue. Ignoring these problems will result in less than optimum conditions for wildlife. Implementation of the actions to solve these problems is relatively inexpensive and can be done with very little economic impact to the present refuge permittees.

13. Constant turnover of refuge managers and other personnel interferes with the implementation of consistent management practices.

Commentors: Harney County Cattlewomen Ranchers for Conservation

Reply: Interference will only occur when a properly documented and biologically justified course of action does not exist. The refuge's Master Plan and the proposed plan and attached appendices give consistent biological and habitat management direction. If the proposed actions result in the desired habitat conditions and increasing wildlife numbers then these management tools will continue to be used. During the development of this plan, key staff have changed, but few changes have been made to the proposed actions and no changes in wildlife objectives have occurred.
Water Management

14. Strongly support proposed actions to repair and improve the water delivery system and construct ponds for late season brood water.

Commentors: Oregon Waterfowl and Wetlands Association
National Wildlife Federation
Larry Hammond
William Pearcy
Arnold Kruse, Northern Prairie Waterfowl Research Center
David B. Marshall

15. Use the expertise of local ranchers/permittee to learn how existing system works and how it can be improved.

Commentors: Harney County Stockgrowers Association
Ranchers for Conservation
Dwight Hammond
Darrel Otley
Martin Vavra, Oregon State University, Squaw Butte Station
Harney Cattlewomen

Reply: The plan in no way prevents those individuals involved with operating and maintaining the water management system from working with permittees to learn and improve irrigation of refuge fields. In fact, each substation manager has and continues to work with many permittees to refine their knowledge of the water management system. However, because refuge objectives and priorities for water management differ significantly in many cases from the irrigation practices employed on private hay meadows and may change during the course of the year, refuge personnel will continue to be the only individuals authorized to manipulate water control structures.

16. Lack of delegated manpower and supervision is the reason for the current deteriorated condition of the water delivery system.

Commentors: Darrel Otley
Ranchers for Conservation
Mr. and Mrs. Buck Taylor

Reply: Lack of staffing and the commitment of resources to other priorities (local, regional, and national) contributed to the deteriorated condition of the water delivery system. But major flooding in the 1980's, seriously impacted this already deteriorated system.
17. Necessary to determine the quantity of water needed to meet objectives for aquatic habitat and how much is available. If deficit explore other water sources ie ground water.

Commentors: Dave Paullin, U.S. Fish and Wildlife Service

Reply: Although this would be valuable knowledge to have, it is not essential information for completion of the ponds proposed for completion during the course of the plan. Some ponds in excess of water availability would provide for greater flexibility in management of ponds for increased productivity. Currently the decision to drawdown a pond during the summer to promote improved aquatic vegetation growth the following year, results in a significant loss of late season wetland habitat. Information on water availability should be gathered before the 55 ponds required to meet the remaining deficit of brood habitat in the valley are completed. Should there be a significant deficit of water, alternatives to be considered might include reevaluation of the brood water objectives or development of other water sources (eg. ground water). This would prevent construction of impoundments in excess of those needed for management flexibility.

18. Include in the plan all necessary brood pond development to meet objectives for late season brood water.

Commentors: Arnold Krause, Northern Prairie Waterfowl Research Center
Larry Hammond

Reply: The reason all of the ponds required to meet late season brood water objectives are not included in the plan is based on a reasonable expectation of completion in a five year period. The 55 additional ponds needed will require considerable engineering expertise and expense. It is important to note that the justification for the additional ponds is reported in the plan and will form the basis for future project planning.

19. The plan has not considered the past in terms of water availability. Need to take advantage of drought years to dry out certain ponds, marshes, and meadows for nutrient recycling and carp control. This should be practiced in normal years also.

Commentors: Dave Marshall

Reply: Because ponded habitat is such a premium in the Blitzen Valley, it is often difficult to justify drying up a unit until forced to by extremely poor conditions. Rehabilitation and enlargement of
existing ponds and construction of additional ponds will provide the necessary flexibility to use prescribed drought on a more regular basis without adversely impacted wildlife associated with this habitat.

20. Planned construction of additional brood ponds is a continuation of historical carp and stagnation problems. It is also in violation of the refuge Master Plan and state water rights.

Commentors: Ranchers for Conservation
Harney County Stockgrowers Association
Dwight Hammond, Hammond Ranches, INC.
Hank Vogler IV

Reply: Properly designed and managed ponds will not increase the carp problem. Placement of fish screens and enough ponds to allow periodic drawdowns will result in much lower carp impacts and improved conditions due to soil aeration which releases plant nutrients.

The land and water management theme established for the Blitzen Valley in the Master Plan is developmental. No prohibitions were made against new construction as long as it focuses on optimizing outputs associated with the habitat, wildlife, and public use themes stated in the Master Plan. The proposed new ponds will optimize the following wildlife and habitat themes: trumpeter swan and diving and dabbling duck production by management of ponds for breeding pair habitat and late season brood water, fall maintenance of waterfowl and greater sandhill cranes, and colonial marsh bird maintenance.

Currently, staff in the regional office and at the refuge are working to assure consistency between state water rights and refuge management of water. Primarily, this will involve improvement of water management system to insure proper application of water.

21. Cost of implementation and planned year of construction is out of sync with budgeting process. Given the three year budget cycle of the Fish and Wildlife Service this plan will already be two years behind when implementation is authorized in 1990.

Commentors: Ranchers for Conservation

Reply: The Service's budget cycle is two years in length. Proposals for increased construction, maintenance, and challenge grant funds have been made annually for the last two years that would aid in plan implementation. Length of the budget cycle will not be the cause for delays in funding authorization.
Water system rehabilitation by unit is continuing as scheduled on a priority basis. Major diversion dams and new pond construction will be completed as funds are made available. See reply to Comment #7.

22. Discrepancy between the upland conditions reported in problem statement and that reported in Figure 3.

Commentors: Amy Schoener

Reply: The value illustrated in Figure 3 represents the percentage of nesting uplands found to be at their potential for producing cover during the most recent habitat condition survey, while the value reported in the problem statement represents a qualitative determination of nesting cover made earlier in the planning process. The problem statement was changed to be consistent with the more accurate value reported in Figure 3.

23. Manage to provide natural habitats for native wild animals.


Reply: The Blitzen Valley has since the turn of the century been an intensively managed floodplain. After purchase of these lands as a refuge, modifications and additions were made to the existing irrigation system to provide for wetland conditions favoring migratory birds rather than forage production on hay meadows as originally intended. It is the belief of many involved with the refuge that migratory bird populations are much higher than occurred in this portion of the refuge prior to settlement. Because of losses of habitat that have occurred across the country due to agricultural and urban development, the enhanced production achieved on areas such as the Blitzen Valley are critical to maintaining the diversity and abundance of wetland-associated wildlife in this country.
Key Species

24. Rough production objectives for willow flycatchers can be calculated based on field work done by NERC staff.

Respondent: Jim Sedgwick, National Ecology Research Center

Reply: We will not establish objectives for willow flycatchers, until we develop adequate monitoring strategies to measure the population's status. An objective won't mean much without a way of measuring where we are.

25. Add to limiting factors for willow flycatchers; distribution, patch size, spacing, and age structure of willow communities.

Commentors: Jim Sedgwick, National Ecology Research Center

Reply: These factors were added to Table 5.
26. Pleased with plan to manage for a diversity of vegetation conditions to create a balance between nesting cover, duck pairing, feeding, and resting areas. However, did not see evidence in the plan to tell me what that balance really is.

Commentors: Dave Marshall

Reply: Objective levels were established for the various habitat outputs (nesting cover, pairing, feeding, and resting areas, and brood habitat) required to meet the needs of the key species. The justification for these values can be found in the attached Key Species and Habitat Management Guidelines appendices.

27. Necessary to change marsh management strategies. Present use of dormant season grazing is not opening up wetlands.

Commentors: National Wildlife Federation
Oregon Waterfowl and Wetland Association

Reply: Although dormant season grazing will continue to be used on approximately 3,000 acres of marsh to provide open, early spring pairing and feeding habitat, several marsh management strategies are planned that will provide for longer term openings in dense, monotypic stands of emergent vegetation. These additional marsh management strategies include mechanical manipulation of marshes to increase water depth and remove emergent cover, prescribed burning followed by deep flooding, herbicides, and construction of impoundments to allow for greater depth and duration of flooding.

28. Neither cattle or herbicides should be used again. What about mowing, labor-intensive pulling, burning, reflooding, transplanting, and replanting?

Commentors: Peter Jensen

Reply: Both cattle and herbicides are a cost effective tool for the manipulation of vegetation. With regards to cattle grazing see the reply to Comment #37. The planned use of herbicides on the refuge is only for those areas where other alternatives have been explored and failed to meet set objectives. Herbicide use is strictly limited and will occur annually on less than 100 acres of wetlands in the valley. Labor-intensive pulling may be effective in control of isolated patches of noxious weeds, but is extremely ineffective on the large extensive areas that require manipulation to meet proposed habitat objectives. Use of the other methods mentioned are proposed in the plan. When biological control is available it will be used instead of a chemical treatment. The
refuge is using two insects, the stem mining weevil (Ceutorhynchus litura) and Canada thistle gall flies (Cardus cardui), to control Canada thistle.

29. What scientific data exist to support increases in the amount of idle habitat? Past increases in idle habitat did not result in increased bird and wildlife numbers.

Commentors: Ranchers for Conservation

Reply: Because the problems with water management, carp, and predation were not adequately addressed, past increases in idle habitat did not result in increased numbers of migratory birds. However, increases in idle habitat were necessary for several reasons. Most importantly increases in idle habitat improved habitat diversity on the refuge. With 128,000 AUMs of grazing on the refuge virtually every acre in the Blitzen Valley was grazed. The result was a monotypic structure within all the basic habitat types ie every meadow was grazed to a 4 inch stubble height, marshes were trampled or mowed, willows were considerably less abundant and structurally less diverse and uplands were far below their potential for providing residual nesting cover. The AUM reductions of the 1970's has resulted in increased wildlife diversity. With regards to migratory waterfowl, two very important habitat components that were in short supply on this refuge have improved. One of these components is residual nesting cover. The second is early and late season water. Reduction in grazing has improved cover conditions 100 fold and has provided the opportunity to flood areas earlier and keep them flooded later due to fewer conflicts with economic use programs in many fields on the refuge.

This plan will result in additional idle habitat. These idle areas will result from the protection of key nesting uplands and willow riparian areas and areas associated with management of late season brood water.

30. What is the basis for desired ratio of 60% treated versus 40% idle meadows? Plan does a poor job of justifying the treatment of meadows.

Commentors: William Pearcy
Amy Schoener

Reply: Based on the professional judgement of refuge biologists, we consider a 60:40 mix of treated to idle meadow to be optimum for the greatest diversity of key wildlife. Treated meadow vegetation (mowed, grazed, burned) provides early season feeding habitat for a wide variety of birds, while idle meadow vegetation can support high densities of nesting birds. Of the 20,139 acres of meadow in the Blitzen Valley, the untreated 40 percent (8,055 acres), in
combination with upland and marsh nesting habitats, should provide ample habitat to support the densities of nests required to meet refuge waterfowl objectives. Meadows which support both good nesting cover and feeding sites will support higher densities of breeding waterfowl and marsh birds.

31. Hopefully planned treatment of meadows will focus on the lower portions to create open, feather edges for loafing and feeding waterfowl pairs. Treatment of marshes should also focus on the edge to create a moat to protect overwater nesters and to provide open feeding and loafing sites for broods and pairs.

Commentors: Arnold Krause, Northern Prairie Waterfowl Research Center

Reply: The habitat management guidelines for both meadow and marsh habitat stress that treatment should occur at the edge to open these areas for waterfowl pairs and broods. These guidelines were followed in the development of all management prescriptions.

32. When undertaking dredging of the Blitzen River particularly in biological unit 11, every effort should be made to maintain the integrity of willows along the river bank. Very high densities of willow flycatchers found here.

Commentors: Jim Sedgewick, National Ecological Research Center

Reply: When dredging of the river takes place, these areas will be protected as well as possible. Often what will happen in such an operation is the dredge spoils will be placed on one side of the watercourse only, thereby leaving the opposite side unaltered.
Livestock Grazing

33. If you compare idle and grazed areas, there are more wildlife on grazed areas. Birds and cattle are compatible, as has been proven on private ground in Harney County.

Commentors: Tyler Brothers
Hank Vogler IV
Ranchers for conservation
Darrel Otley
Harney County Stockgrowers Association

Reply: In certain situations this appears to be true, however, if one looks at the entire production period and the types of use occurring on the various treatment types the comparison is invalid. Recent studies on the refuge show that early in the spring there is higher use by waterfowl pairs on treated areas than idle habitat. Burned areas were found to have the highest use. However, as the season progresses this distinction is less apparent. A description of this study is provided in the Habitat Management Guidelines appendix. With regards to nesting, almost every study that has compared dabbling duck nest densities and nesting success by land use treatments has found that idle habitat receives much higher use than treated habitat. The objective then is to provide treated areas for pairing and feeding habitat interspersed with and adjacent to idle areas for nesting cover. Proposed actions in the plan are directed at achieving this balance of habitat conditions.

34. The decline of willows in the Deer Park field is due to removal of cattle.

Commentors: Dwight Hammond, Hammond Ranches, Inc.

Reply: The decline of willows in this portion of the refuge is due to changes in water management more than land use. Removal of cattle grazing has resulted in both increases in acres of willow riparian habitat and improved structure and diversity of these important plant communities.

35. Comparison of bird numbers and AUM's since the 1970's show same correlation. Recognize other factors contribute to declining trend of birds. But this correlation should at least show you that just cutting AUM's is not going to increase birds.

Commentors: Marc Doverspike, Harney County Stockgrowers Association
Reply: Yes, other factors such as impacts of carp and predation have contributed to the declining trend of birds. The proposed plan directs actions at correcting all the problems. Grazing and haying will continue to be used on the refuge and in fact will change very little from the 5 year period prior to implementation of the plan. Grazing will be used in a more controlled and focused manner that will provide optimum conditions for wildlife.

36. Range and meadow management for AUM's is compatible with wildlife habitat and can increase bird numbers.

Commentors: Marc Doverspike, Harney County Stockgrowers Association

Reply: Range and meadow management strictly for production of forage will not increase bird numbers. There are some fundamental differences between this type of management and management strictly for wildlife. The refuge is to be managed strictly for wildlife for people to enjoy. Range and meadow management for wildlife requires that areas of non-use be provided for nesting habitat, that water be available as early as February 15 for early arriving waterfowl and cranes and be provided for broods as late as October. Bulrush and cattail are considered a deterrent to hay meadow management but are essential for management of habitat for waterfowl and other waterbirds. Construction of ponds "destroys" hay meadows, but is absolutely necessary for production of trumpeter swans and diving and dabbling ducks. This is not to say that treatment of meadows and rangelands by grazing and haying cannot provide important wildlife habitat. Grazing and haying properly applied for wildlife can meet certain important habitat needs of wildlife. See comments 29, 30, 33, and 35.

37. Remove all privately owned livestock from refuge.

Commentors: Water A. Kuciej
Nadine Hamby
Christian Melgard
Marilou K. Laws
Len Gardner
Sylvia K. Steen
Tom E. Clark
Brian Taylor

Reply: Cattle grazing can be used as a very positive tool to achieve habitat conditions required by several wildlife species. However, livestock grazing must be carefully controlled and applied in such a manner that adverse impacts do not occur to wildlife or their habitats. The proposed plan contains the necessary controls to achieve wildlife habitat objectives using this tool.
38. Object to annual grazing permits lack of stability to permittee.

Commentors: Ranchers for Conservation

Reply: Guidance provided in the refuge manual specifically advocates the use of annual permits. Annual permits allow for greater flexibility in the use of cattle grazing and haying. The renewal clause in the refuge manual gives first priority to the existing permittee. As long as the conditions of the special use permit are met and the field is going to be treated, using haying or grazing, the permit will be renewed.

39. Reduction of cattle manure on refuge may result in significant loss of invertebrate food source.

Commentors: Marty Vavra, Director, Squaw Butte Experiment Station

Reply: Although manure is a valuable source of invertebrates, the 8 - 15% decrease in grazing AUMs in the Blitzen Valley will not significantly impact this resource. Increased idle habitat and the corresponding accumulation of detritus, an important invertebrate substrate, should offset any losses due to reduced quantities of manure.

40. Public image of cattle as a management tool has been ignored. Need to develop education of this to public.

Commentors: Ranchers for Conservation

Reply: During the current public involvement process, the benefits to wildlife habitat provided by using a variety of vegetation management tools including haying and grazing were presented to a wide array of groups and individuals. Many of these groups entered this process with very negative feelings toward the use of grazing as a habitat management tool. The success of this involvement process is proven by the consent from the majority of the participants for the proposed actions in this plan that utilize both haying and grazing to achieve desired habitat conditions.

The refuge is also in the process of developing several information kiosks at key locations on the refuge. These kiosks will contain interpretive panels that will discuss all the management tools used on the refuge.

41. Stacking and feeding hay will essentially convert some fields into a
feedlot. Is this the function of a National Wildlife Refuge?

Commentors: William Pearcy

Reply: This strategy will be used on a very limited basis. The areas where it will be used are near large expanses of idle nesting cover or contain dense monotypic stands of emergent marsh vegetation. This intensive treatment will and has provided open, productive feeding and pairing habitat for migratory birds. Stacking and feeding hay in selected sites for this specific purpose can fit well with the function of a National Wildlife Refuge.

42. Would like to know the number of cattle per acre on grazed fields.

Commentors: William Pearcy

Reply: Grazing intensity information is tracked during the annual monitoring program and is reported in the annual narrative. Grazing intensity is reported as animal unit months (AUMs) per acre. It is easily derived from information provided in the individual field prescriptions. These field prescriptions will be part of the biological unit plans, unattached appendices to the plan.

43. More consideration should be given to a pasture rotation system and use of temporary fencing instead of elimination of livestock use.

Commentors: Dale White, County Court, Harney County

Reply: Elimination of livestock grazing is not proposed in the plan. Temporary fencing is being used and some rotational use is planned. Currently, rotational use involves alternating use of various tools between pastures to provide a diversity of vegetation conditions within a field. Use of any of the traditional rotational schemes with the current pasture boundaries would result in considerably reduced livestock grazing and permittees to accommodate the necessary rest pastures. Fencing will be minimized where possible on the refuge. See comment 44.

44. All internal fencing used for livestock management must be removed.

Reply: Fencing is required to achieve control of livestock grazing. Realignment of fences and removal is planned in the Blitzen Valley. The result is a net loss of 17 miles of fence resulting in substantial areas of the refuge without any internal fencing. Where cattle use can be managed with temporary fencing this alternative will be pursued.

45. Request that refuge refrain from significant amounts of additional fencing.

Commentors: National Wildlife Federation
Oregon Waterfowl and Wetlands Association

Reply: See comment 44
46. Hay removal from the refuge may result in nutrient loss and lower plant production. Nitrogen may have to be added to system. Cattle grazing returns nitrogen through urine and feces.

Commentors: Marty Vavra, Director, Squaw Butte Experiment Station
Charles Hughett, National Wildlife Refuge Association

Reply: This potential problem has been recognized and monitoring will track meadow production and condition. Should a problem arise, several alternatives are available including rest followed by burning, fertilization, and rotational use of livestock grazing. The frequency of these alternative treatments will be determined after evaluation of the monitoring data.

47. Conversion to hay only will not help increase bird populations anymore than rake-bunch grazing.

Respondent: Mr. and Mrs. Buck Taylor

Reply: Based on past research at Malheur, when a field is hayed there are areas left uncut that provide residual cover for nesting. These areas had significantly higher densities of nest than areas that were intensively grazed. Haying is a very selective tool that allows treatment of meadow and marshes to create open pairing habitat while protecting areas of nesting cover within the field. It is the professional judgment of the refuge staff that this interspersion of pairing and nesting habitat will provide the necessary conditions to increase the production of dabbling ducks at Malheur.
Prescribed Burning

48. Prescribed burning should be only done on a controlled experimental basis. Comparison should be between burning and moderate use of cattle as a vegetation management tool.

Commentors: Ranchers for Conservation

Reply: Prescribed burning has been performed for years at Malheur on an experimental basis. Rick Young completed a doctoral dissertation on burning at Malheur in 1985. This very involved research effort and years of data and experience at Malheur and other areas, provides the necessary guidance to continue with its safe use. There is as large a body of literature available concerning the use of fire to manage wetland habitat as there is for livestock grazing. Prescribed burning is a proven management tool and will continue to be used at Malheur.

49. Prescribed burning should be used only in extreme conditions, and on a one time only basis because of the danger of fires becoming uncontrolled.

Commentors: Dwight Hammond, Hammond Ranches Inc.

Reply: Seldom has a prescribed fire at Malheur in the past few years become uncontrolled. In those few instances where it has, they were quickly contained without resource damage. The escape of the West Swamp fire in 1989, did result in a peat fire. The refuge could have extinguished this fire at any time. A decision was made to allow it to burn to create openings in rather decadent stands of emergents and reed canary grass. This strategy was very successful. A visit to this area will show the large numbers of wildlife using the much improved wetland habitat. A comparable treatment would have been impossible with livestock. The only other tools that could have worked are the use of heavy equipment or herbicides both of which are extremely expensive.

50. If prescribed burns are used, this is an opportune time to do necessary maintenance to the irrigation system.

Commentors: Dwight Hammond, Hammond Ranches Inc.

Reply: This has been an ongoing practice. During the past several years, maintenance has been performed on the water management system following prescribed burns. Some burns have been completed with this very objective in mind.
Grain Farming

51. There is a discrepancy in the plan concerning the potential farm acres described on the problem statement and the number of farm acres reported in the results section.

Commentors: Amy Schoener

Reply: The smaller value reported in the problem statement is the actual tillable acres on the refuge, the larger figure in the results section represents the total acres of the fields proposed for farming. The values in the result section will be changed to reflect the actual tillable acres.

52. Need more grain on refuge.

Commentors: Ranchers for Conservation

Reply: Analysis of grain needs indicate that approximately 190 tons of grain are required annually for the fall maintenance of greater sandhill cranes, the only species for which we grow grain. Under the current cooperative farming program, 950 acres of grain fields are needed. We are planning to farm approximately 1300 acres to meet the identified need.
53. What is background data in reference to grazing by sheep for noxious weed control?

Commentors: Ranchers for Conservation

Reply: There is no specific data available on the use of sheep to control weeds. The ability to concentrate sheep on a given area of ground by herding and there general preference for forbs suggested they might work to selectively remove noxious weeds. Their use was only mentioned in the plan as a possible alternative. If this technique is used it will be closely monitored and applied on a very limited and experimental basis until evaluated.

54. Weed control is very important using any tool that is acceptable to management.

Commentors: Allan Otley, Riddle Ranch, Inc.
Harney County Cattlewomen
Russ Pengelly
William Cramer, Harney County Historical Society

55. Opposed to the possibility of introducing sheep to control noxious weeds.

Commentors: Amy Schoener

Reply: See the reply to comment 53.
Predator Control

56. Predator control is a must.

Commentors: Russ Pengelly
Mr. and Mrs. Buck Taylor
Allan Otley, Riddle Ranch, Inc.
Dale White, County Court for Harney County

Reply: Currently we have a predator control program on Malheur Refuge to boost our declining sandhill crane flock. In order to meet refuge wildlife production objectives, predator control may be needed as long as the current predator regime is maintained. However, predator populations and predator/prey balances could change and predation losses could become less important. We will continue to monitor predation rates on key wildlife species to determine whether a predator control program is deemed necessary to meet refuge objectives.
Monitoring

57. Monitoring the success of the Blitzen Valley Management Plan is essential. Would expect to see a more detailed plan as to how this monitoring will take place.

Commentors: William Pearcy
National Wildlife Federation
Oregon Wetlands and Waterfowl Association

Reply: Although a habitat monitoring plan was not available at the time the draft plan was released, there is a formal monitoring procedure in place. This procedure was used to collect the baseline data to identify the problems in the Blitzen Valley. This procedure will ultimately measure the success of the plan and allow short term evaluation of the management actions. A Habitat Inventory and Monitoring Plan will be available by November.

58. Monitoring of willow habitat should include information on willow age, vigor, stringer width and height, spacing between stringers and stem density.

Commentors: Jim Sedgwick, National Ecology Research Center

Reply: Many of these attributes were included in a reconnaissance inventory accomplished in the Blitzen Valley in 1987. Refinements are still needed and a database using GIS will be created in order to do further analysis of willow habitats on the refuge.
Fisheries Management

59. Concerned with the lack of mention of redband trout in the 5-year plan. Would like to see some discussion of management goals for red band trout in final plan.

Commentors: Oregon Trout, Rick Miller
National Wildlife Federation
Oregon Waterfowl and Wetlands Association

Reply: Although red-banded trout are not specifically mentioned in the plan, they were taken into consideration during the development of management guidelines for riparian habitat. Habitat Management Guidelines are attached to the plan as Appendix V.

60. Strongly support an active program of screening and riparian restorations on Bridge Creek, Mud Creek, and the Blitzen River from the mouth of Bridge Creek to the southern refuge boundary.

Commentors: Oregon Trout, Rick Miller

Reply: These programs are included in the plan.

61. Strongly support programs that will reduce carp populations.

Commentors: Oregon Trout, Rick Miller
Allan Otley, Riddle Ranch, Inc.
National Wildlife Federation
Oregon Waterfowl and Wetlands Association

62. Does not support use of chemicals to eliminate carp. Should rely on fishing and screening them out.

Commentors: Peter Jensen

Reply: Very little chemical control is planned on the refuge. Drawdowns and screening are the preferred alternatives. However, chemical control may prove to be the only viable alternative for carp control in many instances.
Appendix III. Plan reviewers and participants in the planning process.

William E. Anderson
Oregon Wildlife Federation

Bill Anderson

Donald Anderson

APHIS/ADC

George Archibald
Internation Crane Foundation

Glen Ardt
Oregon Dept. Of Fish & Wildlife

Jim Arnts
Jaycee's

Larry Asmussen
Kiwanis

Association of Ranchers for Conservation

John Baker

Bill Bakke/Cal Cole

Ron Bartels
Oregon Dept. of Fish & Wildlife

George Bauer

Gladys Beckley

Bend Bulletin

Ken Bentz

John Borneman

Diana Bradshaw

Pauline Brayman
Burns-Times Herald

Fred & Betty Briggs

Earl Carson

Central Oregon Audubon Society

David Chamberlain
OSU Extension Service

John Charles
Oregon Environmental Council

Pat Church

Boyd Claggett

David L. Clark

Tim Colahan
County of Harney

Dr. Guy Connolly
U.S. Fish & Wildlife Service

Corvallis Audubon Society

Char Corkran
Oregon Environmental Council

Tom Crabtree

Jean Danielson

Pam Crocker-Davis
Olympia Audubon Society

Carolyn Davies

Emma Davies

Maurice Davies

Rod Drewien
University of Idaho

Bill Dugas
Oakridge Ranger Station

Harvey Dunbar
Donald M. Kerr  
Oregon High Desert Museum

Dave Klinger  
U.S. Fish & Wildlife Service

Malena Konek

Eugene Krider

Arnold Kruse  
N. Prairie Wildlife Research

Dr. Frank Lang  
Oregon Native Plant Society

Brent Laws  
Ducks Unlimited

Richard Leaumont  
Lower Columbia Audubon Society

Cynthia Lenhart  
National Audubon Society

C.D. Littlefield

Lions Club

Wes Mace

Malheur National Forest

Bill Marlett

Dave Marshall

Gary Marshall

R. C. Matzek

Carl Mayo and Son

Joe Mazzoni  
U.S. Fish & Wildlife Service

Tom McAllister

Donna K. McBain  
The Trust for Public Land

Ernest McDonald

Walter McEwen

Eldon McLaury  
U.S. Fish & Wildlife Service

Delmer McLean

Ellen Mendoza  
Sage Advisor

Dr. Charles Meslow  
Oregon Coop. Wildlife Research

Steve Metcalf  
Lower Columbia Audubon Society

Don and Gary Miller  
Rock Creek Ranch

Richard Miller  
Oregon Trout

Joe Moon  
J. Virgil Moon and Son

William B. Morse  
Wildlife Management Institute

Rod Munro  
Izaak Walton League of America

Nature Conservancy, Oregon Chapter

Bill Nelson

Jeffrey Nelson  
Ducks Unlimited

Dan Nichols

Fred Obermiller  
Oregon State University

Oregonian

Oregon Duck Hunters Association

OSU Extension Service

David E. Ortman  
Friends of the Earth
Allan Otley  
Riddle Ranch, Inc.

Charles Otley  
Diamond Valley Ranches

Darrell Otley  
Steens Mtn. Ranch, Inc.

Fred Otley

Harold Otley  
Otley Brothers, Inc.

Howard Otley  
Kiger Ranch

Larry Otley

Don Opie

Wayne Ousley

Geoff Pampush

David Paullin  
U.S. Fish & Wildlife Service

Dan Pavelik

William G. Pearcy

Gene Pierson

Dianna Pope  
Sierra Club

Tom Pringle

Marcus Rawlings

Wesley Richards

Innis Roberts

Bina Robinson  
Coalition to Protect Animals in Parks

Ralph Rogers  
EPA Oregon Operations Office

Rogue River Audubon Society

Salem Audubon Society

Jerry & Judy Santille

Dr. Al Sargent, USFWS
Northern Prairie Research Center

Martin J. St. Louis
Summer WMA

Susan Saul  
U.S. Fish & Wildlife Service

Dr. Ed Schafer  
APHIS

John Scharff

Ron Schlorff  
California Dept. of Fish & Game

Dr. Amy Schoener

Alain Schon

Drewsey Grange #738

Hollie Schroder

John Schwartz

Jim Sedgewick  
National Ecology Research Ctr.

Sam Shaver  
Fur Takers of America

Eldon Smith

Maurita Smyth  
Audubon Society of Portland

Jack Southworth

Ron Spomer

Squaw Butte Experiment Station
Dick Tabor
Burns Masonic Lodge # 97

Buck Taylor

James Taylor

Martha Taylor
Friends of the Earth

Rex Taylor
V.E. Ranch, Inc.

Terry Thatcher
National Wildlife Federation

Daniel Thee

John Theode
USDA/APHIS

Nancy Thomas

Lucille Thompson

Caryn Talbot Throop
Oregon High Desert Museum

Earl Tiller

Gene Timms
Oregon State Senator

Kathryn Tollerton
Defenders of Wildlife

Don Tryon
OSU Fisheries & Wildlife

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U.S. Agricultural Stabilization
APPENDIX IV. Key Species - Emphasis for Management of the Blitzen Valley

INTRODUCTION-

The Blitzen Valley is famous for its great diversity of wildlife. It is difficult for wildlife managers to provide for every species' habitat needs because their needs are varied and often conflicting. We lack good information on specific habitat requirements of many species. To focus refuge management efforts, migratory bird species were prioritized during the Master Planning process (USFWS 1985a). To further assist habitat management planning for the Blitzen Valley, a group of "key species" have been selected.

These species were selected with the idea that if we can do a good job of providing high quality habitat for the various needs of these species, many other refuge species will benefit as well. Selection of these key species does not mean other wildlife will not be considered in planning management of the Blitzen Valley. For example, redband trout will be an important consideration for management of refuge streams, and bobolinks will be considered in management of fields where they occur.

Seven key species were selected for the Blitzen Valley. These are the greater sandhill crane, trumpeter swan, willow flycatcher, and four duck species (redhead, mallard, gadwall, and cinnamon Teal). These particular birds were chosen because they are high priority species and their habitat needs are quite compatible with the needs of other refuge species. Providing high quality habitat to meet the various needs of these key species will benefit a very wide variety of other species which use the refuge. For example, providing good streamside riparian habitat will greatly benefit native redband trout. Providing good meadow habitat for sandhill cranes will benefit other meadow dependent species such as common snipe, Wilson's phalarope and bobolink. Providing the brood habitat needs of the gadwall will benefit species such as pied-billed and western grebes which also need late brood water (Table 1).

The Master Plan emphasized that wildlife diversity would be optimized on the refuge by emphasizing habitat diversity. The needs of these seven species reflect a wide range of ecological conditions. Managing for the various habitat needs of these species should generally promote species diversity on the refuge.

OBJECTIVES-

Production objectives for key species were established in the Refuge Master Plan (USFWS 1985a). These objectives were defined for planning units by Ivey and Paullin (1985). To guide habitat management planning, objectives have been further divided to provide objectives for each biological unit in the Blitzen Valley (Table 2). Since the Master Plan was completed, the sandhill crane objective for the Blitzen Valley has been re-evaluated and
was reduced to reflect a more reasonable number (see Sandhill Crane section). Duck production objectives were divided among the major dabbling duck species nesting at Malheur NWR, based on historical distribution of duck pairs in the Blitzen Valley.

A formal objective for willow flycatchers has not been established. Management guidelines from the USFWS' Portland Regional Office call for increasing populations in eastern Oregon by at least 50% (Sharp 1987). The major opportunity for increasing numbers of this species is to increase the amount of woody riparian habitat.

Table 1. Summary of key species' value in guiding management of the Blitzen Valley.

<table>
<thead>
<tr>
<th>KEY SPECIES</th>
<th>MANAGEMENT NEEDS</th>
<th>EXAMPLES OF ASSOCIATED SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trumpeter Swan</td>
<td>Semipermanent marshes for nesting, with abundance of submergent vegetation for feeding.</td>
<td>Canada goose, ruddy duck, American bittern, white-faced ibis.</td>
</tr>
<tr>
<td>Willow Flycatcher</td>
<td>High quality woody riparian habitats.</td>
<td>Great horned and long-eared owls, yellow warbler, eastern kingbird, redband trout</td>
</tr>
<tr>
<td>Mallard</td>
<td>Dense residual upland vegetation for early spring nesting.</td>
<td>Short-eared owl, ring-necked pheasant American wigeon.</td>
</tr>
<tr>
<td>Cinnamon Teal</td>
<td>Residual meadow vegetation for nesting.</td>
<td>Northern harrier, northern pintail, northern shoveler.</td>
</tr>
<tr>
<td>Gadwall</td>
<td>Late season marsh brood water.</td>
<td>Pied-billed and western grebes, terns, ruddy duck.</td>
</tr>
<tr>
<td>Redhead</td>
<td>High quality marshes with abundant submergent vegetation, late season marsh brood water.</td>
<td>Red-winged blackbird American coot, terns grebes, rails.</td>
</tr>
</tbody>
</table>
Table 2. Production Objectives for Key Species in the Blitzen Valley, Malheur National Wildlife Refuge*.

<table>
<thead>
<tr>
<th>Bio Unit</th>
<th>Production Objectives</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Sandhill Crane</td>
</tr>
<tr>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
</tr>
</tbody>
</table>

Blitzen Valley Total 65** 29 3100 6750 5250 12200

* There are no quantified objectives for willow flycatchers.
** This objective was changed based on current low crane population.

KEY SPECIES' STATUS

Table 3 lists production estimates for these key species in the Blitzen Valley, and shows both long-term (1972-1989) and short-term (1984-1989) trends in production. Production estimates of sandhill cranes and trumpeter swans were based on actual counts of young, while duck production estimates were calculated based on duck pair counts and nest success data.

The formula we have employed in calculating duck production uses numbers of duck pairs observed on ground counts. These numbers are expanded, based on the percentage of habitat covered on the counts, to estimate total pairs in the Blitzen Valley. This pair estimate is then multiplied by a nest success rate determined from annual field studies and again multiplied by an average brood size at fledging for each duck species to calculate production. This formula does not account for renesting rates or rates of total brood loss, both factors which could significantly affect production, and both very difficult to determine without extensive field studies. Based upon our observations in the field, brood mortality appears to be high during some years and production estimates although consistent in process, also appear to have overestimated duck production in most years. In the future we need to account for renesting rates and brood loss rates in our production estimates to better reflect actual production, in our evaluation of refuge objectives.
Table 3. Summary of historical production and long and short-term trends or key species in the Blitzen Valley.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>SANDHILL CRANE</th>
<th>TRUMPETER SWAN</th>
<th>REDHEAD</th>
<th>MALLARD</th>
<th>GADWALL</th>
<th>CINNAMON TEAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>43</td>
<td>11</td>
<td>2425</td>
<td>2210</td>
<td>3535</td>
<td>6595</td>
</tr>
<tr>
<td>1973</td>
<td>2</td>
<td>4</td>
<td>965</td>
<td>1445</td>
<td>1775</td>
<td>1165</td>
</tr>
<tr>
<td>1974</td>
<td>1</td>
<td>9</td>
<td>2090</td>
<td>1370</td>
<td>3825</td>
<td>4670</td>
</tr>
<tr>
<td>1975</td>
<td>12</td>
<td>6</td>
<td>1090</td>
<td>2070</td>
<td>2405</td>
<td>5290</td>
</tr>
<tr>
<td>1976</td>
<td>44</td>
<td>8</td>
<td>1750</td>
<td>3985</td>
<td>1835</td>
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<td>2670</td>
<td>3050</td>
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<td>1978</td>
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<td>2275</td>
<td>3810</td>
<td>2820</td>
<td>4865</td>
</tr>
<tr>
<td>1979</td>
<td>38</td>
<td>30</td>
<td>1370</td>
<td>3450</td>
<td>5580</td>
<td>3860</td>
</tr>
<tr>
<td>1980</td>
<td>33</td>
<td>15</td>
<td>2275</td>
<td>4023</td>
<td>3825</td>
<td>4140</td>
</tr>
<tr>
<td>1981</td>
<td>21</td>
<td>9</td>
<td>1270</td>
<td>3100</td>
<td>3050</td>
<td>3650</td>
</tr>
<tr>
<td>1982</td>
<td>22</td>
<td>14</td>
<td>1780</td>
<td>1630</td>
<td>1970</td>
<td>3720</td>
</tr>
<tr>
<td>1983</td>
<td>35</td>
<td>17</td>
<td>2412</td>
<td>2118</td>
<td>3144</td>
<td>3921</td>
</tr>
<tr>
<td>1984</td>
<td>6</td>
<td>6</td>
<td>1638</td>
<td>2316</td>
<td>426</td>
<td>1884</td>
</tr>
<tr>
<td>1985</td>
<td>8</td>
<td>2</td>
<td>947</td>
<td>1472</td>
<td>505</td>
<td>2864</td>
</tr>
<tr>
<td>1986</td>
<td>46</td>
<td>22</td>
<td>2952</td>
<td>3466</td>
<td>5756</td>
<td>8341</td>
</tr>
<tr>
<td>1987</td>
<td>32</td>
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<td>2599</td>
<td>4703</td>
<td>3527</td>
<td>8703</td>
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<td>1988</td>
<td>**</td>
<td>5</td>
<td>2082</td>
<td>6630</td>
<td>2505</td>
<td>8226</td>
</tr>
<tr>
<td>1989</td>
<td>49</td>
<td>3</td>
<td>3107</td>
<td>4339</td>
<td>3816</td>
<td>11127</td>
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<table>
<thead>
<tr>
<th>Year Range</th>
<th>Average</th>
<th>Trend</th>
<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>1972-1989</td>
<td>27</td>
<td>-1%</td>
<td>+3%</td>
<td>-0%</td>
<td>+0%</td>
<td>-0.3%</td>
</tr>
<tr>
<td>1984-1989</td>
<td>28</td>
<td>+39%</td>
<td>-5%</td>
<td>+11%</td>
<td>+31%</td>
<td>+26%</td>
</tr>
</tbody>
</table>

* Trend = Percent annual change from mean.

** Data incomplete. A minimum of six were known to have fledged but most of the refuge cranes departed before production counts were done.
KEY SPECIES PROFILES

GREATER SANDHILL CRANE-

STATUS-

The breeding population of cranes on Malheur Refuge has declined from 236 pairs in the early 1970's to 168 pairs in 1989. Annual production has been erratic but has averaged 27 chicks per year. This is below the minimum recruitment level necessary to maintain a stable population. Production in 1986, 1987, and 1989 was above average due to the intensive predator control program, while data for production estimates for 1988 are incomplete because of an unusual early migration of cranes out of the area which prevented the production count.

REEVALUATING OUR SANDHILL CRANE OBJECTIVE-

The Master Plan identified 26,354 acres of crane nesting habitat in the Blitzen Valley, and estimated 367 pairs to be the maximum the valley could support.

A model was developed to determine the number of pairs needed to reach the production objective of 116 (our previous objective) under different nest and brood success scenarios (Table 4). Only under the best scenario for nest and brood success could the Blitzen Valley objective be achieved based upon the number of pairs the area could support. This objective cannot be met with low to moderate nest and brood success because the valley cannot support the number of pairs necessary to reach the production objective of 116. If the Blitzen Valley was at carrying capacity for sandhill cranes (367 pairs) they would have to sustain an annual recruitment rate of 13.6% to produce 116 chicks. The mean annual recruitment rate for 15 year period from 1970 to 1984 was 6.2%. From 1986 to 1989, a period of renewed predator control efforts, the mean annual recruitment rate was 11.8%.

Further modeling, using the number of existing pairs in each Biological Unit (Table 5) shows that the previous Blitzen Valley objective cannot be met within the next five years even if conditions were optimum, because of the limited number of existing breeding pairs. The best that can be expected is only 50 crane chicks, which is 43% of the objective level.

The Blitzen Valley does have the potential to produce 116 sandhill crane chicks, but this level of production is not feasible on a sustained basis given the amount of habitat present and the erratic water supplies prevalent in southeastern Oregon. The Blitzen Valley crane production objective is unrealistically high and should be adjusted downward. For example, if the
Blitzen Valley was at 80% of carrying capacity (294 pairs = 215% of current population) and the population was stable (i.e. 10% annual recruitment) then annual production would only be 65. Based on this analysis, we have changed the Blitzen Valley sandhill crane objective to 65 chicks fledged per year. We feel this is a much more reasonable interim objective given the low number of pairs currently nesting in the valley. After we reach this objective, we will reevaluate it.

Table 4. Model to determine elements required to attain the Blitzen Valley sandhill crane objective.

<table>
<thead>
<tr>
<th>Scenario #1</th>
<th>Scenario #2</th>
<th>Scenario #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assume:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45% nest success</td>
<td>60% nest success</td>
<td>75% nest success</td>
</tr>
<tr>
<td>15% chick survival</td>
<td>20% chick survival</td>
<td>25% chick survival</td>
</tr>
<tr>
<td>no renesting</td>
<td>no renesting</td>
<td>no renesting</td>
</tr>
</tbody>
</table>

| No. chicks fledged to meet objective: | 116 | 116 | 116 |
| No. chicks hatched to meet objective: | 773 | 580 | 464 |
| No. of eggs laid to meet objective: | 1,717 | 967 | 619 |
| No. of breeding pairs needed to meet objective: | 894 | 503 | 322 |
| Recruitment rate: | 6% | 10.3% | 15.3% |
Table 5. Summary of potential sandhill crane production in the Blitzen Valley given the current breeding population functioning under different recruitment regimes.

<table>
<thead>
<tr>
<th>Bio Unit</th>
<th>Unit Production Objective</th>
<th>Current # Breeding Pairs</th>
<th>Production at Various Recruitment Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>&quot;Average&quot;&lt;sup&gt;1&lt;/sup&gt; 6.6%</td>
</tr>
<tr>
<td>7</td>
<td>11</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>18</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>21</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>18</td>
<td>29</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>38</td>
<td>44</td>
<td>6</td>
</tr>
<tr>
<td>Totals</td>
<td>116</td>
<td>139</td>
<td>18</td>
</tr>
</tbody>
</table>

<sup>1</sup>Recruitment based on average clutch size of 1.92, 45% nest success, and 85% chick mortality (.15 survival)

<sup>2</sup>Recruitment based on average clutch size of 1.92, 60% nest success, and 80% chick mortality (.20 survival)

<sup>3</sup>Recruitment based on average clutch size of 1.92, 75% nest success, and 75% chick mortality (.25 survival)
FACTORS LIMITING ATTAINMENT OF OBJECTIVE—

The major factor limiting sandhill crane production on Malheur NWR is low brood survival, caused primarily by predation. Littlefield (1985) conducted a telemetry study on sandhill crane young at Malheur NWR in 1983 and 1984 and found predation to be the major mortality factor for crane chicks. Of the 25 crane chicks monitored, 68% were lost to predators (52% to coyotes, 8% to great horned owls, 4% to raccoons, and 4% to an unknown canid).

One dead chick from the telemetry study in 1983 was killed by a parasitic infestation of gapeworms (Syngamus sp. and Cyathostoma sp.), as were two additional chicks in 1988. These parasites use earthworms as an intermediate host. It is unknown how important gapeworms are as a mortality factor, however, it appears they may pose a significant threat to crane production. Other diseases, such as avian botulism, avian cholera, aspergillosis, and tuberculosis may contribute to chick mortality as well.

Some crane chicks may perish from starvation due to lack of water in brooding areas, particularly during late July and August. Brood strife between sibling crane chicks has been shown to usually result in the loss of one chick, when two are hatched. A few chicks die due to accidents such as drowning, vehicle collisions, and fence entanglements.

Another factor limiting crane production at Malheur NWR has been low nest success, again primarily due to predation. Of a sample of 1200 nests located from 1966 through 1989 on the refuge, 33% were predated, with coyotes, common ravens, and raccoons being the most important predators (Table 6). Only 52% of the nests surveyed hatched, with other losses due to infertility, abandonment, and flooding.

Both low nest success and low brood survival have led to very low recruitment into the local population. These factors have caused the population to decline during the 1970's and 1980's.

Deteriorated water delivery facilities have hampered our efforts to distribute water which is needed for early nesting, and has also limited the amount of brooding habitat available for young cranes, particularly during late July and August. Lack of water in early spring causes pairs to delay or abandon nest attempts, while shortages of water during the brooding period cause stress on young which must search harder for food.

<table>
<thead>
<tr>
<th>Sample Year</th>
<th>Size</th>
<th>Hatched</th>
<th>Abandoned</th>
<th>Flooded</th>
<th>Infertile</th>
<th>Predated</th>
<th>Raven</th>
<th>Raccoon</th>
<th>Coyote</th>
<th>Unk. pred.</th>
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<tbody>
<tr>
<td>1966</td>
<td>51</td>
<td>18 (35)</td>
<td>7 (14)</td>
<td>0</td>
<td>0</td>
<td>26 (51)</td>
<td>9</td>
<td>6</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>1967</td>
<td>59</td>
<td>25 (42)</td>
<td>1 (2)</td>
<td>0</td>
<td>0</td>
<td>33 (56)</td>
<td>13</td>
<td>14</td>
<td>--</td>
<td>7</td>
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<tr>
<td>1969</td>
<td>52</td>
<td>52 (59)</td>
<td>3 (3)</td>
<td>1 (1)</td>
<td>0</td>
<td>32 (36)</td>
<td>10</td>
<td>12</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>1970</td>
<td>86</td>
<td>44 (45)</td>
<td>4 (5)</td>
<td>0</td>
<td>0</td>
<td>38 (50)</td>
<td>17</td>
<td>9</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>1971</td>
<td>83</td>
<td>44 (53)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>39 (47)</td>
<td>16</td>
<td>10</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>1973</td>
<td>50</td>
<td>10 (20)</td>
<td>1 (2)</td>
<td>0</td>
<td>1 (2)</td>
<td>37 (76)</td>
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<td>4</td>
<td>5</td>
<td>8</td>
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<tr>
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<td>2 (4)</td>
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<td>0</td>
<td>30 (60)</td>
<td>14</td>
<td>2</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>1976</td>
<td>52</td>
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<td>0</td>
<td>1 (2)</td>
<td>16 (31)</td>
<td>4</td>
<td>6</td>
<td>0</td>
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<td>1977</td>
<td>50</td>
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<td>26 (52)</td>
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<td>3</td>
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<td>55</td>
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<td>1 (2)</td>
<td>10 (18)</td>
<td>1 (2)</td>
<td>24 (44)</td>
<td>7</td>
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<td>5</td>
<td>7</td>
</tr>
<tr>
<td>1980</td>
<td>50</td>
<td>30 (53)</td>
<td>1 (3)</td>
<td>2 (7)</td>
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<td>11 (37)</td>
<td>4</td>
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<td>1</td>
<td>4</td>
</tr>
<tr>
<td>1981</td>
<td>31</td>
<td>15 (48)</td>
<td>0</td>
<td>0</td>
<td>2 (7)</td>
<td>14 (45)</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>1982</td>
<td>81</td>
<td>54 (67)</td>
<td>2 (2)</td>
<td>0</td>
<td>1 (1)</td>
<td>24 (30)</td>
<td>8</td>
<td>2</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
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<td>4</td>
</tr>
<tr>
<td>1984</td>
<td>67</td>
<td>23 (34)</td>
<td>2 (3)</td>
<td>5 (7)</td>
<td>3 (5)</td>
<td>34 (51)</td>
<td>8</td>
<td>5</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>1985</td>
<td>50</td>
<td>50 (48)</td>
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<td>0</td>
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<td>0</td>
<td>2 (3)</td>
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<td>2 (3)</td>
<td>0</td>
<td>3 (5)</td>
<td>21 (34)</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>1988</td>
<td>67</td>
<td>51 (76)</td>
<td>3 (5)</td>
<td>0</td>
<td>1 (1)</td>
<td>12 (18)</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>1989</td>
<td>70</td>
<td>43 (61)</td>
<td>2 (3)</td>
<td>0</td>
<td>2 (3)</td>
<td>23 (33)</td>
<td>9</td>
<td>4</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1200</strong></td>
<td><strong>627 (52)</strong></td>
<td><strong>37 (3)</strong></td>
<td><strong>21 (2)</strong></td>
<td><strong>19 (2)</strong></td>
<td><strong>496 (41)</strong></td>
<td><strong>172 (14)</strong></td>
<td><strong>102 (9)</strong></td>
<td><strong>47 (4)</strong></td>
<td><strong>175 (15)</strong></td>
</tr>
</tbody>
</table>
LIFE HISTORY OF THE SANDHILL CRANE—

CHRONOLOGY—

Sandhill cranes may initiate nesting as early as mid-March (Table 7), although most nests are initiated in April and early May. A few nests are initiated in late May, and these late nests probably reflect renesting attempts by some pairs which lost their original nest. Depending on when they are initiated, nests hatch from late April through early July, and chicks fledge from late June through mid September.

<table>
<thead>
<tr>
<th>Nest Initiation</th>
<th>Nest Hatch</th>
<th>Fledging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>March - 31 May</td>
<td>17 April</td>
<td>29 July</td>
</tr>
<tr>
<td>19 April - 4 July</td>
<td>20 May</td>
<td></td>
</tr>
<tr>
<td>27 June - 11 Sept.</td>
<td>29 July</td>
<td></td>
</tr>
</tbody>
</table>

The brooding period for cranes lasts approximately 70 days. The brooding season lasts from late April until late August in most years; occasionally extending to early September in some years.

FOOD—

Cranes are omnivores, eating a variety of plant and animal foods. During spring, cranes consume plant tubers and rootstocks which are high in protein as well as invertebrates such as earthworms and beetle larvae when these foods become available. During the breeding season, adult cranes require high protein foods to carry them through the nesting period. They primarily feed in irrigated meadows, using marshes and grain fields to a lesser extent.

Cranes will prey upon small rodents, young birds, and eggs, although these are not major food items. Young cranes also require high protein diets for rapid growth, and primarily consume invertebrates such as earthworms and insects. As they grow they feed more extensively on plant items such as seeds. In the fall, cranes tend to feed extensively in refuge grain fields on cereal grain crops which are high in carbohydrates needed to provide energy for migration.
BREEDING HABITAT-

Littlefield (1968) outlined three essential ingredients for a crane nesting territory; a feeding meadow, nesting cover and water. Territories average 43 acres at Malheur NWR and contain irrigated meadow for feeding and flooded marsh nesting cover. An ideal territory contains a shallow marsh with residual emergents in close proximity to foraging meadows.

Of the 1200 crane nests located and monitored at Malheur NWR since 1966, 92% were located in marsh habitats. Most nests were constructed from marsh vegetation as floating platforms over shallow water. Burreed accounted for 43% of all nests sampled, followed by hardstem bulrush (34%), and cattail (6.3%). Average water depth at nests was 25.2 cm while vegetation height at nests averaged 34 cm. The average distance of nests from open water was 25 m and the average distance of marsh nests from meadow habitat was 44 m (Littlefield, unpubl. data). Nests were typically located in small (1-10 acres) seasonal marshes. Nest success was highest in hardstem bulrush, presumably because it provided the greatest security from predators due to deeper water and better concealment.

Only 8% of the crane nests documented on the refuge have been in meadow vegetation. The primary importance of meadows to cranes is for feeding, and brooding young. Generally, cranes are attracted to intensely treated meadows (mowed, burned or rake-bunched grazed) for feeding during early spring. These intensive treatments remove ground cover, allowing solar radiation to warm the soil, causing earlier greenup of vegetation, and earlier invertebrate availability.

Radio telemetry studies conducted on the refuge (Littlefield 1985) showed that the wet meadow zone adjacent to uplands is a preferred area for crane chick brooding. This preference is assumed to be associated with invertebrate abundance and availability.

WATER NEEDS-

Sandhill cranes need water applied to their territories early in spring (by mid March) to provide moist soil areas for feeding. Ideal water management for crane feeding in meadows would provide areas ranging from moist sub-irrigated to water depths of 4 inches. They continue to need some water within their territories until their chicks fledge, which may be as late as mid September. They use open water areas within marshes for night roosting and as loafing sites during the day. During the breeding period (March through August), cranes rely on roosting sites within their territories. Outside of the breeding season, they use large communal roosts at night, usually in open water areas of ponds at least 20 acres in size. They will use smaller marshes for loafing during mid day.

POPULATION RECRUITMENT-

Cranes need at least a 10% recruitment rate to maintain a stable population and at least 15% to significantly increase the population (C.D. Littlefield, pers. comm.).
EFFECTS OF MANAGEMENT ACTIONS ON SANDHILL CRANES—

Sandhill cranes are territorial and generally return and nest in the same field regardless of land-use practices. Land use can alter when or where the nest will be built and the probability of success, but in general, if the field is adequately irrigated the cranes will nest in their traditional territory.

Cranes initiate nesting when their territories are adequately flooded and the females have consumed enough protein to begin egg laying. Cranes nest early in fields that are irrigated early and later in fields that are flooded late. Nest initiation is also affected by land use treatments because treatments which remove ground cover (burning, grazing, haying) result in earlier soil warm-up and availability of protein-rich invertebrate foods. Cranes nest earliest in burned areas, followed by mowed and grazed areas, and nest latest in idle areas (C.D. Littlefield, pers. comm.).

For the sample of nests monitored on the refuge, nest success has varied by land use treatment (Table 8). Nest success has been highest in burned fields, although the sample size was small. Both idle and hay-only fields have supported higher nest success than grazed fields, presumably due to the presence of idle marsh vegetation, which provides better nest concealment than grazed marsh vegetation.

One management action that can be particularly disruptive to cranes is early season mowing by permittees as part of their hay operations. Early dewatering to facilitate haying programs causes serious impacts to the quality and quantity of moist meadow feeding areas. This causes cranes to move to wetter feeding areas. These forced brood movements stress crane chicks and cause increased mortality due to predators, fence entanglement, collision with vehicles and other accidents. Actual mowing activity disrupts normal feeding and movement patterns while also posing a direct mortality threat. Finally, mowing attracts predators, particularly coyotes, which move into mowed fields where hunting for small rodents is good. Crane chicks commonly "disappear" shortly after mowing begins and we believe many of these are killed by coyotes attracted to mowed areas.

CRANE MAINTENANCE

Grain fields in the Blitzen Valley have been used as fall staging areas by a major segment of the greater sandhill cranes which winter in the Central Valley of California. The Blitzen Valley objective for sandhill crane use is 225,000 use-days per year (Ivey and Paullin 1985). This objective was established, based on the idea that if we can hold as many cranes in the Blitzen Valley for as long as possible, we can reduce mortality in the population by reducing the amount of time they are exposed to the Central Valley, where many hazards for wintering cranes exist (e.g. fog and powerlines, disease, etc.).
Table 8. Nest fates of greater sandhill crane nests monitored on Malheur National Wildlife Refuge, Oregon; 1966-1989, by land use treatments (percentages in parentheses)—(Littlefield, unpubl. data).

<table>
<thead>
<tr>
<th>LAND USE TREATMENT</th>
<th>Hatched</th>
<th>Abandoned</th>
<th>Flooded</th>
<th>Infertile</th>
<th>Raven</th>
<th>Raccoon</th>
<th>Coyote</th>
<th>Unk. Predator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hayed and Grazed (n=740)</td>
<td>356(48.1)</td>
<td>22(2.8)</td>
<td>10(1.4)</td>
<td>12(1.6)</td>
<td>126(17.0)</td>
<td>82(11.1)</td>
<td>26(3.5)</td>
<td>107(14.5)</td>
</tr>
<tr>
<td>Graze Only n=18</td>
<td>8(44.4)</td>
<td>-----------</td>
<td>--------</td>
<td>1(5.6)</td>
<td>4(22.2)</td>
<td>2(11.1)</td>
<td>--------</td>
<td>3(16.7)</td>
</tr>
<tr>
<td>Hay Only n=87</td>
<td>53(60.9)</td>
<td>2(2.3)</td>
<td>3(3.4)</td>
<td>4(4.6)</td>
<td>5(5.7)</td>
<td>5(5.7)</td>
<td>4(4.6)</td>
<td>11(12.6)</td>
</tr>
<tr>
<td>Idle n=304</td>
<td>175(57.6)</td>
<td>6(2.0)</td>
<td>10(3.3)</td>
<td>6(2.0)</td>
<td>29(9.5)</td>
<td>22(7.2)</td>
<td>12(3.9)</td>
<td>44(14.5)</td>
</tr>
<tr>
<td>Burn n=45</td>
<td>32(71.1)</td>
<td>1(2.2)</td>
<td>1(2.2)</td>
<td>--------</td>
<td>4(8.9)</td>
<td>--------</td>
<td>2(4.4)</td>
<td>4(8.9)</td>
</tr>
<tr>
<td>TOTALS: n=1194</td>
<td>624(52.3)</td>
<td>31(2.6)</td>
<td>24(2.0)</td>
<td>23(1.9)</td>
<td>168(14.1)</td>
<td>111(9.3)</td>
<td>44(3.7)</td>
<td>169(14.2)</td>
</tr>
</tbody>
</table>
Crane use on Malheur Refuge has suffered a declining trend in recent years, to reach an all-time low in 1988. To reach the objective, we need to provide high quality grain fields as fall feeding areas, associated with suitable roost sites, and we also need to minimize human disturbance in crane staging areas. For optimum crane use, grain fields should be large (>100 acres), and should be within 4 miles of a suitable roost site. Cranes prefer shattered grain from harvesting operations over standing grain (Littlefield, pers. comm.).

**DESIRED HABITAT CONDITIONS TO MEET SANDHILL CRANE OBJECTIVE**

Irrigation should begin in meadows and marshes in early February prior to the cranes' spring arrival, and all breeding territories should be wet by mid April. Water should be widely distributed throughout all crane habitat to minimize territorial conflicts. Water level fluctuations should be minimized during the nesting season to prevent flooding of nests.

Cranes should be encouraged to nest early when possible, to avoid problems with water shortages for brooding colts during summer. Crane territories should be irrigated as early as possible. Intensive land use treatments such as burning and rake-bunch grazing of areas within crane territories appear to stimulate earlier nesting than less intensive land management strategies.

An optimum crane territory should contain 5-10 acres of emergent vegetation, interspersed with 20-30 acres of moist meadows. The average territory size at Malheur NWR is 43 acres (C. D. Littlefield, pers. comm.).

For nesting, erect emergents (1-2 acres minimum) with an average vegetation height at the nest of 35 cm is desirable. Nest cover should provide enough concealment so at least two sides of the nest are visually obscured by vegetation.

The optimum brooding habitat is 5-10 acre emergent stands interspersed with 20-30 acre moist meadows. The moist ecotone between uplands and wetlands is a favored feeding area for crane chicks. Moist feeding meadows should be maintained through September 15.

Ivey and Paullin (1985) calculated that a minimum of 190 tons of grain (in the refuge's share) was needed to meet the crane maintenance objective.
TRUMPETER SWAN

The trumpeter swan is the largest species of waterfowl in North America. Swans need high quality wetlands to survive and reproduce and are an excellent indicator of quality wetland habitats. The species was nearly extirpated from the lower 48 states by the early 1940's when only a small population remained at Red Rock Lakes in Montana. The trumpeter swan became our nation's first "Endangered Species" and restoration efforts included establishing populations at other refuges, such as Malheur. Following successful recovery efforts, trumpeters were removed from the Endangered Species List in 1968, however, populations in the lower states have actually declined slightly in recent years. In Region I of the Fish and Wildlife Service, trumpeters were classified as "sensitive species", a status assigning them special management attention (USFWS 1985b).

Providing for the habitat needs of trumpeter swans at Malheur will benefit a wide variety of marsh species, including over-water nesting species such as Canada geese, diving ducks, grebes, terns, bitterns, and colonial waterbirds such as ibises and egrets. These areas will also provide brooding and molting habitat for geese and ducks and a large variety of other waterbirds.

STATUS-

The Malheur trumpeter swan population peaked at 73 individuals in 1983, and has since declined to 18 individuals in spring, 1989. The number of nesting pairs had declined from 19 in 1980 to only 2 in 1989. This drastic decline in the population is cause for serious concern.

FACTORS LIMITING OBJECTIVE ACHIEVEMENT-

Major problems limiting the local trumpeter swan population are generally related to food resources. The population has not developed migrational traditions and winter food availability has limited the number of swans that can survive through the harsh winter period. Management of ponds for submergent plant production provides the major food resources, however, management capabilities are severely limited by the poor condition of water control facilities and also by the negative impacts of carp (associated with many of the refuge ponds and marshes). Late season (September) brood water is a critical factor which is often in short supply during dry years.
LIFE HISTORY OF THE TRUMPETER SWAN—

CHRONOLOGY—

Trumpeter swans are year-round residents at Malheur NWR. Breeding pairs establish their territories by late April and begin nesting in early May. A few pairs begin incubating eggs as late as early June. The brooding period extends approximately three months, with cygnets gaining flight capability from early September through early October, depending on when they hatched.

FOOD—

An abundance of submergent aquatic plant beds are important as food for trumpeters. Aquatic invertebrates are important foods for young cygnets to meet their high protein requirements for rapid growth. However, they quickly shift to plant foods as they grow larger (Banko 1960). Sago pondweed is the most important food plant at Malheur NWR. Floating-leafed pondweeds are used heavily in the late summer and fall. After these two are used up or become unavailable, other submergent plants such as milfoil are utilized.

Trumpeters will also feed upon tubers of emergents when they are available, and particularly favor these in the spring in areas that had been burned the previous fall or winter.

Carp severely limit the potential of the wetlands for production of submergent plants and aquatic invertebrates and limit the availability of food resources for trumpeters.

BREEDING TERRITORIES—

Trumpeters use marsh habitats exclusively for nesting. Territories are usually extensive marsh areas interspersed with emergent vegetation (Banko 1960). They prefer ponds greater than 20 acres and often use muskrat lodges as nest sites or build large floating platforms of emergent vegetation. Locally, most nesting pairs defend one large pond as their breeding territory. Hardstem bulrush is the preferred nesting material at Malheur NWR. They occasionally use other emergents such as cattail or burreed for nest building. Within their nesting ponds, open water should range from 20 - 50% of the pond area. Dense submergent plant beds with high populations of aquatic invertebrates are an important criteria for successful production. Broods are reared almost exclusively in semi-permanent marshes.

WATER NEEDS—

Trumpeter swan breeding areas should be at operating levels by early March, and water levels should be stable during the nesting period to prevent nest flooding or abandonment. Water depths should range between 10 and 36 inches within feeding areas. Generally, ponds which are managed as semipermanent wetlands will support the best feeding opportunities. Adequate water levels
should be maintained through September to improve brood survival.

LOAFING SITES-

Trumpeters need sites within breeding territories and feeding areas for loafing. Suitable sites include islands, open shorelines, muskrat houses and matted emergent vegetation.

MOLTING-

Trumpeters generally molt their primary flight feathers during July and August and become flightless for a period of 30 to 40 days. During this period they are particularly vulnerable to predators. This is a critical time in adult and cygnet survival. Breeding trumpeters molt on marshes within their territory, while non-breeders usually select marshes which are larger than 50 acres in size and which contain good feeding opportunities as well as good emergent cover for escape from predators.

WINTER HABITAT-

The most critical period for our local population is winter (Ivey 1988). Extreme cold results in freezing of many swan feeding areas, severely limiting food availability. Swans are forced to feed in open-water areas such as warm springs and moving water. Major winter feeding areas in the Blitzen Valley in recent years include the West Canal, the East Canal, Bridge Creek, and to a lesser extent, the Blitzen River. We could utilize techniques such as using aerators to maintain open water, or winter feeding to enhance swan survival during this critical period. We feel these practices would discourage the birds from learning to migrate from this area during harsh winters. There is some evidence that a few swans do migrate from the area, which would be a much better alternative for a healthy swan population.

EFFECTS OF HABITAT MANAGEMENT ACTIONS ON TRUMPETERS

Actions aimed at improving marsh interspersion such as burning, pothole blasting, mowing (in combination with deep flooding), prescribed droughts and the use of herbicides to kill excess emergent vegetation and open up the marsh can greatly enhance swan habitat. Burning during fall or winter in marsh or wet meadow areas can make tubers and rootstocks readily available to trumpeters as food in spring. Peat burns can create open water feeding areas in dense emergent stands. Drawdowns of water levels in marsh areas can reinvigorate soils, reduce carp numbers and increase food production substantially following reflooding. In these large semipermanent marsh areas, cattle grazing has little impact upon trumpeter swans or their habitat.
DESIRED HABITAT CONDITIONS TO MEET TRUMPETER SWAN OBJECTIVE

The Blitzen Valley objective is to produce at least 29 swans annually. Historically, refuge swans have maintained about 75% nest success, 70% brood success, and have averaged 2.9 cygnets fledged per successful brood. Therefore, we need to provide enough suitable marsh complexes to support 20 pairs of nesting swans in the valley, based upon the following formula:

\[
\text{20 NESTING PAIRS} \times 0.75 \text{ (NEST SUCCESS)} \times 0.70 \text{ (BROOD SUCCESS)} \times 2.9 \text{ CYGNETS/SUCCESSFUL PAIR} = 30 \text{ SWANS PRODUCED}
\]

These wetland complexes, to be suitable as trumpeter swan territories, should maintain at least ten acres of open water, with excellent submergent plant foods, good interspersion of water and emergents (10 - 50% emergents), muskrat houses for nest sites, and stable water levels and supplies through the brooding period (early September).

There are at least 25 sites within the Blitzen Valley which could be managed as trumpeter swan territories (Table 8). Nineteen of these have been used historically and 6 new sites will need further development to make them suitable for trumpeters. Management of all of these areas for trumpeter habitat will ensure that the needs of trumpeters will be met, and many other species will benefit as well. These areas will also serve as major brooding areas for other waterfowl and waterbirds.
Table 8. Existing and potential trumpeter swan territory sites in the Blitzen Valley.

<table>
<thead>
<tr>
<th>Biological Unit</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Wright's Pond</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>7</td>
<td>Ibis Pond</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>7</td>
<td>Pintail Pond</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>8</td>
<td>Little Sagebrush</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>8</td>
<td>Unit 8 Pond</td>
<td>Recent nest site</td>
</tr>
<tr>
<td>8</td>
<td>S-Curve Pond</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>8</td>
<td>Buena Vista Ponds</td>
<td>Recent nest site</td>
</tr>
<tr>
<td>9</td>
<td>Unit 9 Pond</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>9</td>
<td>Skunk Farm Pond</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>9</td>
<td>Retherford Lake</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>9</td>
<td>Diamond Swamp</td>
<td>Recent nest site</td>
</tr>
<tr>
<td>10</td>
<td>West Grain Camp</td>
<td>Potential nest site</td>
</tr>
<tr>
<td>10</td>
<td>Witzel Pond</td>
<td>Potential nest site</td>
</tr>
<tr>
<td>10</td>
<td>Krumbo Swamp</td>
<td>Potential nest site</td>
</tr>
<tr>
<td>11</td>
<td>Goose Pond</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>11</td>
<td>Benson Pond</td>
<td>Recent nest site</td>
</tr>
<tr>
<td>11</td>
<td>Jones Pond</td>
<td>Recent nest site</td>
</tr>
<tr>
<td>11</td>
<td>Dredger Pond</td>
<td>Recent nest site</td>
</tr>
<tr>
<td>11</td>
<td>Boca Lake</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>12</td>
<td>Baker Pond</td>
<td>Potential nest site</td>
</tr>
<tr>
<td>12</td>
<td>Darnell Pond</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>12</td>
<td>Mud Creek Fld</td>
<td>Potential nest site</td>
</tr>
<tr>
<td>12</td>
<td>Knox Swamp</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>12</td>
<td>Knox Pond</td>
<td>Historic nest site</td>
</tr>
<tr>
<td>12</td>
<td>Cottonwood Pond</td>
<td>Recent nest site</td>
</tr>
</tbody>
</table>
WILLOW FLYCATCHER

At Malheur NWR, the willow flycatcher is a woody-riparian habitat dependent species. This small passerine has declined significantly during the past century in most western states and is a species which could become federally listed as threatened or endangered. It was listed as a "sensitive species" in 1982 in Region 1 of the Fish and Wildlife Service (USFWS 1982), a status which assigned it special management attention. Because of their sensitivity to habitat degradation, willow flycatchers are an excellent indicator species for woody-riparian habitat quality (Knopf et. al 1988). Based on surveys at Malheur NWR, the refuge supports a healthy, dense population of willow flycatchers.

Providing good habitat for the willow flycatcher in the Blitzen Valley will benefit many other riparian dependent species. Other species which usually use riparian habitat for nesting sites on the refuge include: Swainson's hawk, great horned and long-eared owls, mourning dove, eastern kingbird, black-billed magpie, American crow, American robin, yellow warbler, yellow-breasted chat, and song sparrow. Ground nesting birds such as ducks and pheasant use riparian understory vegetation for nesting, and a large variety of birds, including raptors, woodpeckers, and many passerine species use riparian habitats extensively during migration. Woody riparian habitats are also very important to mule deer on Malheur NWR, which utilize them extensively for food and cover. Woody riparian habitats also support aquatic stream environments by providing water-cooling shade and insect foods for fish such as redband trout.

STATUS-

To date, the only local long term data on willow flycatchers is the Breeding Bird Survey. This annual count of all breeding birds records numbers of flycatchers observed or heard at half-mile intervals along a route in the southern Blitzen Valley. The trend in the number of willow flycatchers recorded since 1972 shows a 15% annual increase; however, numbers peaked in 1985, and the trend for recent years has been fairly stable.

An on-going study in the Blitzen Valley should provide better information on population numbers for use in the future; however, preliminary information suggests that most available habitat on the refuge is occupied and significant increases may only be realized by either reinvigorating decadent willow stands, or by actively encouraging increases in woody riparian habitats.

FACTORS LIMITING ATTAINMENT OF OBJECTIVE-

Apparantly, the major factors limiting the Malheur NWR population include the amount and condition of woody riparian habitat available, including its distribution, patch size, spacing, and age structure. Nest predation and parasitism of nests by brown-headed Cowbirds may limit production during some years (Sedgwick, pers. comm.).
LIFE HISTORY OF THE WILLOW FLYCATCHER

CHRONOLOGY-

Willow flycatchers return to Malheur from their southern wintering areas during May and June. The earliest spring arrival date on the refuge is April 29, while the average is May 11. They establish their territories shortly after they arrive, and begin nesting by late June. They will readily renest if their early nesting attempts fail. The young begin fledging in mid July, and generally all fledge by mid August. They migrate south during August and September.

FOOD-

Flying insects are the major foods of willow flycatchers. Insects made up 96% of their diet in one study (Bent 1942). Most of the insect prey are produced from the herbaceous riparian understory vegetation or aquatic habitat within their territories. Their feeding strategy is a sit-and-wait technique where they take to the air to prey upon passing insects.

TERRITORIAL HABITAT-

Willow flycatcher territories range in size from 1.3 - 4.5 acres in patchy or clumpy woody riparian vegetation (Stein 1958, Walkinshaw 1966). Sedgwick (1987) surveyed linear willow stringer sites in the southern Blitzen Valley in 1987 and found territories ranging from approximately 61 -200 meters long in stringers averaging about 3 meters in width (.6 -1.6 acres).

Size of woody riparian habitat blocks may be a factor influencing willow flycatcher territory selection. In the Sierra's of California, 83% of the meadows supporting willow flycatchers were larger than 20 acres (Serena 1982).

Taylor (1984) found willow flycatchers in the south Blitzen Valley to be primarily limited to transects with the most shrub volume. Areas with high bush density and high shrub-canopy volume appear to be preferred as territory sites. Sedgwick, however, found higher densities of willow flycatchers at Malheur along the Center Patrol Road, where shrub densities and volumes were lower and spacing greater than in the Island Field where shrub densities and volume were higher and spacing less. This suggests there is an optimum level of shrub density and volume which is highly attractive to willow flycatchers. Habitats which are above or below this optimum level may support fewer territories. It appears that willow bushes between 4-7 years old, and with good vigor are most attractive as territorial sites (Sedgwick 1987). Sedgwick also found willow flycatcher densities were higher where willow stringers were on both sides of the road and river, which implies the width of the road or river may be close to some optimum foraging gap in the willow community, making these areas more attractive to flycatcher pairs.

The presence of free water (flowing or standing surface water) appears to also be attractive to willow flycatchers in selection of territories.
(Walkinshaw 1966, Serena 1982, Sharp 1987). A study of willow flycatchers in the Sierras of California by the Kings River Conservation District (KRC) suggested that free water need not be present during the latter stages of incubation, but was always present during pair formation (KRC 1985a). However, the species nests in shrubby openings in the eastern U.S., often away from water. The importance of water to willow flycatchers may be related to how the water presence affects habitat patchiness. Surface water reduces soil aeration, thus preventing willow seedling establishment and suckering.

NESTING-

King (1955) found most nests within 20 - 40" above the ground, while most nests at Malheur are found between 2 - 4 feet. Willows are the primary substrate for nests at Malheur; however, wild roses, currents, and occasionally tall herbaceous forbs such as cow parsnip are used.

EFFECTS OF HABITAT MANAGEMENT ACTIONS ON WILLOW FLYCATCHERS

Habitat management actions which affect the vigor and structure of woody riparian communities will also influence willow flycatchers. These activities include cattle grazing, mowing, burning, mechanical disturbance, water management and long-term idle.

IDLE VEGETATION MANAGEMENT-

Idle management is defined as preventing artificial impacts such as livestock grazing, mowing or prescribed fire from impacting vegetation. Woody shrub communities which have been suppressed or altered by these artificial processes will usually recover when placed under idle management. Managing woody shrub vegetation under an idle management scheme generally results in a succession of shrub growth, providing improved structure for willow flycatchers while plants are young and vigorous. Over time, as plants become old and decadent, the habitat can become less attractive to willow flycatchers and may need periodic disturbance to maintain a productive, vigorous community. This is especially true in the meadow-associated willow areas, where the natural climax plant community is a sedge/rush composition.

GRAZING-

Generally, cattle grazing reduces suitability of riparian habitats to willow flycatchers by direct impacts to the woody vegetation caused by feeding and other activities such as rubbing and bedding. The most critical impacts of cattle to riparian shrubs occur within the lower shrub zone which is also the primary area selected by willow flycatchers for nest sites. Serena (1982) detected a negative relationship between willow grazing by cattle and willow flycatcher presence. Taylor (1984) found the number of Willow Flycatchers in the south Blitzen Valley to be negatively correlated with grazing frequency, and Taylor and Littlefield (1986) reported a negative correlation between shrub volume and both grazing frequency and time since last grazed.
Summer grazing is most detrimental because cattle concentrate in these areas, seeking forage, water and shade. Cattle can disrupt nests during this period by direct disturbance and destruction while grazing woody shrubs (KRCD 1985b), but these impacts are minor compared to their influence on habitat structure. Fall and winter grazing are generally not as harmful; however, the severity of damage is determined by the grazing intensity and climatic conditions which may cause cattle to seek riparian shrubs for thermal cover.

Periodic cattle grazing may be a useful tool for occasionally reinvigorating decadent willows under a short-term, high intensity grazing treatment, which can stimulate suckering and new growth. However, reinvigoration of decadent willows may only be needed about every ten years, and may not be needed at all along streams where natural disturbances occur.

WATER MANAGEMENT-

Providing water within and adjacent to woody riparian communities during June should enhance their attractiveness to willow flycatchers (KRCD 1985b). Water presence, timing and duration are important factors in maintenance of riparian habitats. Most refuge riparian areas are maintained by irrigation, and therefore water management is very important in woody riparian management on Malheur NWR.

DESIRED HABITAT CONDITIONS FOR WILLOW FLYCATCHERS

A habitat suitability model was developed for willow flycatchers in the California Sierras (KRCD 1985b). They list the following factors as important aspects of willow flycatcher habitat selection:

CANOPY COVER-

Defined as canopy cover by woody shrubs at least 1.2 meters tall, 10% cover is listed as minimum for willow flycatcher use, while 50-70% is considered optimum.

FOLIAR DENSITY-

Measured by the Robel method (Robel et al. 1970), density of foliage below 1.2 meters ranging from 76-100% is considered optimum for willow flycatchers.

TREES-

Used as singing perches, tree canopy coverage of 1-10% is considered optimum for willow flycatchers, while up to 50% tree coverage is suitable.

PATCHINESS-

Large continuous willow stands are not optimal for willow flycatchers.
Instead, a degree of patchiness is required. A range of 30-60 distinct patches of woody shrubs per hectare appears optimal. Patchiness ranging from 10-30 and 60-90 patches per hectare are considered suitable.

FREE WATER-

Free water, preferably flowing, should be present during the period of pair formation and nest building (late May and June).

Sedgwick (1987) provided additional criteria regarding willow flycatcher habitat at Malheur NWR. Where willow shrubs are clumped, a minimum diameter area of 82-150 meters appears necessary to attract willow flycatchers, and where long linear willow stringers occur, a 200 meter area seems suitable. It appears that fairly young (4-7 years), vigorous willows are most attractive to willow flycatchers. In willow stringer situations, close proximity of additional parallel stringers creates a more attractive situation for willow flycatchers.
DUCKS

Four key species (redhead, mallard, gadwall, and cinnamon teal) were selected from this group, because of their very different habitat needs. These four are the most common duck species nesting on the refuge. The redhead was chosen to represent the needs of all diving ducks which nest at Malheur NWR. Redheads are late-season nesters which utilize marsh habitats almost exclusively. They select high quality marsh habitats for nesting and brooding, and are good indicators of marsh habitat quality. Providing high quality marshes for redheads and late season brood habitat for their broods will benefit a large variety of other species such as the early nesting canvasback, the late nesting ruddy duck, as well as coots and grebes, which need late brood water also.

Mallards are very early nesters, thus they can be used as an indicator of early season wetland habitat conditions. They have a strong preference for dense, high quality residual nesting cover, and are good indicators of upland condition. Mallards are of interest to a broad spectrum of the public and are the most important duck species to hunters in North America. Because of their importance, there is an abundance of information in the literature on mallards, their life history, and the impact of land use practices on their courting, nesting, brooding, and feeding requirements as they relate to production. Providing early spring wetlands and good upland nesting cover for mallards will benefit other early nesting species such as sandhill cranes, northern pintails, and Canada geese which use wetlands; and short-eared owls, ring-necked pheasants, and American wigeon which also select dense upland nesting cover.

Gadwalls are very late nesters, with most broods fledging in late summer. They are good indicators of late season brood-water conditions. They generally nest after the growing season is well underway, so residual cover isn't very important to gadwalls. They tend to feed and brood in larger, permanent and semi-permanent marshes more so than other dabbling ducks. Providing good brood water conditions for gadwall will benefit other species which need late brood water such as redheads, ruddy ducks, and grebes.

Cinnamon teal are mid-season nesters which primarily select meadow vegetation for nesting. They will use new growth, but prefer idle vegetation for nesting. They are the most common nesting duck in the Blitzen Valley. Providing good residual meadow vegetation as cinnamon teal nesting habitat will benefit other meadow nesting species such as the northern pintail, northern shoveler, and northern harrier which all nest in similar sites.

STATUS-

Long-term trends reveal relatively stable duck production, while short-term trends show substantial improvement (increasing 12-31% per year for key species). Average production from 1984-1988 was approximately 50% of our Blitzen Valley objectives. The drastic improvement in duck production
estimates since 1984 can be primarily attributed to increased nest success due to the experimental predator control program. However, as previously discussed, brood mortality appears to be high in the Blitzen Valley and actual duck production was probably much further from the objectives than the estimates would indicate.

Unfortunately gains in the Blitzen Valley in duck production have been more than offset by losses on Malheur Lake due to flood related habitat losses. Malheur Lake historically was the most important redhead nesting habitat on the refuge; however, record high waters from 1982 through 1986 decimated emergent vegetation critical to nesting redheads and virtually eliminated duck nesting on the lake in recent years.
DUCK PRODUCTION MODELS-

Tables 9, 10, 11, and 12 are production models for redheads, mallards, gadwalls, and cinnamon teal, based upon Blitzen Valley production objectives.

Table 9. Redhead production model for the Blitzen Valley.

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<th>HIGH PREDATION</th>
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<td>Assume:</td>
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<tr>
<td>15% nest success</td>
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<tr>
<td>1.5 nest attempts/pair</td>
<td>1.25 nest attempts/pair</td>
<td>1.1 nest attempts/pair</td>
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<tr>
<td>No. of successful nests needed to meet objective</td>
<td>4700</td>
<td>2350</td>
<td>1175</td>
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<tr>
<td>No. of nest attempts needed to meet objective</td>
<td>31,333</td>
<td>7833</td>
<td>1958</td>
</tr>
<tr>
<td>No. of pairs needed to meet objective</td>
<td>20,888</td>
<td>6266</td>
<td>1780</td>
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</table>

The average redhead breeding population for the Blitzen Valley in the past five years has been 1005 pairs. This equates to roughly 20 acres of wetlands per pair assuming that all habitat was adequately flooded when redheads arrived in spring. To meet the objective, we need to attract more redhead pairs to the area. To do this, we need to enhance the quality of our existing marshes by creating additional openings in marsh habitats in the Blitzen Valley. We also need to increase annual redhead recruitment rates.
Table 11. Production model for gadwalls in the Blitzen Valley.

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<tr>
<td><strong>5,250 = BLITZEN VALLEY GADWALL PRODUCTION OBJECTIVE</strong></td>
<td><strong>5,250 / 5.8 (ave. brood size at time of fledging)</strong> = 905 successful broods needed to meet objective</td>
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<tr>
<td><strong>Assume:</strong></td>
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<td>15% nest success</td>
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<td>60% nest success</td>
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<td>15% brood success</td>
<td>30% brood success</td>
<td>60% brood success</td>
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<tr>
<td>1.5 nest attempts/pair</td>
<td>1.25 nest attempts/pair</td>
<td>1.1 nest attempts/pair</td>
<td></td>
</tr>
<tr>
<td><strong>No. of successful nests needed to meet objective</strong></td>
<td>6033</td>
<td>3017</td>
<td>1508</td>
</tr>
<tr>
<td><strong>No. of nest attempts needed to meet objective</strong></td>
<td>40222</td>
<td>10056</td>
<td>2514</td>
</tr>
<tr>
<td><strong>No. of pairs needed to meet objective</strong></td>
<td>26815</td>
<td>8044</td>
<td>2285</td>
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</table>

The Blitzen Valley has supported an average of about 1300 gadwall pairs during the past five years. To meet our objective, we will need to attract many more pairs in the future.

Because gadwalls nest so late in spring, they are not as dependent on residual nest cover as other duck species. They generally nest after enough new vegetation has grown to provide their nest cover needs. Therefore, nest cover availability is not a factor limiting gadwall production in the Blitzen Valley.

Enhancing existing wetlands and creating additional semi-permanent ponds should attract more gadwalls. Improving reproductive success by providing more late season brood habitat should increase the local population.

Objectives will continue to be difficult to achieve if predation rates on nests and broods are high. We need to monitor nest and brood survival in the future and ensure that predation rates are not excessive.
Table 12. Production model for cinnamon teal in the Blitzen Valley.

12,200 = BLITZEN VALLEY CINNAMON TEAL PRODUCTION OBJECTIVE

12,200 / 6.4 (ave. brood size at time of fledging) = 1906 successful broods needed to meet objective

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<tr>
<td>15% nest success</td>
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<td>15% brood success</td>
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<td>2.5 nest attempts/pair</td>
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<th>No. of successful nests needed to meet objective</th>
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<tr>
<th>No. of pairs needed to meet objective</th>
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<td>33884</td>
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The Blitzen Valley has supported an average of about 3100 cinnamon teal pairs during the past five years. The objective could be met with this number if nest and brood success were high.

Currently it appears there is enough nest cover in the Blitzen Valley to support the cinnamon teal objective, however the distribution of cover is not ideal.

Enhancing existing wetland habitats and creating additional wetland areas should make the cinnamon teal objective fairly easy to achieve. Providing better brood habitat conditions should lead to an increased local population.
FACTORS LIMITING ATTAINMENT OF OBJECTIVES—

Factors limiting duck production primarily relate to habitat quality and availability, and predation. Ivey and Paullin (1985) provide a more detailed discussion of these limiting factors. The amount of wetland habitat available for pairs, broods and molting ducks is dependent on water supplies in the Blitzen River drainage, which varies annually. Water for brood habitat is in short supply in most years, and not enough brooding areas have been developed to meet the needs of duck broods in the Blitzen Valley.

Wetland availability is also restricted by the deteriorated water delivery system in the Blitzen Valley which prohibits timely flooding of refuge wetlands in spring when mallard pairs need habitat. Because of the crippled irrigation system, proper management of many refuge wetlands for wildlife is impossible, resulting in poor habitat quality. Many refuge wetlands contain too many emergents and poor food resources to be optimum for duck use. Because many ducks nest in emergent marshes, good interspersion between emergent vegetation and open water is important. Also, late season brood habitat is very critical for late nesting species such as redheads, and has been very difficult to maintain because of poor water facilities.

In many refuge wetlands, carp have significantly degraded habitat quality, reducing suitability for duck pairs and broods. Their feeding activities remove and destroy aquatic plant and invertebrate foods that are important to breeding ducks. Cornely (1979) found waterfowl use on Malheur Lake more than doubled, following carp control in 1977. Use by canvasbacks increased over 400%, and use by redheads increased over 300% during the first year after the control effort. Berry (1983) also found waterfowl use to increase to more than double previous levels, following carp control in a Utah marsh.

Quality of duck nesting habitat can be negatively affected by land-use practices which remove cover (grazing, haying, burning), making it less suitable for use by dabbling ducks. Untreated areas (idle) may eventually lose vigor and structure and become less attractive to nesting ducks over time. Nesting cover availability is probably not a factor limiting redhead or gadwall production in the valley.

Predation of nests and broods has been a significant factor limiting duck production on Malheur NWR (Ivey and Paullin 1985). Common ravens, coyotes, raccoons and mink are all important predators which have lowered production. In general, predation losses on diving duck nests have been less than dabbling ducks due to increased isolation of their over water nests from terrestrial predators such as coyotes. Coyotes are a minor problem for nesting redheads; however, raccoons are a major nest predator because they frequent ponds and marshes where redheads nest and are adept swimmers.
LIFE HISTORIES OF DUCKS

CHRONOLOGY-

Redheads, mallards, and gadwalls winter on Malheur NWR in low numbers, while cinnamon teal all migrate south for the winter. Mallards return by mid-March and begin to establish their breeding territories. Cinnamon teal begin returning to the area in early March, and most have arrived by late March. Redheads and gadwalls are the latest arrivals with most returning by early May. Table 13 displays breeding season chronology for these key duck species.

FOOD-

Ducks use a wide variety of foods through the year, and readily take advantage of available foods which meet their nutritional requirements at different times of the year. Generally, plant foods are utilized more so during the fall and winter period when ducks need a lot of energy for migration, while animal foods (particularly aquatic invertebrates) become very important during spring and summer when demands for protein for egg-laying, molting and growth of ducklings are high.

Redheads feed extensively on aquatic plants and less on animal life than other diving ducks. Pondweeds are the most important food in their diet, and animal foods include aquatic insect larvae and snails (Bellrose 1976).

Mallards are highly adaptable in their use of foods. Plant seeds are most important as food; however, they will feed heavily on invertebrates at certain times of the year. More than any other duck, mallards have been able to utilize agricultural fields (primarily grain crops) for feeding (Bellrose 1976).

Gadwalls seek shallow marshes with an abundance of aquatic plants for feeding, and prefer succulent stems and leaves to seeds (Bellrose 1976). Animal foods make up a larger portion of the spring and summer diet of adult gadwalls (Serie and Swanson 1976) and ducklings (Sugden 1973).

Cinnamon teal feed in very shallow wetlands and select small seeds of natural plants, supplemented by small amounts of aquatic invertebrates and aquatic plant stems and leaves (Bellrose 1976).

In marshes, emergents generally support more invertebrate foods than submergent plants (Tilton and Swegler 1978), and diverse emergent plant communities generally support high invertebrate populations over time (McCready et al., 1986). Invertebrate populations in submergents appear later in the season as submergent plants grow and are generally more important to broods than adult ducks.

BREEDING TERRITORIES-

A "community of wetlands" is important to provide for all of the needs of
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<td><strong>Mallards</strong></td>
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<td><strong>Cinnamon Teal</strong></td>
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<td>INITIATION</td>
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<td>NESTS</td>
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<td><strong>Gadwalls</strong></td>
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Table 13. Breeding season chronology for redheads, mallards, gadwalls, and cinnamon teal on Malheur National Wildlife Refuge (based on refuge nest data).
breeding ducks. Duck pairs use wetlands for feeding, loafing, and courtship prior to nesting, and generally use several ponds or flooded meadow areas within their breeding territories. One pond does not generally contain all the breeding requisites for a duck pair, unless it is larger than 3 acres (Dzubin 1969). However, as pond size increases pair density (pairs/surface acre) decreases.

Generally, the higher the habitat quality, the more courting duck pairs a wetland can support; however, territorial spacing limits the maximum number of pairs that can be supported (Patterson 1976). The aggressive pairing period for most ducks lasts 20 days (Dzubin 1969). For early nesting species such as the mallard this period can be very prolonged (60 days), where renesting is common. Such is the case at Malheur NWR. For late nesters (e.g. gadwall) the aggressive period is still about 20 days; however, renesting is less likely.

Marsh and wet meadow habitats are used extensively during courtship by waterfowl. They accommodate general needs of these species by providing food, cover, water, and also meet the specific needs of individual species (i.e., providing loafing sites and territorial space). Availability of food appears to be of primary importance to courting ducks. During courtship, birds must accumulate protein-rich food reserves to carry them through egg-laying and nesting. Aquatic invertebrates from marshes and wet meadows meet this requirement for most species.

The most critical factor for duck courtship is wetland availability. Marshes and wet meadows allow for pair dispersal. Since most ducks utilize from 2-7 ponds within their territory, the number of wetlands per square mile is more important than the number of acres wet per square mile.

Since most meadows on the refuge are sheet flooded the wetlands are continuous rather than discreet. Therefore, on continuous wetlands the discreet open areas ("ponds") are created by openings in meadow vegetation, habitat interspersions (e.g. uplands, riparian), or terrain features (meanders on a slough, dikes, etc.). In short, maximum pair habitat is created where small areas of open water less than one acre in size are separated from other similar openings by visual barriers.

The number of duck pairs a wetland can support can be optimized by providing hemi-marsh (50:50 emergent vegetation to open water ratio) conditions (Kaminski and Prince 1981, Murkin et al. 1982). The number of water areas per square mile is more important in determining waterfowl pair densities than the total wetland acreage per square mile (Stoudt 1964).

Kantrud and Stewart (1977) found seasonal marshes, followed by semi-permanent marshes, to be most important to dabbling duck pairs; while semi-permanent marshes, followed by permanent marshes, were most important to diving duck pairs. Suchanek (1980) found that cattail edge negatively influenced dabbling duck pair use and diversity and, conversely, attracted diving duck pairs. Seasonal marshes should have 70-90% open grassy shorelines to be optimum for dabbling duck pairs (A. Kruse, pers. comm.).
Redhead pairs are very tolerant of each other (Lokemoen 1966) and therefore pair densities can be quite high on good quality wetlands. Throughout most of their breeding range redheads occur in low densities: short grass prairie: 0.18 pairs/square mile; mixed prairie: 1.0-2.6 pairs/square mile; parklands: 1.5-2.2 pairs/square mile; and closed boreal forests: 0.29 pairs/square mile (Bellrose 1976). Redheads attain their highest densities in large marshes such as the Saskatchewan Delta (5.3 pairs/square mile), and the Athabasca Delta (11.0 pairs/square mile), while the highest densities were reported from Bear River Marsh in Utah (355 pairs/square mile). Redhead pair density from Ruby Lake NWR in Nevada, an area similar to the Harney Basin, was calculated to be 84 pairs per square mile (Bouffard 1980).

Low (1945) reported larger water bodies were used by redhead pairs prior to nesting. These large lakes (500-1000 acres in size) attracted redhead pairs, not the smaller nesting marshes. Lokemoen (1966) described redhead breeding pair potholes as Type 5 Wetlands (shallow ponds and reservoirs, less than 10 feet deep, fringed by a border of emergent vegetation; Shaw and Fredine 1956). Kantrud and Stewart (1977) found semi-permanent, followed by seasonal wetlands to be most important to redhead pairs.

Mallards require larger areas for breeding territories than most other dabbling ducks (Dzubin 1969). One mallard territory might also support one gadwall pair, and four cinnamon teal pairs. Temporary wetlands, followed by seasonal and semi-permanent wetlands, supported the highest mallard pair densities (Kantrud and Stewart 1977).

Mallards use 1-4 wetland acres per pair, dispersed between 1-6 ponds (Dzubin 1969). Dzubin reported mallard pair densities of 22-36 pairs per square mile of parkland pond habitat, and 17-40 pairs per square mile of grassland pond habitat. A mallard pair density of 93 pairs per square mile occurred in parkland habitat one year with good hen success; however, higher pair densities the following year apparently resulted in much lower hen success, suggesting that a density of about 93 pairs is near the upper limit to maintain good production. Stoudt (1969) reported a peak mallard pair density of 52 pairs per square mile of parkland habitat over a 15-year period. Areas with many small ponds (less than one-half acre) support the highest mallard pair densities. Ruwaldt et al. (1979) calculated mallard pair densities (per wetland acre) for various wetland types, ranging from .02 to .85 pairs per acre (1-49 acres per pair), and averaging .13 pairs per acre (8 acres per pair).

Gadwall pairs showed the highest preference for semipermanent wetlands, followed by temporary and seasonal wetlands in North Dakota, and followed by seasonal and permanent wetlands in South Dakota (Sousa 1985). Constructed wetlands (dugouts and stockponds) accounted for 15% of wetlands studied in South Dakota, and were used by 32.4% of gadwall pairs (Ruwaldt et al. 1979). Flake and Vohs (1979) found gadwall pairs in South Dakota used ponds with scattered dense patches of emergents and avoided ponds with no emergent vegetation. Use of wetlands by pairs was also positively correlated with the presence of round-stem bulrushes and shoreline irregularity. Ruwaldt et al. (1979) calculated gadwall pair densities ranging from .01 to .19 pairs per acre (5-124 acres per pair), and averaging .11 pairs per acre mile (9
acres per pair).

Few studies have described the needs of cinnamon teal; however, blue-winged teal have been studied intensively and are ecologically similar. Kantrud and Stewart (1977) found blue-wing pair densities to be highest on ephemeral wetlands, followed by seasonal, temporary, and semipermanent wetlands, respectively. Use of stock ponds by blue-winged teal pairs in South Dakota increased with shoreline irregularity (Flake and Vohs 1979). Average height of emergents, and percent of wetlands in hemi-marsh were important variables for predicting use of stock ponds by blue-wing pairs (Flake et al. 1977).

Cinnamon and blue-winged teal defend very small breeding territories and therefore, their pair densities are much higher than most other dabbling duck species. Kantrud and Stewart (1977) reported blue-winged teal pair densities to be from 70-240% higher than mallard densities on various wetland types. Ruwaldt et al. (1979) calculated blue-wing pair densities ranging from .12 to 13.6 pairs per wetland acre (.7 to 8 acres per pair), and averaging .45 pairs per acre (2 acres per pair).

LOAFING SITES-

Ducks require loafing sites within wetlands where they can rest and preen their feathers, be secure from predators, and avoid severe weather. Ducks use bare shorelines, mud and sand bars, islands, muskrat houses, logs, and matted emergent vegetation. Wetlands lacking good loafing sites are less suitable for use by ducks. Gadwalls are an exception, in that they readily use areas of open water for loafing (Duebbert 1966).

Ducks are usually gregarious during the non-breeding season and normally large flocks share suitable loafing sites. During the breeding season, numerous isolated loafing sites are needed to accommodate dispersed territorial pairs.

At night, ducks prefer dense emergent cover over open areas for roosting, presumably to avoid predators. Drewein and Springer (1969) found blue-winged teal used ponds with sufficient residual cover as night roosting sites and avoided open water ponds as night roosts during the breeding season. Euliss (1984) observed that northern pintail and green-winged teal used densely vegetated ponds at night during the wintering season and avoided open water ponds.

NESTING HABITAT-

Several studies have been conducted at Malheur NWR to evaluate nesting habitat requirements for ducks. Table 14 shows the nest distribution of key duck species among the major habitat types on the refuge, based upon nests monitored from 1974 through 1987. Most diving ducks rely almost exclusively on marsh emergents as nesting substrate; while most dabbling ducks rely on upland or meadow vegetation types as nest sites. The importance of large blocks of emergent vegetation as nesting habitat for dabbling ducks at Malheur NWR has only recently been realized. Based on our observations since 1987, areas of extensive blocks of emergent cover can receive
extensive use by both dabbling and diving ducks. We have found relatively high duck nest densities in large expanses of hardstem bulrush and burreed in the Blitzen Valley.

Table 14. Nest distribution of redheads, mallards, gadwalls, and Cinnamon Teal among major habitat types on Malheur NWR (based on refuge nest records, 1974-1987).

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>MARSH</th>
<th>MEADOW</th>
<th>UPLAND</th>
<th>RIPARIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>REDHEAD</td>
<td>88%</td>
<td>10%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>MALLARD</td>
<td>22%</td>
<td>28%</td>
<td>48%</td>
<td>2%</td>
</tr>
<tr>
<td>GADWALL</td>
<td>&lt;1%</td>
<td>49%</td>
<td>49%</td>
<td>1%</td>
</tr>
<tr>
<td>CINNAMON TEAL</td>
<td>4%</td>
<td>79%</td>
<td>17%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Bellrose (1976) reported that cover density was a more important requirement for duck nesting than cover type. Density of residual vegetation is an important factor in nest site selection for dabbling ducks in the Blitzen Valley (Clark 1977, Jarvis 1980). Residual cover (provided by idle management) was most important to early nesting mallards, and was also important, to a lesser extent, to cinnamon teal and gadwalls. Foster (1985) studied duck nesting in the Double-O Unit of Malheur NWR. He found vegetation density, determined by Robel pole measure of vegetation height at 100% obscuration (Robel et al. 1970) to be the best variable defining nest site selection. Robel readings of 100% obscuration for redheads, mallards, gadwall, and cinnamon teal averaged 4.5, 4.9, 4.7, and 3.9 decimeters, respectively.

Higher duck nest densities can be expected in broken versus solid stands of marsh emergents (Kantrud 1986). Murkin et al. (1982) found more mallard nests on small islands of emergents on experimental plots where 50 and 70 percent of emergent cover was removed (thus, 50:50 and 30:70 cover-to-open-water ratios) than on plots where only 30 percent of emergent cover was removed (70:30 ratio). Enright (1971) found higher mallard nest densities in residual meadow habitat which was artificially broken up by mowing.

Redheads are almost exclusively marsh nesters, however, they will use other habitat types when emergent marsh vegetation is not available. Nests are typically floating platforms, anchored in stems of emergent vegetation. Nesting in meadows occasionally occurs during wet years when water depths in meadows exceed prescribed levels and opportunities for over-water nesting are created. Hardstem bulrush was the most important nest vegetation, supporting 64% of the redhead nests located on Malheur NWR. Hardstem was found to be the most important redhead nest cover in other studies as well.
Low (1945) defined redhead nesting habitat in Iowa as "shallow water basins with 18 inches or less water and dense emergent vegetation". Marshes of 10 to 20 acres which were within a quarter mile of large permanent lakes were most heavily used by nesting redheads. He suggested a marsh or slough area of about five acres, and within a quarter mile of a large permanent water body as an optimum nesting area for redheads. He found nests in extensive emergent stands interspersed with small open water areas, and suggested for optimum utilization of emergent nesting cover there should be openings of at least a few yards each in the nesting cover, no further than 100 yards apart.

Lokemoen (1966) found redheads to prefer to nest in small potholes which contained large blocks of emergent vegetation with a few small openings. These were classified as Wetland Types 3 and 4 (waterlogged soils to water 6 inches deep, dominated by sedges and grasses; and water depths 6 inches to 3 feet, dominated by deep water emergents; Shaw and Fr- dine 1956). He found they preferred wider bands of emergents (>30 feet wide) over narrow ones in selection of nest sites.

During the nesting period, water level stability is critical to over-water nesters such as the redhead. Rising or falling water levels can cause nest failure due to flooding or stranding, which usually leads to nest abandonment.

Mallard nests were most often located in dense residual cover in upland habitat, while both meadow and marsh sites were also important. Marsh and meadow nests were in dense cover as well. Mallards generally are very adaptable in their choice of nest sites, and will readily use artificial structures for nesting when they are available. Mallards, of all the dabbling ducks, use marsh emergents most often for nesting.

Gadwall nests were located in both upland and meadow sites on Malheur NWR in equal proportions. Gadwalls generally prefer dry sites for nesting and are known for their affinity to islands (Duebbert 1966). Gadwalls often choose nest sites containing annual forbs such as nettle or thistle.

Cinnamon teal nests were primarily located in meadow habitat, with upland areas being of secondary importance on the refuge. They generally preferred grassy nest sites and avoided brushy areas (Jarvis 1980).

BROOD HABITAT-

Duck broods require productive wetlands, high in aquatic invertebrates, with escape cover to protect them from predators and safe loafing sites for brooding. Broods prefer semi-open or open marshes (Kantrud 1986) which are seasonal or semipermanent (Duebbert and Frank 1984). Mack and Flake (1980) observed that broods appeared to prefer hardstem bulrush and avoid cattail.

Growing ducklings require high protein foods and primarily feed on aquatic invertebrates. They need both open water and emergent cover to escape
predators. Seasonal and semi-permanent marshes are most important to broods (Duebbert and Frank 1984), and broods prefer semi-open or open marshes (Kantrud 1986). Mack and Flake (1980) observed that broods appeared to prefer hardstem bulrush and avoid cattail. Brood marshes should be in hemi-marsh condition when possible to provide good emergent cover and should also contain excellent beds of aquatic plants for food. Generally, the greater the habitat quality, the more broods the habitat can support (Patterson 1976); however, overcrowding of broods on an area can lead to increased duckling mortality, primarily because of ducklings getting separated from their hens due to the confusion of numbers.

Low (1945) described redhead brood habitat as areas of "sparse to open cover where water depths ranged from 24 to 48 inches deep".

Because redheads and gadwalls are such late nesters, the impact of late season water shortages for broods is great on these species. Brood marshes should be maintained as semi-permanent marshes, with water held at least through September when possible. In dry areas, where brood water is in short supply, brood ponds larger than 20 acres should be constructed along primary irrigation facilities so they can be easily maintained.

MOLTING-

Ducks require isolation from human disturbance and security from predators during the flightless molt period of the summer months. Generally, large marsh areas (at least 5 acres) are used. Physical characters that appear attractive to molting ducks include an interspersion of dense emergents and open water, off-shore loafing sites (muskrat lodges, islands, matted emergents), and abundant submersed plant foods (Gordon 1987).

At Malheur NWR, only minor molting activity occurs in meadows. Larger ponds and lakes are preferred because of the isolation and security from predators that such areas afford.

EFFECTS OF MANAGEMENT ACTIONS ON DUCKS

PAIRS-

Duck pairs appear to use wetlands that have been treated (burned, grazed, mowed) earlier in the season than wetlands with idle vegetation, which receive more pair use later. Theoretically, treated areas receive more solar radiation, and therefore soils warm much earlier than non-treated areas, resulting in earlier plant growth and earlier availability of invertebrate foods. The new plant growth and invertebrates are sources of protein, which is very important to breeding waterfowl and other birds for egg laying as described by Eldridge and Krapu (1988).

Based on preliminary analyses of data on spring duck and goose use of different land use treatments in the Blitzen Valley during 1988 and 1990, duck and goose use is higher on more intensively treated sites (Table 15). Data was collected from study plots consisting of paired plots in

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predominately meadow vegetation ranging in size from 10 to 30 acres. The data also suggests that ducks apparently shift their use of areas through spring to take advantage of rich feeding areas, shifting from most intensively treated wetlands early to non-treated wetlands late in the breeding season.

It appears that land use practices which create open water areas in emergent marsh and meadow vegetation can enhance conditions for redhead pairs. Any action which creates openings in dense stands of emergents should favor redhead pairs. These include trailing and bedding by cattle, patchy burns, herbicide application, mechanical disturbance, deep flooding and selective mowing. These practices may all be used to enhance conditions for redhead pairs by creating open water areas during the early spring (April and May) season.

Actions which stimulate submerged aquatic plant growth will also favor duck pairs. These include carp control, periodic drawdowns, and prescribed droughts (i.e. prolonged drying).
Table 15. A preliminary summary of data collected from paired plots of different land use treatments for spring use by ducks and geese in the Blitzen Valley, 1988 through 1989 (Ivey, unpubl. data).

<table>
<thead>
<tr>
<th>YEAR</th>
<th>TREATMENTS COMPARED</th>
<th>PRELIMINARY RESULTS</th>
</tr>
</thead>
</table>
| 1988 | PB vs. RBG           | Duck use was 2.3 times greater on PB  
Goose use was 1.9 times greater on RBG |
| 1988 | PB vs. GO            | Duck use was 13 times greater on PB  
Goose use was 4 times greater on PB |
| 1988 | PB vs. RBG           | Duck use was 1.4 times greater on PB  
Goose use was 2 times greater on PB |
| 1988 | PB vs. RBG           | Duck use was 1.7 times greater on PB  
Goose use was 3 times greater on RBG |
| 1989 | HO vs. RBG           | Duck use was 1.5 times greater on RBG  
Goose use was 2.7 times greater on RBG |
| 1989 | HO vs. RBG           | Duck use was 1.4 times greater on RBG  
Goose use was 4.1 times greater on RBG |
| 1990 | RBG vs. ID           | Duck use was 3.1 times greater on RBG  
Goose use was 17 times greater on RBG |
| 1990 | PB vs. ID            | Duck use was 7.5 times greater on PB  
No geese were counted in ID (vs. 41) |
| 1990 | HO vs. ID            | Duck use was 1.5 times greater on HO  
No geese were counted in ID (vs. 94) |

RBG = Rake-bunch graze  PB = Prescribed burn  GO = Graze only  
HO = Hay only  ID = Idle
Cover removal, regardless of the method generally delays nest initiation and lowers overall duck nest density. Table 16 summarizes average nest initiation dates for these four species by land use at nest sites. Generally, the higher intensity the treatment, the later the average nest initiation date occurs. In treatments which remove cover, ducks delay nesting until adequate cover (new growth) develops.

Because redheads and gadwalls nest so late, land use practices which occur in fall or winter don't appear to affect when nests are initiated. Low (1945) observed no ill effects on nesting or nest cover of redheads due to livestock grazing. Burned marsh vegetation generally doesn't grow soon enough during the nesting period to receive much use by nesting redheads.

Jarvis and Harris (1971) studied duck nesting in the Blitzen Valley and concluded that areas containing substantial residual cover (grazed only) supported greater densities of duck pairs, more nesting species, and higher nest success than areas without residual cover (hayed and grazed). Their study area did not contain any idle vegetation. They found nest densities in unhayed meadows (grazed only) to be more than double densities in meadows which were hayed.

Table 16. Average initiation dates for mallard, gadwall, and Cinnamon Teal nests monitored on Malheur NWR, 1974-1986, by land use at the nest site (unpubl. refuge data).

<table>
<thead>
<tr>
<th>LAND USE AT NEST</th>
<th>REDHEAD</th>
<th>MALLARD</th>
<th>GADWall</th>
<th>CINNAMON TEAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle</td>
<td>May 23</td>
<td>May 8</td>
<td>May 31</td>
<td>May 18</td>
</tr>
<tr>
<td>Graze only</td>
<td>May 14</td>
<td>May 13</td>
<td>June 6</td>
<td>May 21</td>
</tr>
<tr>
<td>Hay only</td>
<td>no data</td>
<td>June 3</td>
<td>June 9</td>
<td>May 26</td>
</tr>
<tr>
<td>Hay and Graze</td>
<td>no data</td>
<td>May 31</td>
<td>June 5</td>
<td>May 28</td>
</tr>
<tr>
<td>Burn</td>
<td>no data</td>
<td>May 31</td>
<td>June 2</td>
<td>May 31</td>
</tr>
</tbody>
</table>

Clark (1977) studied duck nesting in the Blitzen Valley and found the density of residual cover (idle) to be the most important character of nest sites as the nesting season began. Refuge fields with residual cover supported greater duck nest densities, higher nest success, and more ducklings hatched than fields which were hayed or hayed and grazed (Clark 1977, Ivey 1979, Jarvis 1980). Nest studies conducted on the refuge by Clark (1977), Ivey (1979), Foster (1985), and Paullin (1989), have all shown that duck nest densities were consistently greatest in idle vegetation. Densities in idle vegetation were 2 to 3 times greater than in treated vegetation.

Data has been collected on over 1,500 nests of these four duck species from
Malheur NWR since 1974. Most of these nests were located during duck nest studies via systematic searches of all habitats. Table 17 summarizes the distribution of these nests among land-use treatments and major plant communities. The majority of nests have been located in idle vegetation types, with only small percentages of nests found in treated vegetation.

At Malheur NWR, substantial duck nesting does occur in areas of large blocks of marsh vegetation under idle or graze-only treatments. Winter cattle grazing in these large, contiguous marsh areas has little impact on the availability of sites with adequate structure for nesting, and may even enhance the attractiveness of these areas by creating open-water travel lanes for nesting ducks to use. Usually, marsh vegetation is only slightly impacted by fall and winter grazing treatments because it is generally unpalatable to cattle, and an abundance of suitable nest sites remain available for duck use.
Table 17. Percentages of mallard, gadwall, and cinnamon teal nests located on Malheur NWR from 1974-1986 among major plant communities under different land use treatments.

<table>
<thead>
<tr>
<th>HABITAT:</th>
<th>PERCENT OF NESTS LOCATED BY SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Redhead</td>
</tr>
<tr>
<td>Idle Upland</td>
<td>0%</td>
</tr>
<tr>
<td>Grazed Upland</td>
<td>1%</td>
</tr>
<tr>
<td>Burned Upland</td>
<td>0%</td>
</tr>
<tr>
<td>Idle Meadow</td>
<td>0%</td>
</tr>
<tr>
<td>Grazed Meadow</td>
<td>7%</td>
</tr>
<tr>
<td>Hayed Meadow</td>
<td>0%</td>
</tr>
<tr>
<td>Grazed and Hayed Meadow</td>
<td>3%</td>
</tr>
<tr>
<td>Burned Meadow</td>
<td>1%</td>
</tr>
<tr>
<td>Idle Marsh</td>
<td>62%</td>
</tr>
<tr>
<td>Grazed Marsh</td>
<td>26%</td>
</tr>
<tr>
<td>Burned Marsh</td>
<td>0%</td>
</tr>
</tbody>
</table>

BROODS–
Duck broods avoid areas with heavy carp infestations because of poor food resources. In general, actions aimed at reducing carp populations in Malheur NWR wetlands are highly beneficial to duck broods.

The effects of land use treatments on duck broods at Malheur NWR have not been studied. Water management is much more important to duck broods than the traditional vegetation management treatments at Malheur. Vegetation treatments can impact duck broods when they lead to reduced surface water habitat during the brooding period.

Draining of refuge fields to allow mowing of meadows is generally detrimental to duck broods and particularly to redheads because of their late brood water needs. Based on refuge records, 85% of all redhead broods are fledged by 15 September but only 15% are fledged by 15 August. These losses of wet areas cause a reduction in feeding habitat and force broods to move to other wet areas, exposing them to predators and other hazards which increase brood mortality.

Vegetation treatments can enhance brood habitat when they cause changes in vegetation to create conditions which are attractive to broods (e.g. create hemi-marsh conditions). Fall or winter burning may enhance brood habitat conditions by removing residual vegetation from marsh habitats, allowing easier access to marshes during periods of brood movement, and temporarily
created more open-water feeding areas. Winter cattle grazing creates trails in emergent marsh vegetation which may be used as travel lanes by duck broods. Glyphosphate herbicide has been used successfully at Malheur NWR to improve habitat interspersion in areas of dense emergent stands, enhancing conditions for brood use.

Flooded meadows are also used by duck broods for feeding but generally are of secondary importance to open water areas such as sloughs and ponds. mallards, northern pintail and cinnamon teal broods are frequently encountered in flooded meadows.

**DESIRED HABITAT CONDITIONS FOR DUCKS**

**PAIRS—**

Optimum conditions for mallards occur when water is shallow flooded 20-30 days prior to the peak of nest initiation (Dzubin 1969) and it is assumed this principle holds true for most duck species. Mallard pairs need seasonal wetlands flooded by mid-March to establish their territories and begin nesting. If we can meet the water needs for mallard pairs, all other dabbling duck species' needs should be satisfied as well. The greater the acreage of wetlands flooded in time for early mallard use, the greater the breeding population the Blitzen Valley can support. Irrigation water needs to be applied as early as possible in spring, and some areas should be flooded and maintained through the fall and winter periods to ensure that adequate wetland habitat is available for duck pairs.

To attract enough redhead pairs to the Blitzen Valley to meet the objective, we need to increase the acreage of open-water marsh habitat, interspersed throughout the valley. Based on our redhead model (Table 9), we need to maintain a breeding population of about 6000 pairs. Assuming our current pair population has saturated the available habitat in the Blitzen Valley, we need to increase the amount of open-water marsh habitat by a factor of at least three-fold. These redhead pair habitats should receive management emphasis to ensure high quality aquatic plant food resources using periodic drawdowns and carp control to maintain their productivity.

Optimum conditions for waterfowl in the prairie pothole region are assumed to exist when a minimum of 150 optimum wetlands account for a minimum of 160 acres per square mile (Sousa 1985). The greater the number of small ponds (dugouts, etc.) that we can provide in the Blitzen Valley up to this density, the more dabbling duck pairs we should be able to support. Providing a good diversity of treatments of various types and intensities as well as non-treated area within major habitat complexes in each Biological Unit should enhance feeding conditions for breeding dabbling ducks.

Deep, open marshes and lakes which contain an abundance of submerged aquatic plants are most attractive to redhead pairs (Low 1945, Lokemoen 1966). Generally, semi-permanent wetland types meet their needs. These types are generally flooded all year, however, periodic drawdowns occasionally occur.

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NESTING—

Dense blocks of emergent vegetation, greater than 30 feet wide, should be maintained throughout seasonal and semi-permanent marshes for over-water nesting redheads. Large blocks of emergent nesting habitat should be interspersed with small open water areas. Nesting marshes should be within a quarter mile of larger, more open pairing and brooding marshes.

Nest cover should be interspersed among wetlands, and also among various vegetation treatments. Upland sites with high potential for producing good nesting cover should be maintained in good condition for mallards and other upland nesters. Areas of vigorous idle meadow, providing good structure should be maintained for meadow nesters such as cinnamon teal. Large cover blocks (50-100 acres) should be maintained to ensure higher nest success. Dense emergent areas, greater than one acre in size should be maintained throughout seasonal and semipermanent marshes for over-water nesting. In hay and graze areas, blocks of unhayed meadow (10-30 acres) should be left to provide nest cover for meadow species. In hay-only areas, a buffer strip of meadow (about 30 meters) should be left adjacent to uplands, and blocks of unmowed meadow should be left in fields which lack uplands.

BROOD HABITAT—

For optimum duck brood habitat, four or more suitable marsh areas (from 2-20 acres each) should be available in each square mile of the Blitzen Valley. This would require approximately 100 high quality brood ponds, widely distributed through the valley. There are currently about 20 ponds in the valley which could accommodate broods and many of these are either too small (less than 2 acres) or devoid of food because of carp or water management problems due to poor facilities.

Brood marshes should be maintained through early October when possible. In dry areas, where brood water is in short supply, brood ponds larger than 20 acres should be constructed (at least 3 per section). Any new brood ponds to be constructed should be directly on a water delivery system to maximize efficiency of water management. Brood marshes should be in hemi-marsh condition when possible, and should also contain excellent beds of aquatic plants.
Table 10. Production model for mallards in the Blitzen Valley.

\[
6,750 = \text{BLITZEN VALLEY MALLARD PRODUCTION OBJECTIVE}
\]

\[
6,750 / 5.8 \text{ (ave. brood size at time of fledging)} = 1,164 \text{ successful broods needed to meet objective}
\]

<table>
<thead>
<tr>
<th>HIGH PREDATION</th>
<th>MODERATE PREDATION</th>
<th>LOW PREDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assume:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15% nest success</td>
<td>30% nest success</td>
<td>60% nest success</td>
</tr>
<tr>
<td>15% brood success</td>
<td>30% brood success</td>
<td>60% brood success</td>
</tr>
<tr>
<td>2.5 nest attempts/pair</td>
<td>2.0 nest attempts/pair</td>
<td>1.5 nest attempts/pair</td>
</tr>
</tbody>
</table>

| No. of successful nests needed to meet objective | 7,760 | 3,800 | 1,940 |
| No. of nest attempts needed to meet objective    | 51,733 | 12,933 | 3,223 |
| No. of pairs needed to meet objective            | 20,693 | 6,466 | 2,155 |

The average mallard breeding population for the past five years has been 1,425 pairs. The objective cannot be met at this level. We need to enhance the quality of existing wetlands in the Blitzen Valley, and also ensure that enough wetland habitat is available for mallards early in spring to attract the number of pairs needed to meet the objective. In order to ensure enough flooded habitat is available for mallard pairs, we need to flood more areas early in spring, create more semi-permanent wetlands, and flood some areas during fall or winter when water demands are low elsewhere.

We need to monitor nest and brood success in the future, and ensure that predation rates are low enough to achieve objectives. The availability of nesting cover does not appear to be limiting mallard production currently, however, its distribution is not ideal. Because they are early nesters, brood habitat is generally adequate during their brooding period.
Appendix V. Management Guidelines for Major Habitat Types and Habitat Complexes on Malheur National Wildlife Refuge.

I. PURPOSE

This report defines strategies for management of the four major habitat types occurring on Malheur National Wildlife Refuge, Harney Co., Oregon, and also provides guidelines for habitat management decisions within defined habitat complexes. Habitat complexes are associations of habitat types which have similar goals and management strategies.

The four basic habitat types include riparian habitats, upland habitats, marsh habitats, and meadow habitats. Riparian habitats on Malheur Refuge include mixed stands of woody vegetation along the Blitzen River and refuge creeks, and shrub-willow communities distributed throughout the refuge. Upland habitats are relatively dry sites dominated by brush, grasses and forbs. Marsh habitats are areas of emergent and submergent vegetation within ponds and emergent stands of bulrushes, cattail, burreed, or common reed within meadows. Meadow habitats are those areas lying between brush covered uplands and deep water marshes, which are generally dominated by sedges and grasses. The Blitzen Valley contains approximately 835 acres of woody riparian habitats, 33,761 acres of uplands, 9000 acres of marshes, and 20,139 acres of meadows.

If management could be applied ideally, it would be possible to manage one habitat type without impacting others, however, because of the interspersion of habitats in the Blitzen Valley it is difficult to manage specific habitats without impacting (often negatively) adjacent habitats. To minimize conflicts between management practices on adjoining habitats, we have defined five habitat complexes for management purposes.

II. IMPORTANCE OF HABITAT TYPES TO WILDLIFE

A summary, showing the importance of the different habitat types to migratory birds is presented in Table 1. A discussion of the wildlife values of each habitat type follows.

RIPARIAN HABITATS

Although riparian zones comprise only 1 to 2 percent of the land area, they provide essential food, water or cover to most wildlife species, and they are the most important wildlife habitat in the western United States (Bull 1978). The importance of these habitats for birds has been well documented (Carothers and Johnson 1975, Gaines 1977, Wauer 1977, Thomas et al. 1979a). In the Great Basin of southeast Oregon, 288 of the 363 terrestrial wildlife species (80%) are either directly dependent on riparian zones or use them more than other habitats (Thomas et al. 1979a). Approximately 30% of Malheur Refuge's birds and 20% of its mammals need riparian habitats, while almost Streamside riparian habitats are also very important to native trout, such
Table 1. Importance of key habitat types of Malheur NWR to local bird species.

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<thead>
<tr>
<th>RP=RI PARIAN HABITAT</th>
<th>UP= UPLAND HABITAT</th>
<th>MS= MARSH HABITAT</th>
<th>MD= MEADOW HABITAT</th>
<th>P= PRIMARY HABITAT</th>
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<td>Sharp-shinned Hawk</td>
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as the redband trout in this area. Woody riparian vegetation along streams provides: 1) water-cooling shade; 2) food in the form of invertebrates; 3) organic materials that stimulate aquatic productivity; 4) protection against cutbanks and sedimentation of spawning grounds; and 5) cover from overhanging shrubs and trees (Platts 1981a, Moring et al. 1985). Much of the stream habitats in the upper Blitzen Valley need rehabilitation to heal cut banks and improve instream habitat for redband trout. Irrigation diversion points need to be screen to prevent losses of trout in the irrigation system, and carp populations need to be reduced or eliminated, if possible in redband habitats.

UPLAND HABITATS

Upland habitats are used as nesting sites by a wide variety of birds, and are also home to a great diversity of other wildlife. Uplands which support dense cover and occur in close proximity to wetlands are important to upland nesting duck species (e.g. mallard & gadwall) and other ground nesting birds as well (e.g. ring-necked pheasants, short-eared owls). Uplands which support little cover are used by other species for nesting (e.g. horned larks, long-billed curlews, burrowing owls). Some refuge uplands have been planted with crested wheat, four-winged saltbush, and various wildlife food plants. The primary wildlife use of these areas are as feeding sites by Canada geese and deer.

MARSH HABITATS

Marsh habitats provide critical over-water nesting structure for many birds as well as habitat for aquatic mammals, reptiles, amphibians, and fish. Most key species depend on marsh habitats for some of their needs. Marshes are particularly important as nesting and feeding areas for waterfowl, rails, grebes, and most colonial waterbirds.

MEADOW HABITATS

Because meadows are a transition habitat between marshes and uplands, they are attractive to a wide variety of wildlife, including both aquatic and terrestrial species. Meadows are important feeding areas for cranes, ducks, geese, rails and some shorebirds. Meadows also provide nesting cover for some ground nesting birds (e.g. cinnamon teal, bobolinks). Meadows also can support large populations of small mammals, such as voles, which are important prey for many raptor and owl species.

III. EFFECTS OF MANAGEMENT PRACTICES ON HABITAT TYPES

RIPARIAN HABITAT

Management practices which alter riparian sites include grazing, haying, fire, mechanical disturbance, herbicides, water management, and recreational use. Recovery of abused riparian zones may be hastened by rehabilitating banks, plantings of trees or shrubs, and livestock removal. A discussion of the impacts of these management practices follows.
Grazing

The detrimental effects of overgrazing on riparian habitats and, on the associated fish and wildlife, have been discussed by numerous authors. Riparian habitats are most susceptible to grazing in arid and semi-arid regions where livestock tend to concentrate along streamsides because of the shade, water, shelter, and more palatable vegetation (Ames 1977, Behnke and Raleigh 1978, Dahlem 1979, Tubbs 1980). Some detrimental effects of grazing on woody riparian vegetation as described by Ames (1977), Brown et al. (1977), Kennedy (1977), Szaro (1980), Tubbs (1980), and Knopf and Cannon (1982) include:

1. elimination of food and cover plants
2. reduction in availability of nest sites
3. elimination of herbaceous understory and stand reproduction, resulting in even-aged non-reproducing mature stands and ultimately disappearance (thus reducing habitat diversity)
4. poor understory structure (shapes of shrubs and trees become like an inverted cone with decreased understory structure)
5. soil compaction and streambank erosion, resulting in wholesale loss of the riparian zone.

Such degradation results in reduced species diversity and density. Taylor (1984) found that species diversity for birds decreased with increased grazing in woody riparian habitat along the Blitzen River on Malheur Refuge. In his study, bird densities were 5 to 7 times greater on a transect ungrazed since 1940 than on 2 transects grazed annually until 1981, and 11 to 13 times greater than on a transect severely disturbed by grazing and dredging activities. He found a positive correlation between the length of time since an area had been grazed and bird abundance, shrub volume, and shrub height classes summed, and a negative correlation between grazing intensity and these factors. He also found that willow flycatchers were nearly limited to transects with the most shrub volume and they showed an inverse relationship to grazing frequency.

Duff (1979) found small mammal and songbird/raptor use increased 350% in a riparian area along Big Creek, Utah, where livestock were excluded for 8 years, compared to adjacent grazed riparian areas. Winegar (1977) reported 27 vertebrate species were recorded on 2.5 miles of an ungrazed exclosure on Camp Creek, Eastern Oregon, while only 9 species were recorded on 2.5 miles of an adjacent grazed section. Schmidly and Ditton (1978) reported capture frequencies for small mammals were 4 times greater on ungrazed than on grazed woodland riparian habitats in Texas. Szaro et al. (1985) found numbers of wandering garter snakes to be significantly higher on ungrazed portions of an alder-willow riparian community in New Mexico. They attributed differences to regeneration of vegetation and increased organic debris in the ungrazed habitat.
Grazing also results in degradation of stream habitat by causing soil compaction, erosion, and by removal of streamside vegetation. Effects of grazing on stream habitats are summarized by Behnke and Raleigh (1978), Platts (1979), Platts (1981a), Van Velson (1979) Marcuson (1970), Dahlem (1979), Storch (1979), Busby (1979), Kennedy (1977), and Ferguson and Ferguson (1983). These include:

1. widening and shallowing of the streambed as banks collapse
2. gradual stream channel trenching or braiding, depending upon soil's substrate composition
3. lowering of the water table (due to channelization of streambed and compaction of the banks)
4. loss of streamside and instream cover
5. increased water temperatures and velocities
6. decreased terrestrial input of fish food
7. increase in sediment load in stream water
8. silt degradation of fish spawning and invertebrate producing areas
9. 3- to 4-fold reduction trout biomass in grazed versus ungrazed stream sections
10. decrease of game fish and increase of rough fish in grazed sections of streams.

Among the most significant impacts of grazing on riparian habitats is its attendant erosion. Cutting of the streambed can produce an arroyo, lower the water table and cause lush riparian vegetation to be replaced by xeric species such as sagebrush (Behnke and Raleigh 1978, Winegar 1977).

Grazing damage to riparian habitats is a function of the type, intensity, frequency, and seasonality of livestock use. Impacts tend to be less for fall/winter grazing than for spring/summer grazing, however, livestock may heavily use riparian vegetation in the fall if adjacent vegetation is less palatable. Discussions of different grazing systems used to lessen impacts of livestock on riparian habitat appear in Busby (1979), Storch (1979), Swan (1979), Platts (1981a), Schmidt (1983), Bryant (1985), and Marlow and Pogachik (1985). Platts (1981a) summarized the effectiveness of different grazing systems on riparian/aquatic habitat and he rated all of them as either fair or poor and reported that only exclusion of livestock resulted in good to excellent condition. Platts (1981b) indicated that habitat alteration by grazing may be insignificant when utilization is equal to 25% or less. Storch (1979) found that rest-rotation grazing worked for maintaining riparian habitat only if the habitat was in good condition.
before the program began. Busby (1979) stated that rest-rotation and deferred grazing systems do not work well for maintaining riparian zones in desert areas because the habitats don't receive enough moisture in one year to recover.

Krueger and Anderson (1985) discussed the use of cattle as a management tool to thin dense shrub-willow habitat in Wyoming, thus increasing habitat diversity. They cautioned however, that managers must carefully control the distribution of grazers, and that enough riparian habitat is in poor condition because of grazing to create plenty of low density shrub-willow habitats.

The literature indicates that while fishery habitat recovers very quickly from the results of overgrazing (Winegar 1977, Storch 1979, Keller et al. 1979, Van Velson 1979), rehabilitation of terrestrial riparian vegetation may require decades (Knopf and Cannon 1982, Duff 1979, Davis 1977). In a study of a grazing exclosure on Big Creek, Utah, Duff (1979) reported a 63% increase in streamside vegetation after 4 years; yet after trespassing cattle occupied the exclosure for 6 weeks, vegetation was set back to pre-exclosure conditions.

At Malheur Refuge, winter cattle grazing has resulted in damage to woody riparian habitats, as cattle use these areas for thermal cover.

**Haying**

The impacts of haying on riparian vegetation are limited to cutting of young growth which deters the lateral spread of woody species. In hay-only treatments on Malheur Refuge, hay is cut to the edge of riparian areas and removed for feeding livestock elsewhere. This practice allows treatment of adjacent vegetation while woody riparian habitats remain undisturbed. Also, it does not require expensive fencing to protect riparian habitats from grazers.

**Fire**

The effects of fire on riparian ecosystems are poorly documented. Generally, the literature suggests that resilience of riparian habitat decreases with increased fire intensity (Ewel 1978).

Willows often regenerate quickly after fire (Loveless 1959, Spencer and Hakala 1964, Leege 1968, Leege 1969, Vallentine 1971, and Rowe and Scotter 1973). Fire on Malheur Refuge has generally resulted in removal of about half of the above ground willow structure, followed by vigorous resprouting. In some cases, a few decadent willows became a dense patch of young growth with improved structure, following fire. Linde (1969) found that in Wisconsin, spring burning resulted in resprouting and increased density of willow stands, while fall burning tended to control willows. The difference was probably related to fire intensity.

**Mechanical Disturbance**

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Little information is available on the resilience of riparian communities to mechanical disturbance (e.g. bulldozing). Bliss and Wein (1972) found that where ground had been disturbed by bulldozers in the western Canadian Arctic, willows were among those shrubs exhibiting a 30-50% recovery in natural plant cover in 3 to 5 years. Observations on mechanically disturbed willow communities at Malheur Refuge indicate that willows regenerate quickly following such actions. Although further investigation is necessary, mechanical disturbance may prove to be a useful tool in revitalizing degraded riparian vegetation. Spread of noxious weeds is a factor which needs to be considered in a decision to use mechanical disturbance that disturbs soil cover.

Use of Herbicides

While controlling of sagebrush in Idaho with 2, 4-D, Blaisdell and Mueggler (1956) noted top kill of willows and reported that a high percentage of those top killed plants sprouted profusely. Herbicides might have a role in rehabilitating riparian communities, however because of potential impacts to other plant and wildlife species, we will not use herbicides for this purpose at Malheur Refuge.

Water Management

Most woody riparian plant species receive water directly from the water table. It is important to maintain relatively high water tables through the growing season to maintain these communities. Many woody riparian areas on Malheur Refuge are maintained by irrigation water and are not adjacent to streams.

Recreation

Recreational users of streamsides can produce impacts similar to grazing. Excessive human use of riparian areas results in soil compaction, erosion, loss of ground cover, reduction of plant species diversity, damage to trees, and absence of reproduction (Settergren 1977, Schmidly and Ditton 1978).

On Malheur Refuge, most recreationists who visit riparian zones do so to fish. They fish along the upper 8 miles of the Blitzen River, and all of Mud and Bridge Creeks within the refuge. The level of use on the refuge is slight, and impacts to woody riparian habitats are minimal. Therefore, the current use level appears compatible with refuge wildlife objectives.

Artificially Improving Riparian Habitat

Woody riparian habitats in poor condition can be enhanced through the use of plantings. Discussion of techniques relating to plantings are provided by Sheeter and Claire (1981), Eckert (1983), Monsen (1983), McClusky (1983), York (1985), and Swenson and Mullins (1985). Improvement of streambank stability directly enhances riparian habitat. Nunnally (1978), Lines et al. (1978), Storch (1979), and Sheeter and Claire (1981), provide information on improving streambank and stream channel condition using
techniques which are compatible with fish and wildlife resources.

**UPLAND HABITAT**

At Malheur Refuge, treatment of upland vegetation is accomplished primarily with the use of two basic tools; livestock grazing and prescribed burning. For the purpose of this discussion, the following definitions will be applied:

**Treatment Intensity** is referred to as "intensity of range use" and has been defined as "the proportion of current year's forage production that is consumed or destroyed by grazing animals. "However, grazing intensity of uplands at Malheur is more accurately defined as "the amount of standing residual and current vegetation (cover) removed or destroyed by grazing animals in relation to the amount of pre-treatment standing cover. "The key word here is "cover" because our objective for native upland areas is to provide cover for nesting birds.

**Treatment Frequency** is the time interval between application of active treatment strategies. These can range from more than one treatment per year, to annual, alternate year, or periodic treatments.

**Treatment Seasonality** refers to the time of year the treatment is performed. This is generally related to a plant phenology (i.e. spring=growth initiation, summer=active growth period, fall=reproduction and carbohydrate storage, winter=dormancy).

Following is a more detailed discussion on the impacts of livestock grazing and burning and how intensity, frequency and seasonality of treatments can affect management of uplands.

**Grazing**

Under the recent Malheur Refuge management program, intentional grazing of upland sites has been limited to crested wheatgrass seedings. The primary objective for grazing the seedings was to provide green growth during the period when native plants are normally dormant, which can serve as a source of protein for wintering wildlife, particularly Canada geese and deer. Grazing intensity was aimed at maintaining optimum vigor and production. Considering long-term trends, 60-65% removal of the current years growth of crested wheatgrass each year is recommended. With a March/April grazing program, grazing at these intensities can occur every year without harm to the seedings. Seasonality of grazing has been limited to March/April treatments to provide a recovery period during the remainder of the growing season.

The native uplands are incidentally grazed under the current refuge program, when adjoining meadow habitats are grazed or hayed and grazed.

A review of the literature shows that standard grazing programs which are designed to maximize forage production are not compatible with maintenance of optimum cover conditions (Jarvis 1980; Foster 1985; Duebbert 1969; Rees...
Very little information is available on the effects of very low-intensity grazing in highly-productive upland sites such as Class I sites found at Malheur (A. Kruse 1987, pers. comm.). Light grazing intensities were found to be compatible with production of blue-winged Teal in grazed mixed-grass prairie in central North Dakota (Duebbert et al. 1986). Other species such as gadwall and mallard were found to select high-quality cover within the treatment areas in Duebbert's study.

Grazing intensity is affected by many variables including soil moisture, stocking density, grazing duration, forage quality, topographic variation and water distribution. The effects of grazing intensity on vegetative cover is generally expressed as more grazing intensity equals less vegetative cover. However, selectivity of grazing animals moderates this relationship as grazing intensity is related to forage palatability.

The result of low or moderate intensity grazing is a mosaic of heavy and light utilization areas. Generally, this situation is created in many refuge fields where rake-bunch-grazing (RBG) is used to treat meadows. Meadow vegetation is cut for hay in early August to preserve its protein. Hay is then raked into bunches to minimize loss of forage quality. This hay is grazed later in the season when the uncut vegetation reaches maximum dormancy. When cattle are turned into the fields (September through January), the rake-bunched forage is more palatable and livestock selectively feed on the rake-bunched hay. The result is that meadows receive intensive use while uplands, which are less palatable, receive less use, therefore moderating impacts to upland cover. In practice, however, there are several variables which can cause livestock to impact upland cover more severely than desired:

1. Fall and winter regrowth in the uplands of cool season grasses (e.g. cheatgrass) can attract livestock to uplands and lead to increased grazing impacts.

2. Poor quality of meadow forage at the time it is used will cause livestock to avoid this forage and seek out higher quality forage in the upland areas. The poor quality can be caused by dry conditions at cutting time, cutting of forage after protein levels have dropped and by leaching of nutrients from forage by rains. Moldiness in the hay will also reduce its palatability.

3. When meadow forage is consumed, livestock must be removed from the field or they will seek out forage in the uplands.

4. The spatial relationship between water, protein supplements and forage can affect impacts to the upland sites. Livestock tend to concentrate around water and supplement blocks causing increased intensity in these areas. If livestock are forced to move through upland sites to get to water or food, impacts due to trampling and incidental grazing will increase.
5. Weather conditions during the grazing period can affect selectivity. For example, a deep snow layer can reduce availability of cut hay, while standing upland forage remains available. Severe cold will cause livestock to concentrate in protected areas, which also causes impacts to cover.

The acceptable grazing intensity of uplands, where optimum cover is the desired objective, is determined by the quality and quantity of cover remaining on the site for early nesting waterfowl. When grazing intensities cause a deteriorated cover condition, then alternative methods of treating the adjoining habitat types need to be initiated. Frequency of grazing under optimum conditions should be regulated by the need to treat vegetation to maintain quality cover. Treatments which are more frequent than needed reduce the quality of cover. Upland sites are much more xeric than the meadows and marshes and consequently the recovery rate from perturbations is much slower than in wetter habitats.

As previously mentioned, most native upland sites are incidentally impacted by grazing of associated vegetation types. The desire for treatments of meadow and marsh habitats is the factor determining frequency of treatment. It is difficult to manage the grazing intensity of uplands to the extent that high quality residual cover remains in the spring, while meadows and marsh areas receive proper treatments. In many cases, the optimum levels of treatment for meadows or marshes causes over treatment of uplands. When this occurs, other alternatives (e.g. hay-only) need to be explored.

Seasonality of grazing in uplands on Malheur Refuge has been generally restricted to the plant dormancy period when vegetation is the least palatable. This encourages the livestock to consume more palatable rake-bunched forage in the meadows. The optimum season for treatment occurs after fall green-up of cool season grasses and before spring green-up. This is normally from about October 15 through January 31, however it is quite variable.

**Prescribed Burning**

Prescribed burning has been used on Malheur Refuge increasingly in recent years, as a result of increased training, cost-effectiveness, understanding of effects and confidence of refuge personnel. Upland sites have been burned to remove the shrub component and promote increased grass and forb production. Uplands also occasionally get burned during wildfires.

Burning intensity can be expressed as a percentage of the total cover removed in relation to the total amount of pre-burn standing cover. Burning intensity is influenced by temperature, topography, soil moisture, fuel moisture, relative humidity and wind speed. In general, burning conducted under conditions promoting hot, intense flames will remove more vegetative cover than less-intense flames. However, a minimum level of fuel is needed before a fire will carry through the vegetation, making it difficult to provide light-intensity treatments with burning. A burn hot enough to carry through a site will remove 80-100% of the cover. Therefore, the short term impacts of burning to cover are severe in comparison to other treatment.
strategies.

Historical records indicate the fire frequencies have ranged from 32-70 years in sagebrush/grass communities (Wright et al. 1979) or perhaps as often as 20-25 years (Houston 1973). This frequency seems acceptable in Class II or III upland sites where it is desirable to maintain brush as a component of the composition. However, in Class I sites where management for dense, residual standing cover is the primary objective, burning should be used on an as-needed basis. A Great Basin wildrye site can recover to pre-burn cover conditions in 3-4 years (Young 1986). Cover conditions on upland sites can deteriorate over time, and treatment may be necessary to reinvigorate vegetation. High quality upland sites which have been idle for 15 years generally could benefit from a burning treatment.

Prescribed burning at Malheur Refuge has been limited to the period when most native plant species are in dormancy. This is because most burns are planned and accomplished when safe burning conditions exist, which is generally after the first snow and before the spring irrigation season begins.

Young (1986) found that removal of residual vegetation by burning in a Great Basin wildrye site had a positive effect on subsequent growth when accomplished during dormancy. He reported a similar effect was reported for many of the other plant species on this site. Blaisdell (1953) reports that big sagebrush is easily killed by fire, that after 12 years, there was only a 10% recovery of sagebrush. Hainiss and Murray (1973) found that sagebrush had returned to pre-burn condition after 30 years.

The effect of fire on grasses is largely determined by season of burn. Burning in June or July is the most-detrimental time to burn bunch grasses.

The intensity of prescribed burning is relatively inflexible compared to other treatments. The minimum burning conditions needed to carry a fire through a site provides a treatment where a minimum of 80% of the cover is removed. Frequency of burning depends upon habitat vigor, objectives and recovery rates. Seasonality of burning will provide the greatest stimuli for community change, but due to safety considerations and burnability during the year, Malheur Refuge prescriptions have been restricted to dormant season burns.

MARSH HABITAT

Water is the most significant factor affecting the physical characteristics of marsh habitats, and water management is the most important tool available for manipulation of marshes to enhance conditions for desired wildlife species. Water presence, depth, periodicity and fluctuation all greatly influence marsh plant communities.

Vegetation within marshes can be manipulated to improve wildlife habitat using various management practices, including: fire, livestock grazing, blasting with explosives, and the use of herbicides. Mechanical practices such as mowing, discing, crushing, or physically displacing marsh bottoms
with machinery (e.g. level ditching) may also be used. Linde (1969), Weller (1978), and Linde (1985) provide excellent summaries of marsh management techniques. A primary concern for marsh managers is to maintain a desirable mix of vegetation and open water. Too much emergent vegetation is the most common problem in the man-made marshes at Malheur Refuge.

**WATER MANAGEMENT**

Marshes are extremely complex and dynamic systems and are continually changing, even when water conditions remain stable. If stable, permanent water levels are maintained, marshes generally progress from densely vegetated with emergent plants, through a hemi-marsh phase, toward open water with only an emergent fringe in shallow shoreline areas. For wildlife productivity, stability is deadly to a marsh system (Weller 1978).

**Drawdown**

This tool involves temporarily draining water off a marsh. It is effective in establishing emergent and other "moist soil" vegetation and can be used to encourage emergents in areas lacking a desirable amount. Drawdowns are also used to reinvigorate submergent plant communities, as they lead to aeration and consolidation of bottom soils which increases nutrient availability to rooted, submersed plants when the area is reflooded (Kadlec 1962). For best results, soils should be maintained moist throughout the drawdown period to maximize decomposition of organic sediments. Weller and Fredrickson (1974) recommend 5-7 years as a drawdown frequency.

Management of annual plants which germinate following drawdown has become an art in wetland management and is described by Fredrickson and Taylor (1982). This practice is termed "moist soil management" and involves timing of drawdowns to encourage germination of desirable annual plants which are later reflooded for use by waterfowl and other wetland species. Generally, moist soil management areas are de-watered in spring, and irrigated or shallow flooded during the growing season to promote an abundant seed crop. These areas are flooded at a deeper level during late summer or fall and are used primarily as feeding areas by waterfowl and other waterbirds through the fall and winter periods.

**Drought**

A longer term drawdown could be termed a prescribed drought. Droughts produce fairly rapid change in plant communities and generally cause replacement of wetland vegetation types with terrestrial vegetation types. Prescribed droughts can be effective in reducing or eliminating undesirable wetland vegetation and can lead to improved marsh conditions following reflooding. To be effective, the drought should last longer than one growing season.

**Deep Flooding/Drowning**

Generally, the greater the water depth, the greater the trend for open water areas to develop. Emergents rapidly disappear when water depths exceed
their tolerances. Totally flooding emergents through the dormant season can result in mortality of tubers and rootstocks resulting in effective control. The most practical technique is to use a tool which removes all above-ground biomass (e.g. mowing or burning) and then flood the treated area, depriving the rootstalks of access to oxygen by removing emergent stems. The control effort can be enhanced by increasing water depths and duration of flooding.

**VEGETATION MANAGEMENT - EMERGENTS**

Treatments which remove emergent cover generally don't significantly change marsh composition unless they are effective in causing plant mortality. Most treatments only remove above ground biomass, leaving living tubers and rootstocks below ground for regrowth the next year. Good emergent control can be attained by using a cover removal treatment, followed by deep flooding.

**Mechanical Tools**

The use of mechanical tools (mowing, discing, crushing) for emergent control has been described by Nelson and Dietz (1966), Weller (1975), Linde et al. (1976), and Linde (1985). These tools require the area to be dried, or using machinery specialized for use in wet marsh areas. These treatments generally remove only above ground vegetation, leaving living tubers and rootstocks below ground for regrowth the next year. Treatments should be followed with deep flooding to achieve effective control. Use of these tools can result in a very specific and selective treatment.

Mowing can be very selective and efficient as an emergent removal tool. Mowing of emergents is difficult and hard on mowing equipment because of the dense vegetative structure. It is easier to mow if the area to be treated is burned prior to the treatment. Mowing does allow very close cutting of emergent stems which yields very effective control after flooding. The major disadvantage of mowing is that the treatment is expensive and time consuming.

Crushing has also been shown to be a selective treatment. It involves the use of heavy equipment such as a dozer or a tractor with a heavy drag to crush emergent vegetation. Crushing generally isn't as effective as mowing; however, much larger areas can be treated for the same amount of time and effort, making it an attractive method for emergent control.

Discing is another effective emergent cover removal tool which usually requires burning prior to treatment. Optimum control is achieved with deep plowing or rototilling in hot weather to desiccate exposed tubers. This is a very expensive and labor intensive practice.

**GRAZING**

An excellent summary of the impacts of grazing on marsh habitats is provided by Kantrud (1986). Cattle and horses are appropriate animals for use in marsh grazing. Dormant season grazing doesn't generally alter marsh composition except for short term changes in structure, which are primarily
Grazing impacts can be intensified during this period by attracting cattle into marsh emergents by providing salt, protein supplements, or hay within the emergents.

Growing season grazing can affect emergent composition. Schultz (1987) experimented with cattle grazing during the growing season to create openings in dense cattail. He found cattail stem density decreased and invertebrate numbers and duck pair use increased following grazing. Although his grazing treatment did not produce a permanent reduction in cattails, he felt more intensive grazing during the growing season (greater than 3.75 AUM/acre) or sequential annual treatments should bring about longer lasting effects. To be most effective, grazing should occur when plant reserves are low as during flowering (Linde et al. 1976). Emergent marsh vegetation is generally not selected by cattle, and they must be forced to utilize this type of vegetation. Grazing has advantages over other treatments in that dewatering isn't necessary and it isn't as expensive as are mechanical control methods.

**BURNING**

The use of fire to manipulate emergent vegetation has been thoroughly described by numerous authors (Lynch 1941; Linde 1969; Vogl 1980; Linde 1985; Young 1986). Kantrud (1986) provides an excellent review of the effects of marsh burning on breeding waterfowl. Generally, marsh burning that leads to increased habitat heterogeneity results in increased use by breeding waterfowl. Emergent burning usually leads to increased protein in plants during the following growing season (Smith et al. 1984) which, in turn, makes plants more attractive to muskrats and grazing waterfowl. These "aquatic herbivores" may alter marsh communities by their grazing activities following a burn (Smith and Kadlec 1985a).

Generally, two different types of marsh burns are recognized (Young 1986): (1) cover burns which remove above ground plant biomass, and (2) subsurface burns which oxidize materials within the soil (peat burns).

Cover burns generally only remove above ground materials, usually leaving below ground rootstalks and tubers of marsh emergents undamaged. Cover burns alone generally don't alter vegetation communities within marshes and only cause short-term changes in plant productivity due to release of nutrients during the burn. Young (1986) studied the effects of dormant season burning on marsh emergents at Malheur Refuge. He concluded that the timing of the burning during the dormant period had little effect on results in growth of emergents the following spring. Generally, burning resulted in increased above ground standing crop, increased shoot densities, and decreased shoot weight for two years following the burn for all marsh emergents with the exception of burreed, which burning did not seem to significantly affect. Cover burns can be used to remove excess litter and stimulate new growth within marshes, and have been used in conjunction with mechanical methods (cutting or discing) to achieve changes in plant communities. Nelson and Dietz (1986) used cover burns to allow easier mowing or discing of areas that were later flooded to control cattails. Burning, alone, can lead to increases in emergent biomass due to the
release of nutrients (Smith and Kadlec 1985b). To control emergent vegetation, burning should be supplemented with a mechanical treatment (e.g., cutting) and flooding to drown rootstalks and tubers.

Young (1986) provides burning prescription recommendations for use in planning cover burns in marshes during the dormant season.

Peat burns can be effective in controlling emergents by killing tubers and rootstalks. They generally deepen marsh areas as organic peat soils are turned to ash. These burns require very dry soil conditions and are generally achievable only following a long dry period. Peat burns are difficult to manage and have been known to burn underground for months (Vogl 1980). The ability to rapidly flood the area is a pre-requisite for control of peat burns.

HERBICIDES

Application of herbicides to control emergent marsh vegetation has the advantage of being highly selective and may be cost-effective in some situations. Currently, only glyphosate is registered by the Environmental Protection Agency for use in aquatic environments. This herbicide has been found to be safe in its effect on the environment. It rapidly breaks down into relatively harmless compounds of carbon dioxide, nitrogen, phosphate, and water.

Solberg (1989) conducted a study at Waubay Wetland Management District in South Dakota to determine the value to breeding waterfowl of glyphosate herbicide treated stands of dense cattail. Glyphosate was used to create openings in dense cattail stands. His results showed positive responses of breeding waterfowl by increased use and nest densities in glyphosate treated cattail stands. Jones and Lehman (1986) describe the use of glyphosate to control common reed.

BLASTING

The use of explosives to create openings within dense marsh emergents is termed pothole blasting. This was first accomplished with the use of dynamite (Scott and Dever 1940), but the use of ammonium nitrate-fuel oil (AN-FO) mixtures as a blasting agent has become more popular in recent years (Mathisen et al. 1964). Hopper (1978) studied waterfowl use and longevity of blasted potholes in Colorado and provided recommendations to consider for management. He recommended larger potholes over the smaller ones (created by a 150-lb. AN-FO charge) and provided guidelines for conducting pothole blasting. This procedure may prove a valuable treatment in some situations. The method is generally inexpensive, but the procedure is labor intensive for the amount of open areas created by the charges.

MUSKRATS

Muskrat populations are beneficial in creating openings in marsh emergents and increasing habitat diversity within the marsh. Their lodges built of emergent vegetation within the marsh provide floating platforms which are
used as loafing sites by many species of waterfowl and waterbirds. Muskrats can also be very destructive to artificial wetlands, by causing washouts of dikes and water control structures through their burrowing activities. Drawdowns of artificial marshes can force muskrats to seek shelter by burrowing into dikes adjacent to borrow ditches. Mathiak and Linde (1956) suggest using level ditching to maintain muskrat populations during drawdowns. They recommend providing zig-zag ditches with alternating spoil banks within marshes to serve as den sites for muskrats. This practice should attract muskrats to the level ditches and away from the managed dikes during drawdowns and lessen damage to facilities.

**VEGETATION MANAGEMENT — SUBMERGENTS**

Submergent plant communities within marshes are very dynamic and respond to soil and water chemistry, amount of light available, nutrient availability, water temperature, and grazing by wildlife. Kadlec (1962) summarized the general ecology of submergent aquatic plants. He found that marshes generally become unproductive in 4-5 years without a nutrient recycling drawdown. Over time, marsh soils become increasingly anaerobic and tend to develop unconsolidated bottom soils. Build-up of organic material binds up marsh nutrients, and overall productivity declines. Anaerobic conditions develop, favoring duckweeds. Floating leafed pondweeds tolerate unconsolidated soils which may have too few available nutrients for other aquatic submergents.

Drawdowns lead to increased nutrient availability due to decomposition and aeration of bottom sediments, and bottom soils become consolidated. Aerobic conditions favor most rooted submergents. During drawdowns, decomposition of organic sediments is maximized in wet areas; therefore, marsh soils should be moist (but not flooded) through the drawdown phase.

**CARP**

Any fish in a marsh competes with waterfowl and waterbirds for submergent invertebrate and plant foods. Carp, by their actions, are the most destructive fish in this regard. High carp populations are a detriment to waterfowl habitat. Their foraging, spawning and feeding habits increase water turbidity, and decrease macrophyte and invertebrate production, thus decreasing waterfowl food supplies (Berry 1983). The carp's primary foods are aquatic invertebrates. They directly compete with waterfowl and waterbirds for those resources.

Sigler (1958) found midge larvae (Chironomidae) to be the most important food in carp diets in Utah. Chironomids are also important foods to breeding ducks and ducklings and have also been shown to be important foods for mallards, northern pintails and green-winged teal during the non-breeding season as well (Euliss and Grodhaus 1987).

At Malheur, carp have been recognized as a serious problem, limiting waterfowl production and use since their invasion into Malheur Lake in 1952. Before carp invaded the refuge, duck production averaged over 111,000 ducks produced annually in the 1940's, and peaked at 147,000 ducks produced in
1948. During the years after the carp population became established, duck production has averaged less than 30,000 ducks produced annually. Spring and fall migrational waterfowl use of the refuge has followed similar trends.

At Malheur, periodic carp control programs, using rotenone, were carried out to improve waterfowl habitat. The control programs were unsuccessful in eliminating carp, but resulted in low carp populations for two to four years following treatment. The first control effort was initiated in 1955 with subsequent major programs in 1961, 1969, and 1977. The last rotenone treatment cost over $200,000 for the chemical and aerial application. Since then chemical and application costs have substantially increased.

Although these carp control efforts failed to eliminate carp from Malheur Refuge, they were successful in enhancing habitat for waterfowl for a few years, until carp populations rebounded. Sago pondweed acreage in Malheur Lake have been mapped since 1955. Ivey and Paullin (1985) found acreage of sago pondweed were six times greater for two-year periods after rotenone was applied on Malheur Lake than before. Concurrent with increases in sago pondweed following carp control efforts, waterfowl use and production increased. Diving duck use was four times greater and tundra swan use was two times greater for two-year periods before and after rotenone treatments on Malheur Lake. Ivey and Paullin (1985) also found a significant positive correlation between pairs of diving ducks and acres of sago pondweed in Malheur Lake from 1972 to 1984. They also found a significant positive correlation between diving duck use and sago pondweed acres in Malheur Lake since 1975, and between tundra swan use and sago pondweed acres in Malheur Lake since 1956. Cornely (1980) found a significant positive correlation between refuge diving duck production and sago pondweed acres on Malheur Lake.

Carp infestation is very difficult to control. Only a few carp in a system have the ability to saturate the habitat within three years. Rotenone is an effective chemical for providing temporary carp control; however, it is expensive and it rarely results in total control. The best technique to control carp, where feasible, is to drawdown the marsh, however, benefits may be short term if re-invasion of carp is not prevented. Carp barriers can be used to stop or slow re-invasion of carp into marshes and may extend the productivity of an area for several years.

MEADOW HABITAT

Meadows are a transition habitat between deep water marshes and uplands. They are attractive to a wide variety of wildlife that includes both aquatic and terrestrial species, and they serve a variety of wildlife needs. Residual meadow vegetation serves as a nesting substrate for early nesting ducks such as mallards and cinnamon teal. Treated meadow vegetation (mowed, grazed, burned) provides high protein browse for a large variety of birds and other wildlife during the early spring period, when high protein feed is needed for egg-laying. Theoretically, treated meadow sites receive more solar radiation, resulting in early warming of soils and earlier availability of important invertebrates for food. These treated meadow
sites on Malheur Refuge generally support high waterfowl and crane use during the early spring period.

Vegetation within meadows can be manipulated to improve wildlife habitat using various management practices, including: water management, mowing, livestock grazing, burning, and the use of herbicides to control undesirable plants. The impact of each of these practices on meadow vegetation and wildlife are summarized below:

Water Management

The single most important factor affecting both meadow vegetation and the wildlife that use it is the presence or absence of water. Production of meadow vegetation is generally hampered by too much water during the early part of the growing season and shortages during the latter part. The influence of water on meadow vegetation in the Harney County has been summarized by Rumburg and Sawyer (1965). The key points of this paper were:

1) Hay yields from native wet meadows increased with increased length of continuous wild-flood irrigation as long as the water was 5 inches or less above the soil surface.

2) Water levels of 7.5 inches above the surface were detrimental to yields if they persisted 50 days or longer.

3) Delaying irrigation by two weeks at the beginning of the season and extending it two weeks at the end increased yields by 0.25 tons per acre.

4) The highest yields were obtained from plots flooded 2.5 inches for 75 days.

Plant species diversity in meadows decreases with increased irrigation (Rumburg and Sawyer 1965). The least tolerant of water are grasses and forbs followed by sedges. The most water tolerant meadow plants are the rushes which generally increase with increasing water within the limits outlined above.

In addressing the issue of livestock forage quality, Rumburg and Sawyer (1965) stated, "There is a general tendency to assume that hay high in rush or sedge composition is of inferior quality compared with hay high in grass composition. There is little basis for this assumption.....nitrogen content increased with increasing depths and lengths of flooding".

Typically, refuge meadows have been irrigated in the spring and early summer then drawn down in late summer. Meadows are capable of regrowth after they are hayed if they are reflooded in late summer. This regrowth of meadow vegetation can be very attractive to geese and ducks during fall.

Mowing

Mowing is the primary mechanical tool used in meadows. From a vegetative
standpoint mowing has several impacts:

1) it basically shuts down plant growth for the growing season
2) it removes both residual and new growth
3) it exposes the soil surface to increased insolation and evaporation
4) it stimulates early new growth.

Locally, the primary interest in meadow hay from an economic standpoint is the quantity and quality of refuge hay that can be used by permittees for winter feeding of cattle. The protein content of meadow hay decreases as the hay date is delayed (Cooper 1956). In essence, earlier cut hay produces higher quality forage (Rumburg 1963). In a study conducted near Burns, Raleigh et al. (1964) concluded, "...that native flood meadow hay in this area (Harney County) should be harvested in early July to attain maximum livestock production per acre." Owen (1975) found that mowing had no significant effect on the nutritive value of new vegetation the following growing season.

From a wildlife habitat standpoint mowing of meadows provides several benefits:

1) it creates habitat diversity
2) it can be very selective relative to location of treatment
3) it allows early warming of soils in the spring which facilitates earlier green-up and invertebrate production
4) irrigation water spreads quicker in mowed sites
5) mowing invigorates new growth in meadows which is reflected by taller, more erect, lusher vegetation which can be used by wildlife as food and cover.

Some disadvantages of mowing meadows are:

1) it requires de-watering 10-14 days prior to mowing
2) it removes residual nesting cover for the following nesting season which is attractive to many ground nesting birds (particularly early nesters)
3) it removes detritus, an invertebrate food source
4) if the hay is hauled off site it represents a net nutrient loss to refuge fields.

At the invertebrate level it has been shown that mowing decreases total biomass production by removing detritus but increases invertebrate species
diversity (Kaminski and Prince 1981). Compensation for these disadvantages is that mowed soils warm sooner, and invertebrates become available earlier for breeding birds which rely on them.

Mowed sites, particularly if they are shallow flooded, are preferred feeding areas for geese, sandhill-cranes, many dabbling-ducks and several marsh and shorebird species. In studying white-fronted geese, Owen (1975) found that mowed sites were preferred feeding areas, particularly early in the season and related this preference to ease of movement, better visibility, and feeding efficiency. Vegetation height was the most important factor in goose foraging ecology.

Timing of Mowing - Mowing of meadow habitat can result in wildlife mortality, caused by direct contact with the mowers blades, and indirectly by increasing their vulnerability to predators which are attracted to mowed areas. Mowers are particularly a threat to active bird nests and young on the ground. Timing of mowing is a critical factor in order to minimize these negative impacts on key wildlife species. The earlier the mowing schedule, the greater the negative impacts to wildlife; and conversely, the later the mowing, the less the nutritional value of the hay.

Another detriment to wildlife associated with mowing is the dewatering that is required 10-14 days prior to mowing to allow equipment access into the meadows. Such dewatering eliminates brooding, feeding, loafing, molting opportunities for most of the birds that use flooded meadows. In addition, drawdowns displace broods and molting birds thus increasing exposure to predators. The earlier the drawdown schedule the greater the impact to both the number of birds and species involved.

Table 2 illustrates the breeding chronology of five key migratory bird species, based on unpublished refuge data. Generally, most duck nests hatch by mid-August and broods move to wetter areas. By mid-August, about 85 percent of sandhill crane colts are fledged in a normal year. However, there is a lot of variation in breeding chronology between years and birds may fledge earlier or later in a given year. Sandhill cranes, pheasants, some shorebirds, and many passerine birds brood their young in meadows. These birds are particularly vulnerable to mowers.

To minimize conflicts with breeding birds, August 10 has been selected as the standard refuge mowing date. This date is a compromise between the desire to minimize wildlife losses and the desire to provide open meadow habitat needed for wildlife using a low-cost, and economically viable tool. The vast majority of refuge permits will prescribe this date for mowing meadow hay. Mowing will be allowed earlier in some fields in order to meet management objectives (e.g. control of noxious weeds), and may occasionally be delayed to protect late sandhill crane colts. These exceptions will be evaluated on a case-by-case basis.
Table 2. Nest chronologies of sandhill cranes (GSC), mallards (MALL), cinnamon teal (CT), gadwalls (GAD), and redheads (RED) at Malheur Refuge, based on unpublished nest data, 1974-1988.

<table>
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<th>Date</th>
<th>Percent of Nests Hatched</th>
<th>Percent of Broods Fledged</th>
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<td></td>
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<td>MALL</td>
</tr>
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<tr>
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<td>100.0</td>
<td>99.7</td>
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<tr>
<td>Aug. 15</td>
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Grazing

Cattle grazing in waterfowl production habitat (including meadows) has been studied more than any other habitat management tool employed at Malheur Refuge. Among the more common disadvantages of grazing meadow habitats documented in the literature are:

1) puddling of soil (Griffith 1964) and decreased water

2) dike and levee degradation (Chabreck 1968)

3) increased water turbidity resulting in decreased submerged aquatic plant production (Low and Bellrose 1944; Chamberlain 1948; Jahn and Hunt 1964; Bue et al. 1964)

4) competition with waterfowl for food resources (Chabreck 1968, Gjersing 1975)

5) undesirable changes in vegetative composition that favor non-palatable or weedy species (Bennett 1938, Bue et al. 1952, Griffith 1964, Chabreck 1968)

6) decreased carrying capacity for duck breeding pairs (Bue et al. 1964, Drewien 1968, Kirsch 1969, Smith 1971)


9) increased soil erosion by wind, water and gravity (Stoddart et al. 1975)

10) decreased carrying capacity for duck brooding (Gjersing 1975).

In summarizing Braun et al. (1978) reported that at least 55 waterfowl studies have shown livestock grazing to be detrimental to waterfowl production and that they knew of only one study (Burgess et al. 1965) that reported higher success of nesting ducks on moderately grazed areas than on idle lands.

Most of the studies cited above (except the Malheur studies) dealt with grazing during the duck breeding season, a time when direct conflicts between the needs of cattle and ducks can be great. At Malheur, cattle grazing has primarily been conducted as a fall/winter program, so cattle
aren't present during the breeding season and impacts of the grazing program on breeding waterfowl and other wildlife are indirect.

Some advantages of grazing meadows are:

1) intensity can be regulated

2) it can provide habitat diversity and patchiness, particularly in areas of higher precipitation (Ryder 1980)

3) most of the nutrients removed by grazing are kept in the field via animal excreta

4) it can trample seeds into soils, increasing chances of successful germination (Laylock 1967)

5) cattle dung hosts invertebrate production which in turn can be utilized by wildlife as food,

6) it can be used throughout the year under a variety of weather and water conditions

7) grazing can stimulate growth of new vegetation.

A study of Malheur Refuge land use in relation to spring waterfowl use was initiated by Ivey in 1988. Paired plots of different land use were established and waterfowl were counted weekly during April and May. One set of plots comparing rake-bunch grazing and idle management was established in 1990. A preliminary analysis of data from these two paired, 800 ha plots, showed duck numbers to average 6 times higher in April, and two times higher in May on the grazed plot in comparison to the idle plot. Canada Goose counts were 17 times higher on the grazed plot versus the idle plot. Although these results are preliminary, they support the idea that management of the Blitzen Valley meadows should entail providing a variety of treatments to meet the various needs of migratory birds for feeding and nesting.

The traditional fall-winter cattle grazing on Malheur Refuge meadows has occurred in one of four ways: graze only (GO), rake-bunch grazing (RBG), baled and fed (BAF), or stacked and fed (SAF). In GO, cattle are simply turned out in unmowed meadows and allowed to graze as they choose. In rake-bunch grazing, meadow hay is mowed and raked into windrows but left in place for cattle to feed on. The cows are free to feed on the cut hay or uncut vegetation in the field. In BAF, meadow hay is cut and baled in large bales (1000+ lbs) which are left in the field for cattle to feed upon. In SAF, meadow hay is cut and stacked loose or baled in fenced stack yards within the field and fed out on a daily basis. The advantages and disadvantages of each are discussed below.

The graze only treatment has the advantage of flexibility. By regulating stocking rates, the GO treatment can be light, moderate or heavy. Through the selective grazing behavior that cattle exhibit, habitat diversity within
fields is created (i.e. some areas are grazed heavy, some light and some not at all). Economically, the GO treatment is the least labor intensive for the permittee since it does not require moving, baling, stacking or feeding. Also, GO does not require dewatering, therefore the tool can be used in the spring and summer when meadows are wet. A disadvantage of the GO treatment is that it is more difficult to control than haying.

A major advantage of any mowing to the permittee is that it "fixes" protein content at a higher level than if the same vegetation was allowed to cure in the field uncut. Thus, in the RBG treatment, cattle are attracted to the higher protein in cut hay. This can be used to direct grazing pressure away from areas (e.g. uplands) that do not need to be grazed. The RBG tool is less expensive to the permittees than the BAF or SAF treatments.

Disadvantages of RBG is that:

1) it requires dewatering

2) it doesn't always keep grazing pressure off sensitive uplands. For example, if fall rains cause green-up in upland vegetation cattle commonly abandon the RBG hay and feed heavily in the uplands. In addition, if deep snows make RBG hay difficult for cattle to find then they will commonly shift to uplands to forage on erect vegetation. RBG is just not as selective as HO, SAF, or BAF.

The BAF treatment is relatively new at Malheur Refuge. The baled hay is fed in the same field where it is cut, however, the bales can be and are moved where grazing pressure is desired (e.g. in a dense stand of emergents that need to be opened up). The primary advantage of the BAF treatment is increased selectivity and refinement in the field prescription. Disadvantages are:

1) cattle impacts at the feeding site (e.g. trampling) can easily become extreme

2) increased permittee cost

3) it requires dewatering to facilitate mowing.

The SAF treatment generally involves moving bales from where they are cut to an adjacent field where they are fed. This provides an increased level of selectivity and refinement in field prescription not afforded by the other haying and grazing tools. The primary disadvantage with SAF is the increased permittee expense.

Traditionally, meadow grazing on Malheur Refuge has been conducted during the dormant fall-winter season. Dormant season grazing affects plant structure by removal, trampling or bedding.

Grazing during the growing season can affect species composition, but its use on Malheur Refuge has been limited to experimental trials. The advantage is that it can create habitat diversity during the important
spring-summer nesting and brooding season without dewatering. The primary disadvantage is that cattle in wetlands during the spring-summer period cause both direct and indirect impacts to wildlife (e.g. disturbance, trampling) that are using those wetlands. Because growing season grazing has been used so little at Malheur Refuge its overall potential as a habitat management tool warrants further study.

**Burning**

Fire effects in meadows have been studied at Malheur Refuge by Young (1986). In meadows he studied sedge, Baltic rush, and spike rush. Among his findings were that dormant season burning:

1) increased above ground standing crop for at least 2 years after burning
2) increased shoot densities
3) increased reproductive effort (inflorescences) in sedge but not in rush or spike rush. In short, fire rejuvenates meadow vegetation.

Advantages of fire in meadows are:

1) fire is a natural ecological process
2) it creates habitat diversity
3) it can be relatively inexpensive in some situations
4) a wide variety of wildlife respond very favorably to burns, particularly for feeding.

Disadvantages of fire are:

1) it is sometimes very expensive to plan and execute
2) the threat to other property and resources can be high
3) clean hot burns can decrease habitat diversity by making fields homogeneous
4) it removes nesting and escape cover thus causing short term impacts to species needing residual cover
5) it removes detritus used by invertebrates.

**Herbicides**

Herbicides have been used selectively in some meadow habitats on Malheur Refuge to control noxious weeds such as Canada thistle, whitetop, and perennial pepperweed.
IV. MANAGEMENT, HABITAT STANDARDS, AND HABITAT OBJECTIVES

RIPARIAN HABITATS

Management of Rivers and Streams

The following management considerations apply to refuge rivers and streams:

1. Assessments of stream banks, stream beds, stream channels, and riparian habitats should be conducted for all refuge rivers and streams.

2. Streambank stabilization practices should be applied to problem areas as outlined by Storch (1979), Lines et al. (1978), Nunnally (1978) and Sheeter and Claire (1981). Stream bank stabilization will enhance adjacent riparian areas by elevating water tables and curbing erosion, and will also reduce siltation, particularly into Malheur Lake.

3. Exclude livestock from these areas by either fencing or treatments such as hay only or non-use of adjacent fields. Moring et al. (1985) recommended using ungrazed buffer strips of at least 23m (75 ft.) along watercourses to protect stream values.

4. Plant native species of riparian trees and shrubs to speed recovery of selected areas. The goal in these areas should be to maintain at least 60% of the area along water courses in mixed woody riparian habitat where possible.

5. After recovery of these areas, it may become necessary (on rare occasions) to stimulate decadent stands of riparian vegetation. Before applying any treatment extensively, experimental treatments using fire, mechanical disturbance, grazing or various combinations should be tried on small plots to determine the best approach.

Oregon/Washington Interagency Wildlife Committee (1979) described optimum fish and wildlife habitat conditions for streams and riparian habitats in eastern Oregon and Washington. They listed the following standards:

1. Stream surface shaded. Between 60% and 100% of the stream surface should be shaded from June to September between 10 AM and 4 PM.

2. Stream bank stability. Stream banks should have 80% or more of their total lineal distance in a stable condition.

3. Stream bed sedimentation. No more than 15% of stream substrate should be covered by inorganic sediment.

4. Grass-Forb cover. Riparian zones should provide at least 80% of the site enhancement potential.*

5. Shrub Cover. Riparian zones should provide at least 80% of the site enhancement potential.*
6. **Tree cover.** Riparian zones should provide at least 80% of the site enhancement potential crown cover for sites that would naturally be dominated by trees. For riparian zones that naturally contain only a few trees per acre (20 or less), optimum tree cover for wildlife is considered to be 100% of potential.

(*Site enhancement potential is defined as a subjective estimate of the potential vegetative production, natural or introduced, as determined by the evaluating team.*)

These standards pertain to fish more than wildlife, and it is appropriate to apply them to streams which support redband trout in the Blitzen Valley.

**Management of Woody Streamside Habitats**

The following standards apply to woody riparian vegetation along streams as habitat for birds and other wildlife:

1. At least three distinct layers of vegetation should be evident in the riparian zone.

2. More than three separate riparian shrub and tree species should occur interspersed along each reach of stream.

3. Continuous woody riparian habitat should occur along at least 60% of each side of stream within each stream reach.

4. At least half of the woody riparian habitat along each reach should provide 100% shade (a measure of foliage density).

Specific guidelines for management of woody riparian habitat for Willow Flycatchers are listed in the Key Species appendix.

**Priorities and Objectives for Rivers and Streams**

Unchannelized reaches of refuge rivers and streams provide the greatest potential for providing high quality woody riparian habitats. These areas have the potential to provide vegetation with a wide range of structural diversity (an important factor in maintaining species richness), as well as high quality fish habitat. Riparian bird species and redband trout will have the highest priority in management considerations in these areas.

**Blitzen River—Page Springs Dam to Bridge Creek**

This reach of the river suffers from numerous cut-bank areas and is generally unstable. This area is unchannelized, although several irrigation dams impact its hydrology. Riparian vegetation ranges from poor to excellent condition, and the area supports a good mix of trees and shrub species. Much of this reach is in an arroyo state, with a low water table. The primary management need is to stabilize
streambanks in this reach, through practices including the use of juniper tree rip rap on cut banks, plantings of native trees and shrubs, and installation of gabions, deflector structures, and other engineering features to limit bank cutting.

**Blitzen River-Busse Dam to Springer Dam**

This reach of the river is in very poor condition and contains very little woody riparian habitat. It is generally a deep arroyo with a low water table. Many of the willows along the river appear decadent and many have died. There is very little plant species diversity in woody riparian habitat. Numerous cut banks are present. The primary problem here has been past water management. Due to water diversions for refuge irrigation upstream, the function of this reach of the river has been drastically altered, making it difficult for woody riparian habitats to become established.

The recommended management for this area is to exclude cattle to protect riparian growth and encourage expansion. Stream banks need to be stabilized and the water table needs to be raised during the growing season along much of this reach. Because of the need of water for irrigation of upstream refuge habitats, it is unlikely that significant improvements in woody riparian habitats will occur here in the near future.

On the Blitzen River, a minimum 400' corridor (200' on each side) should be managed as riparian habitat along unchanneled reaches. These areas total approximately 26 miles and include about 1280 acres.

**Channelized reaches of the Blitzen River**

These areas have low potential for high quality riparian habitats because they are channelized and usually have dikes and roads on both sides of the river. However areas with good woody riparian growth do support high populations of willow flycatchers. Plantings of native trees and shrubs would help stabilize banks and provide a narrow band of habitat; however, plantings should not be placed in areas where conflicts with other facilities can occur (e.g. irrigation structures, major roads).

**Bridge, Mud, and Krumbo Creeks**

These creeks have riparian habitat ranging in condition from poor to good. The primary management need for these areas is to eliminate livestock grazing. These areas should be enhanced with native tree and shrub plantings to hasten recovery.

On Bridge and Mud creeks, all of the areas between the refuge boundary and the East Canal, and within the rimrock, paralleling each side of the creeks will be managed as riparian habitat (approximately 170 acres). Also, Bridge Creek from East Canal to the channelized portion
will be managed as riparian habitat using a 200' corridor (100' on each side). This totals about 60 acres. For Krumbo Creek, all the area between the adjacent rims and from the refuge boundary down to Krumbo Reservoir will be managed for riparian habitat (approximately 40 acres). These areas to be managed for streamside riparian habitat total 1550 acres (about 1% of total refuge).

All major springs in the Blitzen Valley

Although most of these areas currently lack woody vegetation, these springs have the potential for providing excellent woody riparian habitat. They should be planted with native shrubs and trees, and livestock should be excluded.

Management of Shrub-Willow Communities

Numerous shrub-willow communities (not associated with streams) are scattered in meadows throughout the Blitzen Valley. The following management standards apply to shrub-willow communities within refuge meadows where riparian habitat is to be emphasized in management:

1. Willows should be rounded in shape instead of angular and should not appear v-shaped.

2. These communities should contain good structural diversity with herbaceous or shrubby understory and a variety of willow height and age classes present.

3. These habitats should be maintained in the best possible condition given the management objectives of each area. For example, if a field is designated as primarily a sandhill crane production area and it is determined that grazing will enhance crane production, this decision will override concerns with grazing impacts on the willows. On the other hand, if riparian species are the primary objective, riparian habitat will be managed to provide optimum conditions for riparian species.

4. Important stands of shrub-willow habitat should be protected from conflicting uses (i.e. livestock grazing) by either fencing, hay-only or idle management of the area.

5. The size of areas that should be protected from livestock grazing and other conflicting uses will depend upon the importance of the site to riparian species and its location.

Shrub-willow communities should be maintained at least the current acreage in the Upper Blitzen Valley, and should be increased (at least two-fold) in the Lower Blitzen Valley. Most of these areas are fairly monotypic, even-aged stands. Although they don't provide much diversity, they are very important to some species (e.g. Willow Flycatchers, Yellow Warblers, Long-
The Upper Blitzen Valley contains the majority of the shrub-willow communities on the refuge. Shrub willow habitats here are generally in good to excellent condition, although some could be improved by excluding livestock. In contrast, the Lower Blitzen Valley shrub-willow communities are generally in poor to good condition. Many have been degraded by cattle grazing. Most of these areas could be improved and expanded by excluding livestock.

Management of Riparian Habitats along Facilities

These habitats should be managed to maintain high quality habitat following standards identified above where possible; however, when the presence of riparian habitat interferes with an important function of a facility (e.g. blocking an irrigation ditch) the riparian vegetation should be removed or modified to alleviate the problem.

No specific objectives for riparian habitat acres will be identified for riparian habitats along facilities (ditches, dikes, roads) because willows and other woody vegetation growing along irrigation ditches, on dikes and on roads can cause disruption of the major functions of those facilities. These habitats will be maintained in the best condition possible, but may be removed or severely reduced where conflicts with functions of important facilities develop. The following recommendations to these areas apply:

1. If woody vegetation interferes with a function of a refuge facility (e.g. restricting irrigation flow in a ditch, blocking a road) that vegetation should be removed.

2. It should be a policy only to eliminate vegetation that causes problems. When willow areas must be sacrificed temporarily to rebuild a dike or clean a ditch, etc., practices that will encourage fast replacement of riparian vegetation should be used, such as burying living branches to insure quick regrowth.

Management of Krumbo Reservoir

The fisheries management plan for Krumbo Reservoir (USFWS 1984) calls for planting willows along the shallows of the lake (to provide fish cover) and exclusion of livestock from the area to protect willow growth.
UPLAND HABITATS

Class I and II upland sites should be managed to provide optimum early season, residual nesting cover for species such as upland nesting ducks, pheasants, and Short-eared Owls. These sites should remain idle, except when periodic treatments are needed to reinvigorate vegetation and improve structure of nesting cover. Prescribed burning should be the primary tool used in these sites to reinvigorate vegetation.

Class III and IV upland sites don't have the potential to produce dense nesting cover. These areas should be managed to promote native vegetation in most cases. Crested wheat seedings fall in this category. Some of these seedings will be grazed intensively to provide goose browse, while others will be planted to shrubs and managed as winter deer range. For small areas of uplands within fields dominated by meadow or marsh habitat, grazing impacts will be accepted.

MARSH HABITATS

"It seems obvious . . . that a large wetland with complex zonation and layers, and with water areas of different sizes in emergent vegetation, should attract the greatest species richness and probably provide the best-fitted habitat for optimal populations" (Weller 1978). Managing marshes for habitat diversity should result in good habitat conditions for most waterfowl and waterbird species.

Seasonal Marshes

These areas should generally be managed to achieve hemi-marsh conditions (50-70% open water) with 50-70% open shore (patchy in distribution). Hardstem bulrush and burreed should be encouraged while cattail and common reed should be discouraged whenever possible. These marshes should be flooded in March and water should be maintained at fairly stable levels through the growing season (early September). Within sandhill crane territories, larger, more contiguous emergent stands (1-2 acres) should be maintained for crane nesting.

Semi-Permanent Marshes

These marshes should be managed to achieve hemi-marsh (50-70% open water) conditions. Submergent plants in open water areas should receive management emphasis. Water levels should be maintained all year except for periodic prescribed drawdowns or deep flood periods for habitat enhancement. Some large stands (greater than .5 acre) should be maintained (preferably hardstem bulrush) for use by colonial nesting waterbirds whenever possible.

MEADOW HABITATS

A wide range of vegetation conditions, brought about by a diversity of treatments, should be provided in meadow habitats to serve the diverse needs of wildlife. Based on the professional judgement of refuge biologists, we consider a 60-40 mix of treated to idle meadow to be optimum for the
greatest diversity of key wildlife. Treated meadow vegetation (mowed, grazed, burned) provides early season feeding habitat for a wide variety of birds, while idle meadow vegetation can support high densities of nesting birds. Of the 20,139 acres of meadow in the Blitzen Valley, 40 percent (8,055 acres), in combination with upland and marsh nesting habitats, should provide more than enough habitat needed to support the densities of nests needed to meet refuge waterfowl objectives. Meadows which support both good nesting cover and feeding sites will support higher densities of breeding waterfowl and marsh birds.

Within-field diversity is more desirable than diversity between fields, and should be provided when feasible. Hay-only and spot burning can provide within-field diversity.

A buffer strip of 20–30 meters of idle meadow vegetation adjacent to uplands should be provided as nesting cover for ground nesting birds. Also, some idle or grazed-only meadow should be left in drier sites within fields. Wet meadow sites should receive the most intense treatments, because nests in these sites can be lost to flooding during irrigation.

Meadows should be fully irrigated by early March, when possible, to accommodate early nesting cranes, geese and ducks.

V. MANAGEMENT OPTIONS FOR HABITAT COMPLEXES

The proximity and interspersion of habitat types in the Blitzen Valley complicates management and often reduces management options. For example, grazing a meadow to provide a spring waterfowl feeding area may eliminate essential nesting cover on adjacent uplands. To minimize conflicts between management practices on adjoining habitats, we have defined five common habitat associations or "complexes" that have similar goals and where we would apply similar management strategies. Each field in the Blitzen Valley has been classified into one of the following habitat management complexes: (1) Upland/Riparian; (2) Meadow/Marsh; (3) Rangeland; (4) Brooding/Maintenance; and, (5) Management. The management strategies which have been developed for each of these complexes provide guidance for development of prescriptions for each field.

UPLAND/RIPARIAN COMPLEX

Fields containing significant amounts of high potential upland habitats and/or woody riparian habitats have been assigned to this habitat complex. Management emphasis in these areas is to maintain high quality residual nesting cover for early spring nesting, and to maintain riparian habitats in good condition.

Management of upland and riparian habitats will be dominated by the idle strategy. Treatment frequency for these areas will be determined by monitoring vegetation vigor. Prescribed burning will be the major tool used to reinvigorate uplands. A very light intensity rake-bunch grazing treatment may prove to be an appropriate treatment of some fields within this complex.
For meadow habitats within this complex, 40-60% of the area will be treated, primarily by hay only or spot burning. These treated areas will serve as early spring feeding sites for waterfowl, cranes and a variety of other birds, and will provide high protein vegetative and invertebrate foods necessary for egg laying. As a general rule, a buffer of idle vegetation of 10 - 20 meters will be maintained between uplands and meadows to serve as nesting cover for meadow nesting species.

Marshes will be managed using chemicals, mechanical manipulation, or fire, in conjunction with water management, as needed, to create open water areas in rank emergent vegetation. Mowing along emergent marsh and meadow ecotones will be encouraged to provide open grassy shorelines and attract duck pairs.

MEADOW/MARSH COMPLEX

Fields assigned to this complex are dominated by marsh and meadow habitat types and lack significant amounts of high quality uplands or woody riparian habitats. Management emphasis in these areas is to provide high quality meadow habitat (both as feeding and nesting sites), and also provide high quality marsh habitats.

Significant amounts of high quality upland or riparian habitats within fields of this complex will be protected from grazing by realignment of fences or by idle or hay-only management strategies. Low quality upland sites will not be protected from treatments.

Most meadow habitats (70-80%) in fields of this complex will be subject to frequent, high-intensity treatments using grazing, mowing or burning. Selected meadow areas will be managed as early season idle nesting cover which will be achieved via idle, hay-only, or spot burning management strategies. In rake-bunch-grazed areas, about 20% of the meadow vegetation (in drier sites) will remain unmowed (graze-only treatment) to serve as nesting cover. Also, grazing intensity should be low in some fields to provide nesting cover.

Most marsh habitats in fields of this complex will be subject to graze-only treatments. Hemi-marsh and open water conditions will be emphasized for permanent marshes. Management strategies to achieve hemi-marsh conditions will include grazing, mowing, burning, and herbicide treatments. Some extensive blocks of emergent marsh nesting cover will be maintained as nesting cover.

RANGELAND COMPLEX

Fields assigned to this complex are primarily upland sites composed of low potential areas of native or introduced vegetation (e.g. crested wheat). The primary value of native rangelands sites is to serve as wildlife habitat for songbirds and big game mammals. Crested wheat areas can be managed to provide browse for Canada geese. No significant marsh or meadow habitats occur in these fields.
Native rangeland sites will be managed as idle to promote recovery of native vegetation. Some crested wheat areas will be intensively grazed by cattle to provide high protein grass for goose browse. Other crested wheat sites will be planted with native shrubs to enhance mule deer winter range. Streamside riparian corridors will be permanently excluded from grazing and plantings of riparian shrubs may be used to enhance recovery.

**BROODING/MAINTENANCE COMPLEX**

This complex covers farm fields, ponds, and areas to be managed as feeding or brooding sites. Management emphasis will be on providing quality feeding areas for wildlife, especially cranes, trumpeter swans, and duck broods. No significant areas of riparian or upland habitats occur in fields of this complex.

Ponds will be managed to provide optimum food production, either as submergent aquatics, or as moist soil vegetation. For waterfowl brooding, ponds should be in hemi-marsh condition. Water management is most critical for ponds. Drawdowns and deep flooding are important tools in manipulation of pond vegetation. Muskrat populations need to be monitored and managed to achieve desired marsh interspersion. Carp control (drawdowns, installation of barriers, rotenone) will be needed in areas where carp populations impact aquatic food resources.

**MANAGEMENT COMPLEX**

This complex includes small areas which serve as facilities for managing cattle such as corrals, holding pens, barns, and stock yards; as well as residential areas and visitor facilities. These areas are needed to accommodate the various uses, pertinent to refuge management.
VII. Literature Cited

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