APPENDIX A

Available Management Techniques

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Appendix A: Available Management Techniques

Many techniques are available to create, protect, enhance, and manage wildlife habitats under the Northwest Power Planning Council's wildlife program. This section summarizes the primary techniques that may be implemented under some or all of the alternatives being evaluated in this EIS.

The techniques have been classified into 10 major categories:

- Resource Acquisition Techniques,
- Plant Propagation Techniques,
- Habitat Creation and Conversion,
- Water Development and Management Techniques,
- Water Distribution Techniques,
- Fire Management Techniques,
- Vegetation Management: Enhancement and Control,
- Species Management Techniques,
- Multiple Use Techniques, and
- Transportation/Access Techniques.

For each major category, a series of specific techniques is listed and described in the following sections. Each specific technique description includes an overview of the technique followed by a brief listing of some general benefits and drawbacks of the technique.

1 RESOURCE ACQUISITION TECHNIQUES

This section describes several techniques that may be used to obtain lands for wildlife mitigation.

1.1 Fee-Title Acquisition and Transfer

1.1.1 Overview of Technique

Fee-title acquisition and transfer is a three-step process: (I) directly purchasing property, (2) placing restrictions or protective covenants on the title, and (3) reselling or transferring ownership of the property. For the wildlife mitigation program, properties would most likely be transferred as trust lands to Tribal or state fish and wildlife agencies. Terms and conditions of long-term funding and management would be formally stipulated in a signed agreement between BPA and the management entity.

This approach can be used to protect important habitat areas, such as mule deer winter range, a waterfowl breeding area, or a high-quality native habitat (e.g., shrub-steppe).

1.1.2 General Benefits

- allows complete control of restrictions and covenants
- restrictions are usually permanent
- enhances tribal cultural values, and provides increased opportunity to practice traditional tribal activities

1.1.3 General Drawbacks

- higher expense than other land acquisition techniques
- may diminish local property tax base or revenue generation (e.g., forest products, agriculture)

1.2 Easement Acquisition

1.2.1 Overview of Technique

Easement acquisition is the purchase of partial rights to a property. Easements may be temporary; however, typically, perpetual easements are acquired for habitat management. The purchaser, referred to as the dominant tenant, owns the rights to specific aspects of use on the subject property, such as timber, grazing, mineral, or development rights. The seller, referred to as the servient tenant, retains the right for other uses of the land. The cost of the easement is derived from the difference between the assessed value of the property with and without the easement. Easements can be a very cost-effective approach to protecting habitat.

General types of easements that could be obtained include wetland and high-quality native habitat protection easements and forest and agricultural practices easements. Agricultural practices easements could stipulate the types and acreages of crops to be cultivated, defme the amount of cropland to be set aside for wildlife foraging areas, and set limitations on certain cropland management practices, such as fertilizer and pesticide use.

1.2.2 General Benefits

- potentially less expensive than fee-title acquisition and transfer in the short term (but long-term cost effectiveness may be higher, see below)
- potential for lower loss of tax revenues on commodity production

1.2.3 General Drawbacks

- limited management capability
- may provide less control over restrictions and covenants than does fee-title acquisition and transfer because a tenant is involved
- potential loss of tax and commodity revenues if lands are converted from crop or timber production
- possible loss of tax and commodity revenues if lands are converted from private to public ownership
- long-term cost effectiveness may be less than fee-title acquisition because the fewer options available under Easement Acquisition can result in lower habitat value gains (BPA 1993)

1.3 Long- Term Lease

1.3.1 Overview of Technique

Long-term leases involve leasing a property over a long period, generally for 50 years or more. The Canadian Wildlife Service has used this method to protect waterfowl habitat on private farmland in the prairie potholes of central Canada (Gilbert and Dodds 1987).

1.3.2 General Benefits

- allows flexibility for both owner and lessee
- less costly than fee-title or easement acquisition and transfer
- minimal or no loss of tax revenues

1.3.3 General Drawbacks

- not permanent
- possible loss of tax and commodity revenues if lands are converted from crop or timber production

2 PLANT PROPAGATION TECHNIQUES

Cultivation of desirable plants for wildlife is one of the most commonly employed active methods of wildlife habitat improvement. Four general techniques are available to propagate plants:
(1) transplanting, (2) seeding, (3) irrigation, and (4) fertilization.

2.1 Transplanting Vegetation

2.1.1 Overview of Technique

Transplanting vegetation involves the planting of established plants. Plants can range from seedlings to mature but typically involve 1- to 2-year-old plants. Plants may be planted by hand or by machine. Machines are best used for placing seedlings on relatively flat ground.

2.1.2 General Benefits

- can have a high success rate relative to other techniques, especially where seeding has failed
- significant results can often be seen within 5 years
- can be accomplished without major disturbance of the soil over a large area

2.1.3 General Drawbacks

- more time and labor intensive than seeding
- established plants cost more than seedlings or seed
- may not be necessary where natural regeneration occurs

2.2 Seeding

2.2.1 Overview of Technique

Seeding can be used to produce food or cover habitat for wildlife, create or simulate native plant communities, or stabilize exposed soils. The process of seeding for wildlife habitat improvement is typically similar to crop production, where first a seedbed is prepared by prescribed burning or by plowing, disking, or trenching. Where heavy brush is present, sites may be cleared by dragging a heavy chain over the planting area to break off or uproot unwanted shrubs. Disking may be used to augment soils with mulch or other materials. Seeds can be distributed either by hand, tractor (with drill, spreader, or other device attached), or fixed-winged aircraft or helicopter. Use of aircraft generally requires over 50% more seed (payne and Copes 1986).

After planting, many types of seed need to be covered to germinate. Covering is accomplished through mechanical methods (such as dragging a large chain or cable, or by harrowing) or through placement of mulch or other organic material on top of planted beds. Grazing in seeded areas is usually postponed until seeded plants are established.

Once seeds have been distributed and covered, fertilizer and/or irrigation may be needed to support survival and development (these techniques are described separately below).

2.2.2 General Benefits

- generally involves less labor than transplanting
- distributing seeds costs less per unit area than transplanting established plants

2.2.3 General Drawbacks

- seeds are more vulnerable to desiccation than established plants and may not survive on disturbed or otherwise open sites
- may take several years to reach program objectives

2.3 Irrigation

2.3.1 Overview of Technique

Irrigation involves the application of water on plants to encourage survival and growth. There are several irrigation methods that may apply to wildlife habitat enhancement. Central pivot irrigation systems involve a mobile irrigating pipe anchored to a central pivOL The pipe slowly moves as water is delivered, eventually covering a circular area, just like the sweep of the hour hand on a clock. Water cannons and sprinklers are another method used to deliver water. These are essentially grand versions of home watering sprinklers. Flat lands can also be irrigated through water diversions using a series of conveyance channels and rills (also called furrows). Water trucks can be used to apply water to small areas.

Because irrigation is relatively expensive, it is used sparingly in wildlife habitat enhancement projects. The most typical use is to support newly transplanted or seeded areas through the initial stages of establishment. Where water is readily available, irrigation becomes a more viable technique.

2.3.2 General Benefits

- can make the difference between success and failure of planting efforts in dry climates or if conditions become unexpectedly dry
- can accelerate the establishment of vegetation

2.3.3 General Drawbacks

- can be expensive, especially if water and irrigation equipment are not readily available

2.4 Fertilization

2.4.1 Overview of Technique

Fertilization is the application of nutrients to support plant survival and growth. Typical chemicals applied include elemental nutrients such as nitrogen, phosphorus, potassium, sulfur, and zinc. Fertilizers may be organic and may include compost or other less refined materials to augment soil nutrient content. This assessment also considers the application of lime to reduce soil acidity as a type of fertilization.

Fertilizer can be applied in several ways. Broadcast application involves spraying liquid fertilizer from a helicopter or fixed-winged aircraft. Land-based application may include banding, where fertilizer is applied in bands from a tractor. Banding is more controllable and requires less fertilizer than broadcast application. Fertilizer is also sometimes applied in irrigation water.

2.4.2 General Benefits

- increases success, growth, and establishment of planted vegetation
- can be used to improve habitat in areas where poor habitat conditions are the result of chemical deficiencies in the soil

2.4.3 General Drawbacks

- can be expensive
- can impact water quality

3 HABITAT CREATION AND CONVERSION

This section discusses specific techniques other than vegetative propagation that involve creating habitat for wildlife. Techniques described include creating wetlands, artificial islands, and artificial nest structures.

3.1 Creating Wetlands

3.1.1 Overview of Technique

Wetlands can be created either by excavating to groundwater, diverting surface water flow, or impounding surface water flow. Excavation to below the water level is a common practice that is sometimes combined with surface water diversion. Flow from surface water sources can be diverted to created depressions, to natural depressions, or to diked or bermed areas. Impoundments involve the construction of some mechanism on a stream or intermittent channel to serve as a dam, with the created wetland forming behind the dam.

Common practices for wetland creation include the use of heavy equipment, including excavators, backhoes, and graders. Blasting may also be used to excavate soils. Soil may be moved out of or brought onto a site, depending on the specific characteristics of the site. Wetlands can also be created using the traditional knowledge of tribal cultures. For example, introducing beavers (which build dams that create ponds) can result in high-quality wetland systems that may more accurately reflect natural conditions. Other species, such as muskrat and otter, may also interact with wetlands to create more natural conditions.

3.1.2 General Benefits

- can provide water where water is a limiting factor in the distribution of certain desirable species

3.1.3 General Drawbacks

- displaces upland habitat
- can inadvertently affect adjacent lands, potentially causing unintended land use restrictions

3.2 Artificial Islands

3.2.1 Overview

Creating islands involves placement of a structure or material within standing water. Islands may be either permanent or temporary, depending on management objectives.

Several types of structures have been developed to create islands. Simple although temporary islands can be made from brush or hay. Floating" islands" can be made by mounting a platform on logs or styrofoam.

More permanent and substantial islands can be made from soil and rock. These are most practical to install during excavation of created wetlands, although islands can be placed in existing wetlands, especially those that can be drained. Payne and Copes (1986) recommend that earthen islands be between 10 and 50 feet wide, with 3 feet elevation, covering at least 0.05 acre, and having 6: lor flatter slopes. Vegetation is usually planted on created earthen islands. Construction of earthen islands usually involves a bulldozer and front-end loader.

3.2.2 General Benefits

- provides nesting habitat .reduces predation rates .creates more shoreline

3.2.3 General Drawbacks

- can require substantial effort
- can cause temporary turbidity and sedimentation

3.3 Artificial Nest Structures

3.3.1 Overview of Technique

Artificial nest structures are often developed in areas where suitable habitat is present to support breeding animals, but where there is a lack of suitable nesting habitat. Nest structures include birdhouses, nest baskets, and nest platforms. Nesting cavities may also be created by installing snags (dead standing trees) or by blasting or otherwise opening shallow caves on cliffs. Other structures include bat roosting boxes and placement of logs for turtle basking sites.

3.3.2 General Benefits

- can allow for increased species diversity
- can simulate conditions that had occurred naturally but that have been removed through human activities or other disturbances
- can have high public profile and appeal

3.3.3 General Drawbacks

- may attract predators
- can be visually unattractive
- usually provide only temporary benefits
- often require annual maintenance

4 WATER DEVELOPMENT AND MANAGEMENT TECHNIQUES

The development and control of water is one of the most effective management tools to improve habitat values. Techniques vary widely, from creating a small water source for quail to establishing a wintering refuge for waterfowl.

This section describes some of the major techniques available to secure water and to develop water sources at wildlife areas. Please see Section 2.3 (Irrigation) and Section 5 (Water Distribution Techniques) for other water-related techniques. Techniques described in this section include creating wells, diverting water, developing springs, impounding water, installing guzzlers (self-filling structures that provide drinking water), and acquiring water rights.

4.1 Wells

4.1.1 Overview of Technique

Well systems involve drilling to and tapping into groundwater sources to provide water for habitat improvement for administrative or public use. Construction usually involves a small drilling rig which is typically mounted on a vehicle. Following access to the well, pipe is installed to transport water from the well, and a pump and distribution assembly is placed at the well head and housed in a small structure. Distribution lines are then established. The diameter of pipe and distribution lines depends on water demand but is typically less than 12 inches.

4.1.2 General Benefits

- obtaining water rights for a well can sometimes be easier than obtaining surface water rights

4.1.3 General Drawbacks

- pumping, delivery, and maintenance costs to support a preserve that does not generate revenue may be excessive
- may raise concerns regarding aquifer depletion

4.2 Diversions

4.2.1 Overview of Technique

Water diversions involve drawing water from surface sources, usually streams or rivers. Water can be drawn using siphons, pumps, or conveyance ditches. Siphons can be portable hoses or may be housed in permanent structures. Pumps require a small area for the pump assembly (generally less than 100 square feet) and associated pipelines for distribution (see "Water Distribution Techniques" section below). Conveyance ditches can be lined or unlined and involve excavation of channels ranging from a few feet up to 12 feet or more in depth and width.

4.2.2 General Benefits

- relatively simple and inexpensive technique

4.2.3 General Drawbacks

- water rights may be difficult to secure
- water source can be unpredictable and shortages may occur
- some concerns may arise regarding potential effects on the aquatic environment from runoff, leaching, and drawdown of the water source

4.3 Spring Development

4.3.1 Overview of Technique

Springs and seeps occur where groundwater escapes to the surface. In general, springs provide greater amounts of water than seeps. Both can be tapped and collected to provide water to wildlife.

Spring or seep development requires (1) a field of gravel or sand to collect water, (2) a pipe to drain the field, (3) a storage area or head box to collect and temporarily store water, and (4) a pipe connected to a trough to serve as a drinking basin for wildlife.

In most cases, development of a spring requires excavation to install the drainage field and, if necessary, an impermeable barrier to prevent flowthrough. For wildlife use, spring and seep development involves relatively minor construction because of the small area required to provide a benefit.

4.3.2 General Benefits

- provides water for wildlife
- can increase vegetation and associated habitat values

4.3.3 General Drawbacks

- source water for springs can change naturally or by disturbance caused during spring development

4.4 Check Dams/Impoundments

4.4.1 Overview of Technique

Impoundments can be one of the simplest ways to create a water feature. Several scales and designs of impoundments are available to the wildlife manager. Impoundments can range from simple earthen levees to elaborate concrete dams. Examples include simple embankments made from onsite soils; clay-core dams, which contain a hard clay center; and diaphragm dikes, which contain an outer layer of concrete, steel, or wood to hold back water .

The level of construction required depends upon the magnitude of the impoundment. Simple soil berms require relatively little construction work while an elaborate concrete dam would require larger crews. Construction of dikes and levees typically involves heavy equipment, including a front-end loader, excavator, dump truck, bulldozer, and grader. Blasting may be required to remove rock or stumps or to dig out the foundation area.

Impoundments usually require spillways to allow excess water to pass during heavy flows. Spillways may be constructed from concrete, wood, steel, or earth. On smaller impoundments, simple overflow tubes may be sufficient to release potential floodwaters.

4.4.2 General Benefits

- provides controllable water features to attract desired species or to establish desired habitat

4.4.3 General Drawbacks

- design can require extensive engineering considerations
- excavation may affect archeological resources

4.5 Guzzlers

4.5.1 Overview of Technique

Guzzlers are permanent water catchment and storage devices used to provide drinking water for wildlife. They are typically composed of a lined receiving area that is filled from rainwater collected on an impervious surface (called an apron). Several types of designs, materials, and sizes have been used to construct guzzlers.

The size and design of a guzzler is determined by the expected water source and dry season, as well as the type and number of animals it is intended to serve. Some guzzlers constructed for game birds in temperate areas (i.e., non-arid) take up less than 200 square feet, while guzzlers constructed for deer or similar large animals in arid lands can take up to 4,000 square feet or more. A compact guzzler has been designed for quail. It consists of a 6-foot by 12-foot roof positioned above a storage container. The Natural Resource Conservation Service has developed a guzzler design that would be appropriate for use on wildlife mitigation lands.

The holding container can be constructed of concrete, plastic, fiberglass, or metal. Aprons can be made from sealed pavement, asphalt, metal roofing material, plastic sheeting, or similar material. The holding container may be buried or left above ground.

Construction of guzzlers typically involves small construction equipment (such as a bobcat or backhoe) and crews of four or five people.

4.5.2 General Benefits

- can allow species use in areas where water deficits have previously excluded use
- once installed, guzzlers require little maintenance

4.5.3 General Drawbacks

- may not be appropriate in some situations because factors other than water are limiting species abundance or distribution
- can be visually unattractive
- can attract predators
- ground disturbance during construction may affect archeological resources

4.6 Water Rights Acquisition

4.6.1 Overview of Technique

Water may be required for habitat improvement projects, or for domestic use at administrative or public use facilities. Water rights acquisition typically involves purchasing existing water rights which is often accomplished as part of the land purchase. Most surface water sources in the western United States have already been fully allocated, so purchasing water rights can be the only way to acquire water where well water is not available.

4.6.2 General Benefits

- can provide water without the need to search for and develop a new water source, although in some cases the source may need to be developed (e.g., construction of a diversion dam)

4.6.3 General Drawbacks

- can be expensive
- water rights are not always available if there are conflicts with prior rights

5 WATER DISTRIBUTION TECHNIQUES

The distribution of water is a critical element in any water management program. This section describes the three major techniques used to distribute water at wildlife areas: pipelines, culverts, and drainage ditches/conveyance channels.

5.1 Pipelines

5.1.1 Overview of Technique

Pipelines associated with habitat enhancement areas usually involve pipes ranging from 4 to 12 inches in diameter. They can be placed in the ground or above. Placement in the ground typically involves minor trenching using a backhoe or similar equipment.

Pipelines are used to distribute water for irrigation to support habitat enhancement, for flooding to create and maintain wetlands, or for domestic use at administrative or public facilities.

5.1.2 General Benefits

- minimizes water losses from infiltration and evaporation

5.1.3 General Drawbacks

- requires more initial investment to install and can require more effort to maintain
- disturbs vegetation
- trenching may affect archeological resources

5.2 Culverts

5.2.1 Overview of Technique

Culverts are structures that allow water to flow through an otherwise impassible barrier. They are most commonly used to allow water passage through roadbeds to maintain water levels of wetlands, to support riparian vegetation, or to protect natural drainage corridors.

Culverts are best placed during road construction, but they may be installed in finished roads as well. Installation usually requires a backhoe or similar excavating equipment.

Culverts are typically corrugated metal but may also be constructed of concrete. Types used in habitat enhancement projects may include standard culverts or box culverts. In general, standard culverts (which are simply round, corrugated metal tubes) are most commonly used. Box culverts, which are square culverts, are typically larger than standard culverts and can be constructed to allow for a natural stream substrate. Box culverts are most commonly used when fish passage is a design consideration.

Occasionally, gabions (rock-filled wire cages), rocks, logs, concrete weirs, or low-head dams (with, for example, a l-foot rise) are placed below culverts to facilitate fish passage or to protect riparian habitat.

5.2.2 General Benefits

- allows drainage to follow natural course .relatively simple to install and maintain

5.2.3 General Drawbacks

- can cause erosion downstreaIn when a significant drop occurs at the outfall .can inhibit fish passage

5.3 Drainage Ditches/Conveyance Channels

5.3.1 Overview of Technique

Drainage ditches and conveyance channels are similar in construction and purpose. Drainage ditches are used to divert or drain water while conveyance channels are used to deliver water. Installation of both generally requires trenching or ditching. The ditches or channels may be lined or unlined. Ditches are constructed using a backhoe or excavator .

Drainage ditches and conveyance channels may be used to control the water regime of a managed wetland. They may also be used to support irrigation of habitat enhancement areas or to protect certain habitats from unwanted flooding.

5.3.2 General Benefits

- important element of controlled water regimes

5.3.3 General Drawbacks

- excavation may affect archeological resources

6 FIRE MANAGEMENT TECHNIQUES

As one of the most powerful natural agents of disturbance, fife plays a major role in shaping vegetation communities and associated wildlife habitats. Because of this, fire management can be a major element in any wildlife management program.

This section describes two different techniques for managing fire and the fuels that support fire. The first technique involves an active approach, while the second is more passive. A combination of the two techniques can be developed based on specific land characteristics and management objectives. Please see Section 7.5 (prescribed Burn) for a description of the use of fife as a tool to control vegetation.

6.1 Prompt Fire Suppression and Fuels Management

6.1.1 Overview of Technique

This technique involves active management to replace the role that natural fire regimes play in rangeland and forest ecosystems. Methods employed include direct and aggressive attack of most unplanned fires. Prescribed burns may be used to reduce fuel loads (see the section on prescribed burning under "Vegetation Management" below). Thinning and other silvicultural methods in forested areas may also be used to reduce fuels.

6.1.2 General Benefits

- more predictable and controllable than natural fire
- can be used to protect developed areas or other areas where fire would be detrimental

6.1.3 General Drawbacks

- requires relatively high devotion of resources
- requires thorough understanding of natural systems and processes, some of which may not be fully understood

6.2 Natural Fire Management

6.2.1 Overview of Technique

Natural fire management allows naturally caused fires to burn with minimum suppression. Few if any agencies widely use this technique, although it is applicable to certain wilderness or natural areas. Fire suppression under such a management approach is aimed primarily at protection of life, property, or valuable resources. Fuel reduction and fuel breaks may be implemented near homes and other developments near areas where natural fire management is applied. Otherwise, fire is allowed to occur naturally.

6.2.2 General Benefits

- allows natural processes to occur
- if natural fires occur frequently, then the severity of each fire may be relatively low

6.2.3 General Drawbacks

- difficult to implement in areas where previous fire suppression or other events have significantly altered fuel loads and natural vegetative structure, composition, and condition
- fire behavior and occurrence can be unpredictable
- substantial risk of property damage, loss of human life, or injury

7 VEGETATION MANAGEMENT: ENHANCEMENT AND CONTROL

Noxious weeds, non-native invasive plants, and aggressive, weedy species can take over disturbed lands and degrade habitat values. Much of the Columbia River Basin has been disturbed by intensive grazing, farming, and other human activities; therefore, some mitigation areas are expected to contain relatively poor habitat dominated by undesirable plant species. The control of such unwanted vegetation can create more natural habitats and encourage native plant and animal species.

This section describes the wide variety of techniques available to control vegetation, including herbicides, mechanical removal, biological control, hand pulling, prescribed burning, and water level manipulation.

7.1 Herbicides

7.1.1 Overview o1f Technique

Herbicides are chemicals applied to kill plants. They are typically applied in liquid form. Three main types of equipment can be used to apply herbicides: (1) aircraft, either helicopter or fixed-wing; (2) wand or broom sprayers mounted on or towed by trucks, and (3) backpack equipment containing a pressurized container with an agitation device. Herbicides can also be hand applied by injection, daubing cut surfaces, and ground application of granular formulas.

Herbicides are typically mixed with water or oils as a carrier and may also contain a variety of additives to promote saturation and adherence, to stabilize, or to enhance chemical reactions. Dyes are also sometimes added for water quality monitoring undertaken as part of the herbicide application procedure.

Typical uses of herbicides are site preparation for planting, control of undesirable plants that are competing with desirable plants, noxious weed control, right-of-way maintenance, and recreation site and facility maintenance.

Each of the wide variety of herbicides carries its own risks, benefits, and drawbacks. An analysis of each type is beyond the scope of this assessment. Refer to the U .S. Forest Service Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation (USFS 1988).

7.1.2 General Benefits

- in certain situations, can be less expensive and more effective than other methods
- large areas can be covered in a short time
- can be targeted by taking advantage of the seasonal vulnerability of specific species
- has little direct impact on soil surface integrity

7.1.3 General Drawbacks

- can carry substantial risk to environmental and human health, including impacts on water quality
- can kill nontarget species
- can be controversial
- concern over risks may require extensive permitting or environmental review

7.2 Mechanical Removal

7.2.1 Overview of Technique

Mechanical removal of vegetation typically involves the use of tractors or other heavy machinery equipped with a blade, mower, or other device to remove vegetation. Cables and chains attached between vehicles may also be used to clear vegetation.

While the degree of disturbance depends on the type of equipment used, mechanical removal breaks the surface of the soil and can remove some or all of the parts of plants, including roots.

Mechanical removal can be carried out over large areas or can be confined to smaller areas (known as scalping). Vegetation is sometimes removed in strips, rather than clearing all areas (known as contouring or furrowing).

7.2.2 General Benefits

- low cost and high efficiency

7.2.3 General Drawbacks

- can disturb soils
- typically nonselective
- use can be restricted by steep slopes or other uneven topography
- plants may resprout if the whole plant is not removed

7.3 Biological Control

7.3.1 Overview of Technique

Biological control of vegetation involves the use of disease, insects, other parasites, and desirable plants to inhibit growth and spreading of unwanted vegetation. Insect adults or larvae can be used to attack seedheads, stems, or flowers of target plants. In many cases, host-specific species of insects can be found.

Bacteria, viruses, fungi, and other microbes can also be used to control vegetation, but these techniques are mostly experimental at this time (USFS 1988). Another experimental approach involves the use of chemicals naturally produced by plants to inhibit or repel other plants. Traditional knowledge of tribal cultures can be very useful in identifying competitive relationships among plants.

Extreme care is required to effectively apply biological control. When selecting a specific type of control agent, such as a species of insect, managers must research and consider (I) the agent's known effectiveness against the target plant species, (2) the agent's ability to survive site conditions, and (3) the specificity of damage the agent will cause.

Use of any biological agent requires close coordination and consultation with local, state, and federal agencies as well as adjacent landowners. In particular, the USDA .Agricultural Research Service and local weed control boards should be consulted prior to considering the use of biological controls.

7.3.2 General Benefits

- involves fewer risks to water quality

7.3.3 General Drawbacks

- requires intensive monitoring
- may be difficult to obtain appropriate insects or other control agents
- potential risk of disrupting natural systems

7.4 Hand Pulling

7.4.1 Overview of 'Technique

Hand pulling of vegetation can be effective where small areas are targeted for plant control.

7.4.2 General Benefits

- can target specific species
- involves much less disturbance of soils

7.4.3 General Drawbacks

- labor intensive
- not practical for covering large areas

7.5 Prescribed Burn

7.5.1 Overview of Technique

Prescribed burning is the intentional use of fire to create desired changes, such as wildlife habitat improvement, within a specific treatment area. There are three types of prescribed burns: (1) broadcast burning, (2) pile burning, and (3) underburning.

Broadcast burning involves general ignition of essentially all flammable materials within the treatment area. Hand-held or helicopter-borne drip torches are used to quickly ignite fuels. Sites are sometimes cleared or otherwise disturbed prior to igniting a broadcast burn. An example of broadcast burning is slash burning, where woody residuals from logging are burned to prepare a recently harvested timber site for regeneration.

Pile burning involves collecting and piling fuels to be burned in place. This technique allows a more selective approach to burning but is also more labor intensive.

Underburning involves burning only the lower layer of vegetation, while avoiding burning in the overstory (such as the tree canopy). It is used to reduce fuel loads {to avoid wildfires), eliminate unwanted brush, or stimulate forage production.

Prescribed burns can be used to:

- increase forage abundance and accessibility .reduce unwanted vegetation
- prepare an area for replanting, especially where soils, topography, or slope limit the use of other methods
- create habitat for edge or early seral species .maintain early seral stage
- increase vegetative diversity and associated wildlife communities .simulate natural disturbance regimes
- reduce fuel load and risk of catastrophic fire
- alter distribution patterns of animals (such as wintering deer)

7.5.2 General Benefits

- can simulate the natural role fire plays in the development of most vegetation communities
- can cause desired changes in vegetation relatively inexpensively, compared with chemical or mechanical techniques
- can have minimal impact on surface soils, when compared with mechanical methods, thereby reducing the exposure of mineral soils and associated encouragement of invasive weeds

7.5.3 General Drawbacks

- possible air pollution and soil erosion .risk of fire escaping
- can be difficult to control because of the complex and unpredictable factors involved
- not selective within treatment area; may harm beneficial or desirable plants and animals
- ffects can be severe and long term

7.6 Water Level Manipulation

7.6.1 Overview of Technique

Controlling water levels is a common practice in managing wetlands. Intensive water level manipulation is most commonly used to create waterfowl habitat, where wetlands are seasonally flooded to provide wintering and migratory habitat.

Water level control is also used to control vegetation. For example, reed canarygrass, a non-native invader, can be controlled through flooding during the growing season. Non-native wetland plants can be controlled through draining during the growing season. Water control can also be used to control non-native fish or wildlife species, such as carp.

Water level control can involve raising, maintaining, and/or lowering water levels, depending on project objectives and season. These manipulations can be annual, seasonal, cyclic (e.g., every 5 years), or occasional with no set schedule, .depending on project objectives.

Associated activities include construction of berms, dams, or dikes to contain water; placement of pumps and siphons to obtain water; placement of flap gates, weirs, and pipes to control inlet and outlet; and placement of culverts and digging of conveyance channels to distribute water.

7.6.2 General Benefits

- can be relatively inexpensive
- can be integrated with flood control management, water storage, and irrigation systems

7.6.3 General Drawbacks

- .may affect water quality or quantity of adjacent landowners or downstream water users
- can create: artificial conditions that require constant maintenance by restricting the development of mature, self-sustaining habitats

8 SPECIES MANAGEMENT TECHNIQUES

This section describes the techniques that focus on increasing or decreasing specific wildlife species as a means to meet wildlife mitigation objectives. These techniques include introduction, reintroduction, or augmentation of wildlife populations, and control of predators or nuisance animals.

8.1 Introduction, Reintroduction, or Augmentation of Wildlife Populations

8.1.1 Overview of Technique

Reintroduction or augmentation of wildlife populations is feasible where suitable habitat exists but the species is absent or present in less than desired numbers. In general, the overriding cause of species absence or reduction for the planning area needs to have been remedied. Most reintroductions have focused on threatened and endangered species or game animals.

Threatened or endangered species that have been reintroduced or transplanted in the Interior Columbia Basin include woodland caribou (in northeastern Washington and northern Idaho) and peregrine falcon (in the Columbia Gorge and elsewhere). Peregrine falcons have been released through a technique known as hacking. Hacking involves placing nestlings or young of one species into another species' nest for rearing. Reintroduction of threatened or endangered species is usually followed by extensive monitoring and study.

One other type of species management involving transplantation from the wild is actually a salvage operation. This involves relocating individuals that are threatened by pending occurrences, such as timber harvest, insect damage, or fire.

8.1.2 General Benefits

- can accelerate natural colonization or can alleviate problems caused by barriers to dispersion
- can restore cultural values to tribal cultures

8.1.3 General Drawbacks

- potential problems with transferring diseases
- introduced species can compete with existing desirable species
- requires a detailed understanding of the ecological system in which the species is being placed

8.2 Control of Predators and Nuisance Animals

8.2.1 Overview of Technique

Controlling predators and nuisance animals involves the removal or reduction of undesirable wildlife species. Native, predatory wildlife are generally considered a part of a functioning ecosystem. Undesirable species are typically those that extensively damage habitat, other species, or human property, or that are endangering public health or safety. Examples of such problems include:

- rodent, deer, or elk foraging damage to reforestation, crops, or habitat restoration projects
- bullfrog predation on native amphibians
- carp damage to desired wetland vegetation
- beaver activity or increasing water temperatures interfering with water regimes
- raccoon predation of waterfowl or sharp-tailed grouse nests
- rabies outbreaks in skunks

Removal or reduction of animal populations can be accomplished either directly, through killing or transplanting unwanted animals, or indirectly, through habitat modification or placement of barriers or harassment devices. Efforts that focus on habitat modification are generally more effective and long term and have less adverse effect on the environment. Hunting may also be used as a management tool to reduce or maintain population levels.

Direct methods include shooting, poisoning, and trapping. Poisoning, which has fallen into general disfavor among wildlife professionals, is used most often for predators, such as coyotes, and for small

rodents. Trapping involves the use of live or mortal traps to capture animals. Some animals, such as deer or rabbits, can be herded to holding pens, where they are then either destroyed or relocated.

8.2.2 General Benefits

- can effectively reduce predation on desirable species that are particularly vulnerable

8.2.3 General Drawbacks

- effects are often only short term
- direct measures usually require constant effort

9 MULTIPLE-USE TECHNIQUES

Wildlife habitat can be managed in cooperation with other land uses. This section describes how habitat improvement can be integrated into other land uses.

9.1 Integration of Wildlife Habitat and Crop Production

9.1.1 Overview of Technique

Farmland and rangeland can be co-managed for seasonal wildlife use. For example, retaining and flooding cropland stubble promotes winter waterfowl use, timing of crop harvest can improve (or harm) raptor nesting success, and planting uncultivated areas can improve habitats for certain species. Co-management of agricultural lands can be achieved through nonbinding cooperative agreements, easement acquisition, or land purchase/transfer and lease. Lands brought under co-management are typically already in agricultural use.

The methods and equipment for co-management include those typical of existing agricultural practices, including the use of tractors, combines, and trucks; application of fertilizers, herbicides, and/or pesticides; and irrigation.

Crop production on lands co-managed for wildlife use are more likely to employ conservation farming practices (e.g., no till or minimum tillage methods, establishment of buffer strips).

9.1.2 General Benefits

- can provide for multiple use and benefits, including revenue generation

9.1.3 General Drawbacks

- nonbinding agreements can be temporary

9.2 Provision of Educational and Recreational Opportunities

9.2.1 Overview of Technique

Recreational use of wildlife mitigation areas can be provided where such use does not interfere with overall program objectives. Wildlife-related activities are usually most compatible with wildlife enhancement areas.

Passive wildlife activities include outdoor education and interpretation, bird watching and other wildlife observation, nature photography, walking/hiking, and canoeing. Activities associated with such use can include development of interpretive trails and signs, wildlife viewing stations, and interpretive centers, including access and interpretive facilities for people with disabilities.

Consumptive wildlife-related activities, namely fishing, hunting, and trapping, are not as easily accommodated on wildlife enhancement areas but may be appropriate in certain circumstances. Consumptive use, when allowed, can be limited to certain seasons or to designated areas within a larger wildlife mitigation area.

Recreation that is not oriented toward wildlife can sometimes be provided at wildlife enhancement areas. Such activities may include camping, picnicking, swimming, boating, and sightseeing. Again, these activities may be prohibited where and when they would interfere with other management objectives or may be limited to designated areas.

9.2.2 General Benefits

- increases public awareness and appreciation for the mitigation area
- provides some economic benefits

9.2.3 General Drawbacks

- human activities may disturb some wildlife species
- recreational activities require staff to assist and monitor use

9.3 Facility Development

9.3.1 Overview of Technique

Some facilities may be developed for administrative, management, or recreational purposes in conjunction with the overall goal of providing wildlife habitat. Administrative facilities may include office space, parking, and housing. Management facilities may include garages, storage sheds, and fenced or open yards to store equipment and materials. Recreational facilities may include parking areas, interpretive centers, and observation stations. Facilities must be planned to comply with the Americans with Disabilities Act.

9.3.2 General Benefits

- onsite or near-site facilities provide efficient staff access to th~ mitigation area
- recreational facilities provide opportunities for public education and appreciation of nature

9.3.3 General Drawbacks

- development generally contradicts the overall objectives of habitat improvement and protection

9.4 Grazing

9.4.1 Overview of Technique

Grazing involves releasing livestock onto rangeland for the purpose of providing forage and shelter to the animals. Grazing can also be used as a management tool to manipulate vegetation and has been used to reduce shrub density, thus releasing trees from competition and reducing fire fuels. Grazing can also be used to create habitat diversity between grazed and ungrazed areas.

Cattle and sheep are the most typical livestock in the Interior Columbia Basin. Modern grazing management involves intensive grazing systems that utilize fencing, rotation of use, and control of movements.

Related management techniques that may be employed under a grazing management system include control of undesirable plants, seeding, fertilization, water improvements and pipelines, and construction of holding corrals, cattleguards, and fences.

Range management on public lands is usually carried out through range allotments. Range allotments are essentially lease arrangements for a specific number, kind, and timing of livestock use within a designated area. An allotment is typically implemented under an allotment management plan that specifies how and when the allotment area is to be grazed.

9.4.2 General Benefits

- can cause desired changes to vegetation while providing revenues and local economic benefits

9.4.3 General Drawbacks

- where range supply is limited, ranchers may come to rely on their allotments, which hampers the land manager's flexibility in management
- on rangeland in poor quality, a high initial investment may be required on behalf of the land manager and the permittee
- long-term costs are associated with monitoring
- can have adverse impacts to soil, aquatic resources, and vegetation

9.5 Forest Management

9.5.1 Overview of Technique

Silvicultural techniques are often applied on wildlife mitigation lands containing forests. Examples of such techniques include conifer tree planting, selective tree harvesting, tree thinning, and debris and prescribed bumming. These techniques are used to manipulate the species composition, forest canopy density, vertical structure, and tree stand density to achieve wildlife habitat objectives.

In some cases, timber sales can be used on mitigation lands to meet wildlife objectives while providing funds. Commercial tree thinning or selective harvest can sometimes be used to reduce canopy cover to increase deer winter range values. Selective commercial harvest or thinning can be used to increase stand diversity or create multiple canopies. Timber cutting and/or harvest can also be used to reduce fire or disease hazards, to speed development of old-growth conditions, or to create openings for species such as sharp-tailed grouse.

In other cases, timber sales can be used strictly for revenue generation as part of a multiple-use management objective. Under such a management objective, timber harvest may take place with little or no benefits to wildlife, other than the generation of revenue that can be used to offset costs associated with wildlife habitat enhancement.

The methods used to implement silvicultural techniques include use of tracked equipment, chainsaws, hauling trucks, and yarding equipment (e.g. cable, rubber-tired or tracked tractors, cable towers). In some cases, helicopters are used where equipment cannot access trees safely or without extensive resource damage. In many cases, silvicultural techniques for habitat improvement can be accomplished by small work crews using chainsaws without the need for heavy equipment and the associated disturbance caused by such equipment.

Timber management on lands designated as wildlife habitat is much more likely to avoid impacts on soils, streams, and wildlife habitat.

9.5.2 General Benefits

- can provide for multiple use and benefits, including revenue generation, while achieving mitigation goals
- can directly alter habitat characteristics to benefit.target species

9.5.3 General Drawbacks

- timber sales can be expensive to administer and manage

10 TRANSPORTATION/ACCESS TECHNIQUES

10.1 Land Use Restrictions

10.1.1 Overview of Technique

Access restriction is available to control the loss of habitat through human-caused disturbance. Restrictions can be applied to allow or disallow people, dogs (e.g., dog training and trials), or motor vehicles. Restrictions may also be specific to areas, seasons, or activities.

Public access can be restricted through the use of fencing and signs and can be discouraged by not providing trails or roads. Restrictions can be seasonal, such as in winter to protect wintering mule deer, or in spring and summer, to protect nesting great blue herons.

Fences and gates can effectively restrict unwanted human or animal access to protect wildlife habitat. Purposes can include public safety, habitat protection, and vandalism prevention. As with any facility design feature, fences and gates must be compatible with the Americans with Disabilities Act. Several types of fence and gate styles are available, but most consist of the same basic components, including the vertical structure of the fence itself and a foundation (fence posts anchored to the ground with concrete). Fences can be composed of wood, plastic, or metal. Barbed-wire fences with wood posts are commonly used to control livestock access or to protect riparian areas. Taller, wire fences are used to block elk or other larger animals (such as along roadways). Chainlink fences are used primarily to protect developed structures from vandalism and theft.

10.1.2 General Benefits

- provides secure habitat for wildlife
- minimizes the need to (llanage people in restricted areas
- can effectively control people or animals

10.1.3 General Drawbacks

- access can be difficult to control, especially where historic access is already established
- can be expensive to install and maintain
- can unintentionally restrict animal movements (such as mule deer migration routes)
- fences and gates can detract from natural settings

10.2 Road Construction

10.2.1 Overview of Technique

Roads may be constructed to provide access for habitat management activities. Road construction can involve a wide range of techniques and levels of effort. Unimproved gravel roads are constructed by simple clearing and grading. Some roads may require cut and fill. Gravel substrate is sometimes added to improve stability. Paved roads involve clearing, grading, placement of a substrate (usually gravel), and finally application of asphalt or concrete.

Drainage structures are typically installed in conjunction with roads to allow streams to pass underneath the road, to direct runoff from road surfaces, and to direct surface water away from roads. Typical techniques to facilitate drainage include roadside ditching, bridge construction, and culvert installation.

10.2.2 General Benefits

- roads allow direct access for management activities and public use
- roads focus vehicle travel and impacts, and reduce the tendency to form a braided network of informal roads where formal roads are lacking

10.2.3 General Drawbacks

- expensive construction and maintenance
- if provided for public access, can increase risks of vandalism, theft, and dumping
- potential liabilities for public safety
- .roads can have adverse effects on wildlife and other natural resources

10.3 Road Maintenance

10.3.1 Overview of Technique

Roads present on wildlife mitigation areas may provide important access for management activities. These roads will need to be maintained.

The type of road maintenance performed depends on the road surface type. Gravel roads are maintained through grading and placement of additional gravel, soil, or other materials. Paved roads maintenance may involve repair of potholes, painting, or resurfacing. In general, road maintenance involves relatively minor construction efforts, typically involving a small work crew equipped with one or two vehicles.

10.3.2 General Benefits

- maintains safe travel
- can reduce future costs if problems are addressed early

10.3.3 General Drawbacks

- in certain circumstances, can involve more costs over the long run than road reconstruction

10.4 Road Decommissioning

10.4.1 Overview of Technique

Road decommissioning involves closing and eliminating roads from a transportation system to improve habitat values by restricting access and replanting vegetation. Attempts may be made to restore roadbeds by removing pavement, loosening underlying soils, or adding soils. Cutbanks may be planted or otherwise stabilized and culverts may be removed.

10.4.2 General Benefits

- can reduce road maintenance costs
- can increase habitat value through restoration efforts and through significantly reducing human access

10.4.3 General Drawbacks

- results in loss of access

11 CITATIONS

Bonneville Power Administration. 1993. Oregon trust agreement planning project. Portland, OR.

Gilbert, F. F., and D. G. Dodds. 1987. The philosophy and practice of wildlife management. Robert E. Krieger Publishing Company. Malabar , FL.

Payne, N. F., and F. Copes. 1986. Wildlife and fisheries habitat improvement handbook. (Wildlife and Fisheries Administrative Report [unnumbered].) U.S. Department of Agriculture, Forest Service. Washington, DC.

U.S. Forest Service. 1988. Management competing and unwanted vegetation. Final environmental impact statement. Pacific Northwest Region. Portland, OR.

USFS. See "U.S. Forest Service".