WILDLAND FIRE MANAGEMENT PLAN

HART MOUNTAIN NATIONAL ANTELOPE REFUGE

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

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EXECUTIVE SUMMARY

When approved, this document will become the Hart Mountain NAR fire management plan. This plan is written to provide guidelines for appropriate suppression and prescribed fire programs at Hart Mountain NAR. Prescribed fires may be used to reduce hazard fuels, restore the natural processes and vitality of ecosystems, improve wildlife habitat, remove or reduce non-native species, and/or conduct research. The 1994 Hart Mountain NAR Comprehensive Management Plan (CMP), 1994 Final Environmental Impact Statement (FEIS), and 2001 DRAFT Pronghorn Management Plan (PMP) serve as Refuge policy document references.

Format changes adhere to Service policy and direction from the Fire Management Handbook (release date 6/2000). The 1995 National Fire Policy has been addressed and updated throughout the document. The 2000 FWS prescribed burning policies and direction have been implemented and updated accordingly.

This discussion summarizes some of the ecological considerations in the (1994 CMP, Record of Decision) . The primary ecological factor that influenced the decision was the relative importance of processes that created habitat conditions under which native wildlife communities of the Hart Mountain NAR area evolved. As pointed out by Maser and Thomas (1983), wildlife are a product of habitat management, and habitat management can be equated to process management. In short, by restoring and maintaining the structure, species composition, and processes of native ecological communities and systems, healthy and balanced populations of pronghorn and other native wildlife will be maintained to the extent that wildlife populations can be influenced on Refuge lands.

Of the processes that have significantly influenced Refuge wildlife, fire and livestock grazing are the two that Refuge managers have direct control over. By managing these processes (including rest from either), managers influence vegetation succession, habitat interspersion, soil formation and erosion, plant species composition and structure along streambanks, stream channel structure and stability, and other processes and components of ecological systems.

While periodic fire historically had a major influence on the landscape of the northern Great Basin, grazing by large herbivores did not. The subsequent introduction of domestic livestock and suppression of fires probably altered habitat within what is now Hart Mountain NAR more than any other human activity.

Native wildlife communities of the area evolved under the influence of periodic fire and depend on conditions created by it. On the other hand, we have no reason to believe that native wildlife communities require a level of grazing that is above and beyond that which occurs under the existing populations of native ungulates. Additionally, a level of grazing above that which occurs with native ungulates can be detrimental to some species/communities of wildlife and plants, and ecological systems (e.g., low gradient streams).

Therefore, while it is of utmost importance that the Service reintroduce periodic fire through prescription in order to accomplish Refuge purposes, there are no compelling reasons to suggest that livestock grazing is necessary for accomplishing them. In fact, the National Wildlife Refuge System Administration Act and Service policy require that livestock grazing not be used or permitted until it can be demonstrated that it would not hinder progress toward accomplishing the purpose of the Refuge set forth in Executive Order 7523. (Record of Decision, 1994 CMP).

INTRODUCTION

The Hart Mountain National Antelope Refuge fire management program has evolved with the body of ecological thought and philosophy of ecosystem based management. Prescribed fire has been used on the Refuge at least since the early 1950's to manage vegetation. The primary objective of early burns was to improve range conditions. This has changed by recognizing the value of biological diversity and community structure. Similarly, the philosophy of Refuge management has changed since the creation of the Refuge, due to changes in ecological theory and the values of the American society.

Fire is a critical ecological process that served in part to shape and diversify the Great Basin vegetation communities. Practices of fire suppression have reduced the natural role of fire on the Refuge. As such, shrubs dominate cover over much of the Refuge. This condition is not only unnatural and less productive for wildlife management, but presents a significant hazard fuels dilemma. The application of prescribed fire will reduce shrub cover and increase habitat diversity and edge. In addition, hazard fuel loadings will be reduced to levels that do not foster large and catastrophic wildland fires.

Recognizing that the fire management of natural areas within a refuge will include objectives other than those which are ecological, the role of fire in natural ecosystems remains paramount. The other management objectives, such as protection of life and property, boundary protection, and smoke management are superimposed on this basic objective.

The mission statement for the agency, as released in 1994, directs the Refuge "to conserve, protect, and enhance the Nation's fish and wildlife and their habitats for the continuing benefit of people." The Fire Management Handbook officially endorses the use of prescribed fire as long as the fires meet management objectives.

The current theme of management of the Refuge is to restore deteriorated habitats to promote healthy and balanced populations of all native wildlife species. Historically, fire was a primary factor in the determination and distribution of native vegetation communities on the Refuge. This plan is focused on the use of prescribed fire in the role of the Refuge ecosystem restoration.

Determination of what constitutes a natural fire regime for the Refuge is difficult at best. Over seventy years of aggressive fire suppression policy and the use of cattle grazing for vegetation management have altered the natural distribution of native vegetation. The fire return interval for the woody shrub vegetation types common to the Refuge vary from 12 to 25 years in mountain big sage, to 25 to 100 years in Wyoming big sage, and 100 to 200 years in low sage. The Refuge Comprehensive Management Plan has prescribed that up to 40,000 acres of late succession shrub-dominated communities be treated with fire over a 15 year period. During this period of time, natural fires will continue to occur, but we cannot assume that their effects will be natural due to variability in ecological condition and presence of cheatgrass, an aggressive introduced annual grass. Indeed, prescribed fires will also have effects other than what would be naturally occurring. As a result, fire effects monitoring must be conducted to ensure that Refuge fire management practices are continually working toward Refuge management objectives.

COMPLIANCE WITH USFWS POLICY

Hart Mountain National Antelope Refuge was enacted into law by President Franklin D. Roosevelt, by Executive Order 7583, December 21, 1936. These lands were withdrawn and set aside as a "range and breeding ground for antelope and other species of wildlife". The first Fire Management Plan written for Hart Mountain National Antelope Refuge was written in 1961. The most recent plan was approved in 1998. Early plans focused primarily on range improvement.

It is intended that this plan adhere to the U. S. Fish and Wildlife Service Fire Management Handbook. As such, this Fire Management Plan will serve as the detailed program of action to implement Department of Interior and U.S. Fish and Wildlife Service fire management policies and objectives on Hart Mountain National Antelope Refuge lands. This includes wildland fire suppression and prescribed fire operations.

The Fire Management Plan is a detailed program of action to implement fire management policies and objectives. The Department Manual, DM 910 (USDI 1997) states the following regarding wildland fires:

> “Wildland fires may result in loss of life, have detrimental impacts upon natural resources, and damage to or destruction of man-made developments. However, the use of fire under carefully defined conditions is to be a valuable tool in wildland management. Therefore, all wildland fires within the Department will be classified either as wildland fire or as prescribed fires.
>
> Wildland fires, whether on lands administered by the Department or adjacent thereto, which threaten life, man-made structures, or are determined to be a threat to the natural resources or the facilities under the Department's jurisdiction, will be considered emergencies and their suppression given priority over normal Departmental programs.
>
> Bureaus will give the highest priority to preventing the disaster fire - the situation in which a wildland fire causes damage of such magnitude as to impact management objectives and/or socio-economic conditions of an area. However, no wildland fire situation, with the possible exception of threat to human survival, requires the exposure of firefighters to life threatening situations.
>
> Within the framework of management objective and plans, overall wildland fire damage will be held to the minimum possible giving full consideration to (1) an aggressive fire prevention program; (2) the least expenditure of public funds for effective suppression; (3) the methods of suppression least damaging to resources and the environment; and (4) the integration of cooperative suppression actions by agencies of the Department among themselves or with other qualified suppression organizations.
>
> Prescribed fires...may be used to achieve agency land or resource management objectives as defined in the fire management plans....Prescribed fires will be conducted only when the following conditions are met:
>
> a. Conducted by qualified personnel under written prescriptions.
> b. Monitored to assure they remain within prescription.
>
> Prescribed fires that exceed the limits of an approved prescribed fire plan will be reclassified as a wildland fire. Once classified a wildland fire, the fire will be suppressed and will not be returned to prescribed fire status.”

The authority for funding (normal fire year programming) and all emergency fire accounts is found in the following authorities:

Section 102 of the General Provisions of the Department of Interior's annual Appropriations Bill provides the authority under which appropriated monies can be expended or transferred to fund expenditures arising from the emergency prevention and suppression of wildland fire.

P.L. 101-121, Department of the Interior and Related Agencies Appropriation Act of 1990, established the funding mechanism for normal year expenditures of funds for fire management purposes.

31 US Code 665(E)(1)(B) provides the authority to exceed appropriations due to wildland fire management activities involving the safety of human life and protection of property.

Authorities for procurement and administrative activities necessary to support wildland fire suppression missions are contained in the Interagency Fire Business Management Handbook.

The Reciprocal Fire Protection Act of May 27, 1955 (42 USC 815a; 69Stat 66) provides Authorities to enter into agreements with other Federal bureaus and agencies; with state, county, and municipal governments; and with private companies, groups, corporations, and individuals regarding fire activities. Authority for interagency agreements is found in "Interagency Agreement between the Bureau of Land Management, Bureau of Indian Affairs, National Park Service, US Fish and Wildlife Service of the United States Department of the Interior and the Forest Service of the United States Department of Agriculture" (1996).

The Refuge Comprehensive Management Plan and Environmental Impact Statement have received extensive review in accordance with NEPA/NHPA requirements. The use of prescribed fire as a management tool was clearly identified during this process. As an action plan based on these documents, the Fire Management Plan is not required to undergo NEPA review.

The Fire Management Plan is a detailed program of action to implement fire management policies and objectives as outlined in the Comprehensive Management Plan. A variety of citations in the Hart Mountain National Antelope Refuge Environmental Impact Statement (EIS) and Comprehensive Management Plan direct the Refuge to manage fire.

1. Occurrence of unnaturally high shrub and juniper cover as a result of a lack of periodic fires, Long Range Objectives.
2. The manipulation of vegetation cover types with fire at intervals corresponding to pre-settlement return intervals where known, Habitat Objectives.
3. The management of fire, whether prescribed natural fire, prescribed fire and/or wildland fire, Alternatives Considered in Detail.
4. The role of natural fire, Affected Environment.

Figure 1: Inholdings

FIRE MANAGEMENT OBJECTIVES

Comprehensive Management Plan objectives and their implications to fire management.

1. Management for healthy and balanced populations of pronghorn and other species of native wildlife in their natural habitat.
   a. Re-introduce fire in natural ecosystems.
   b. Protect sensitive areas from fire intrusion.

2. Manage for threatened and endangered species of plants and animals in their natural ecosystems.
   a. Use fire as a management tool to improve the ecological condition of the Refuge.
   b. Manage site specific fire applications to protect or promote listed and candidate species.

3. Restore and maintain the structure, species composition, and processes of native ecological communities and ecosystems of the northern Great Basin Region.
   a. Promote greater diversity within plant communities of the Refuge with use of fire.
   b. Establish a fire effects monitoring system that inventories pre-burn species composition and resulting post fire response, over time.

4. Provide opportunities for wildlife/wildlands-dependent recreation orientated to the Great Basin ecosystem while maintaining the rugged, remote and undeveloped character of the Refuge.
   a. Incorporate a wilderness value protection scheme within fire management strategies.
   b. Employ fire prevention strategies that reduce human ignition occurrence in campground and transportation corridor areas.

An additional fire management objective that does not easily correspond to stated Refuge objectives is to protect life and property, and recognize the human values that can be impacted by fire management planning. A variety of Native American archeological sites, early European settlement sites, and unique natural areas exist on the Refuge. While there are not any designated wilderness areas on the Refuge, much of the area is remote and rugged in nature. Refuge improvements include a headquarters complex and undeveloped campgrounds. Inholdings (Figure 1) within the boundaries of the Refuge include 11,998 acres of state owned land and 14,600 acres of private and county lands. The remaining 251,295 acres within the boundary are Refuge lands. Private and Bureau of Land Management ownership represents neighboring land status.

Broad Objectives of the Fire Management Program

1. Protect life, property, and resources from unwanted fire.

2. Use fire to accomplish resource management objectives.

3. Restore fire as a natural ecological process.

4. Develop and implement a process to ensure the collection, analysis, and application of high quality fire management information needed for sound management decisions.

Specific Objectives of the Fire Management Program

1. Protect from fire important human, scientific, cultural, historic and pre-historic, and scenic resources, all retained use and occupancy sites, private lands, and key visitor and administrative facilities.

2. Restore and maintain the structure, species composition, and processes of native ecological communities and ecosystems of the northern Great Basin Region.

3. Reconstruct Refuge fire history, where possible, for use in future fire and resource management decision making.

4. Develop and implement a fire effects and behavior monitoring program that aids fire managers in developing, refining, and executing prescribed fire prescriptions.

The core application of this Fire Management Plan is focused on improving wildlife habitat condition on the Refuge. This Plan describes implementing prescribed fire to type convert the existing, largely mono typical shrub condition to a more diverse vegetal community where representation of grasses and forbs is increased. The Plan also recognizes the organic role of natural fire on the Refuge by defining less intensive wildland fire suppression strategies where practical. Finally, this Plan promotes a scientific based monitoring system that will be used by future managers to measure the success or failure of the Plan.

DESCRIPTION OF REFUGE

Hart Mountain NAR natural and cultural resources are fully described in the Environmental Impact Statement and Comprehensive Management Plan. The following is a brief summary of that information.

The Refuge is located in south-central Oregon in eastern Lake County, and is situated within the northwestern Great Basin. The settlement of Plush lies 30 miles west of Refuge headquarters. Lakeview is located 65 miles to the west. The nearest concentration of residences to the east is Frenchglen, which is about 40 miles from headquarters.

PHYSICAL RESOURCES

Geology

The Refuge area consists of mountainous upland and lava tableland. Mountainous uplands occur mostly along the western boundary of the Refuge and represent about one-fourth of the Refuge land mass. High lava tableland lies to the east and comprises most of the rest of the Refuge. The highest elevation, Warner Peak, is 8,065 feet, and the lowest elevation, in Warner Valley, is about 4,400 feet.

The greatest percentage of the Refuge consists of lava tableland. Numerous playas, lake beds and remnant volcanic land forms are scattered over this area. The tableland gently slopes to the east toward Catlow Valley.

A group of dome shaped hills, the Intermediate Hills, are generally located between the lava tablelands and mountainous upland. Guano Creek and Rock Creek, the two largest streams on the Refuge, head at the divide separating the Intermediate Hills and higher mountainous terrain. Guano Creek drains southeasterly, and Rock Creek flows northeasterly.

Climate

Normal annual precipitation varies with elevation. The tableland receives 8 to 10 inches and the mountainous areas experience 8 to 20 inches, usually in the form of snow. This results in a semi-arid, cool climate. The possible occurrence of frost during any month restricts the growing season to the summer months.

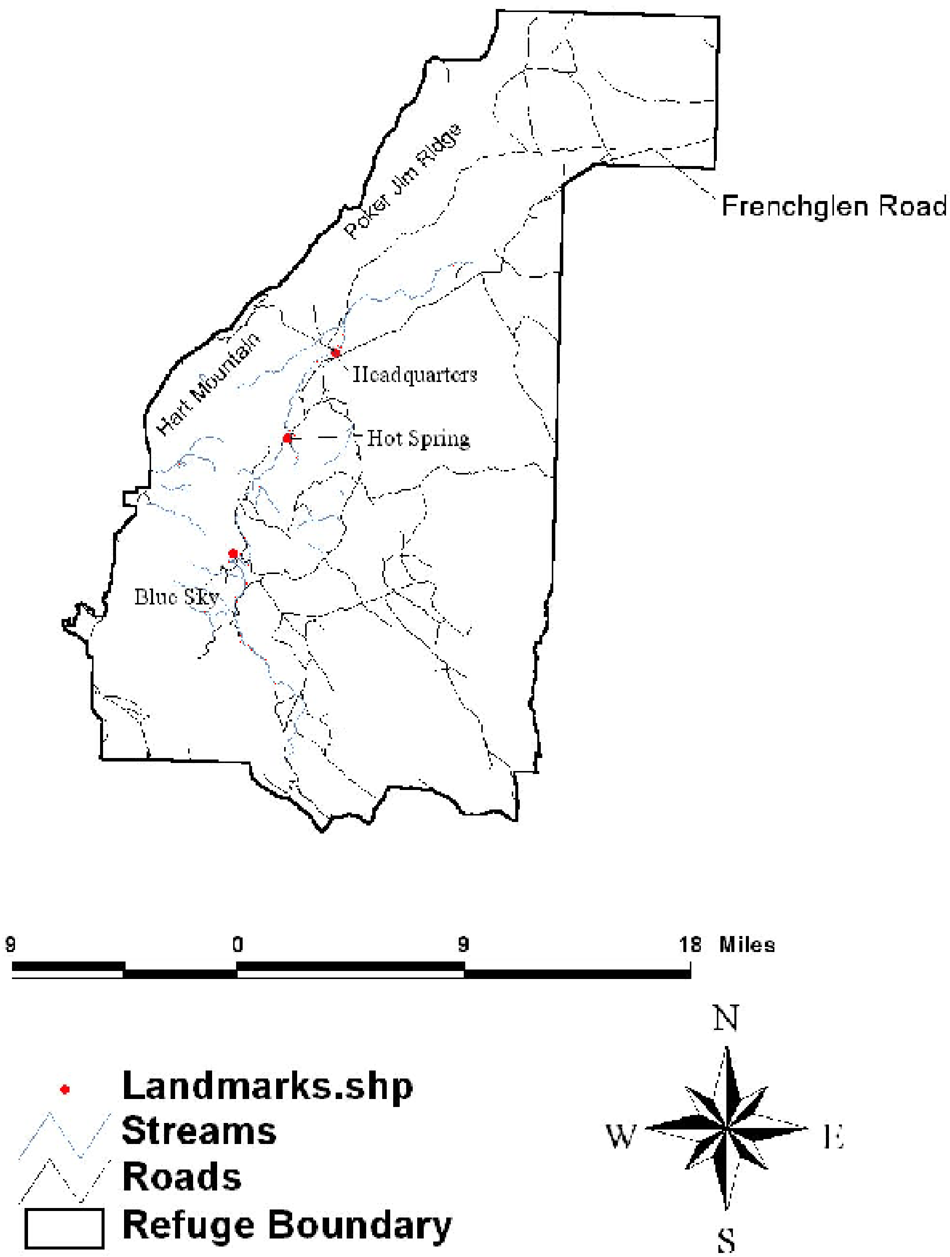
Air

The Refuge is currently classified as a Class II airshed. The area is subject to periodic hazy conditions of unknown origin.

Soils

Soils on the Refuge are largely a result of lake sedimentation, volcanic activity and erosion. Soils at higher elevations are subject to down slope movement. The lava tablelands have alkali areas as well as desert pavement in more rocky sites. Extensive rimrock formations occur along the western escarpment, usually situated above talus slopes.

Figure 2: Vicinity Map



Soils occurring on sites dominated by shrubby rolling hills, 6,000 to 6,500 feet in elevation, are moderately deep to deep, and stoney or gravelly on the surface. Erosion hazard is moderate. This represents about 6% of the Refuge. The dominant vegetation cover on these sites is bitterbrush, Idaho fescue, and big and low sagebrush.

Soils found at mahogany rockland sites, roughly 6,000 feet elevation, are shallow to moderately deep over basalt bedrock. These soils are stoney and gravelly throughout. These areas are scattered over the mid elevations of the Refuge, around 6,000 feet and represent less than one percent of the Refuge. Curlleaf mountain mahogany is the dominant life form on these sites.

Both stoney terrace and claypan terrace sites occur on gently sloping tablelands around 5,600 feet elevation. Stoney terrace soils are very stoney on the surface. Claypan terrace soils have gravelly loamy surface textures. These sites occur in association. Stoney terrace soils represent about 33% of the Refuge, while claypan terrace represents about 3%. Both of these sites are dominated by low sagebrush.

Arid loamy terrace soils occur from about 4,500 to 5,500 feet elevation. These soils are gravelly throughout with a hardpan or cemented gravel at 18 inches. Erosion hazard is slight. This type represents about 22% of the Refuge. These sites are dominated by big sagebrush.

Snow pockets occur on north facing slopes where snow drifts form and persist late into the year. Slope gradient is from 15% to 60% and elevation is above 6,000 feet. Soils are loamy, deep and very gravelly, and erosion hazard is slight. These sites are scattered throughout the higher elevations and represent less than one percent of the Refuge. Chokeberry, bittercherry, aspen and snowbrush dominate these sites.

Mountain swales occur between 6,000 and 7,000 feet elevation. Soils are loamy, deep and very gravelly and erosion hazard is slight. Like snow pockets, the mountain swales represent less than one percent of the Refuge. Basin wildrye, big sagebrush, green rabbitbrush and mountain snowberry are common varieties of plant life found on these sites.

Poorly drained bottom sites, or meadows, occur as nearly level bottoms in basins. Elevation is between 4,500 and 6,500 feet. Surface soil layers are black. Subsoils are very gray and mottled due to poor drainage. A restrictive layer which retains the water table usually occurs at three to four feet. Hazard is high for gully erosion. Meadows represent about 2% of the Refuge. Tufted hair grass, Nevada bluegrass, rushes, and sedges dominate these sites.

Juniper rolling hills and south exposures occur on prominent hills, ridges, plateaus and south facing slopes with a 2% to 50% gradient. Elevation is about 4,300 to 6,000 feet. Soils are stoney to very stoney throughout the profile and usually shallow over basalt bedrock. Erosion hazard is slight. Dominant plants are western juniper and sagebrush.

Aspen groves occur near some springs and along drainages above 6,000 feet. Soils have dark colored, thick surface layers with loamy and gravelly subsoils. Erosion hazard is slight. These sites represent less than one percent of the Refuge.

High rolling hills occur on sloping or rolling mountain tops above 7,500 feet. Soils are deep and gravelly throughout the profile. Erosion hazard is slight. Common vegetation for these sites is rough fescue and Idaho fescue. About 4% of the Refuge is represented by these sites.

Rolling hills occur above the shrubby hills site and below the high rolling hills site between the elevations of 6,500 and 7,500 feet. Soils are loamy and gravelly throughout the profile and erosion hazard is slight. About 10% of the Refuge is represented by this site.

Over 330 species of wildlife are known to occur on the Refuge. Featured species include antelope, bighorn sheep, mule deer, sage grouse and Redband Trout. Currently, there is only one federally or state listed threatened or endangered species, Bald Eagle (*Haliaeetus leucocephalus)*. See Appendix C for a comprehensive list of plants and animals.

CULTURAL RESOURCES

The Refuge has numerous pre- and post-European settlement sites. Native American sites are common and include rock art and lithic scatter concentrations. Over two dozen historic sites, mainly wooden structures or their remains, have been identified on the Refuge. Known sites are listed by the Regional Archeologist, and a site list is maintained at the Regional Office and the Oregon State Preservation Office.

VEGETATION

Prominent vegetation includes annual and perennial grasses and forbs, rushes, sedges, shrubs, sagebrush, mountain mahogany, western juniper woodlands, quaking aspen, ponderosa pine and white fir stands. A vegetation map can be found in Figure 3. There are no plants currently listed as threatened or endangered on the refuge (Appendix C).

Desert Shrub and Shrub-grassland Biomes

Upland desert shrub and shrub-grassland habitats comprise about 90% of the Refuge. The four major vegetation types that are included in this category are Wyoming big sagebrush, low sagebrush, mountain big sagebrush, and big sagebrush-bitterbrush.

Montane Shrub Biome

The mountain shrub vegetation type includes stands of mountain balm, gland ocean spray, bittercherry, and currants. It occurs on north slopes where snowdrifts from during winter. Many mountain balm thickets were severely impacted by frost during the winter of 1990-1991 when snow drifts did not insulate the vegetation. Recovery of these areas seems to be taking place based on the prevalence of re-sprouting shrubs. Livestock grazing may have impacted some mountain shrub thickets in the Intermediate Hills. A number of mountain shrub stands are being invaded by juniper.

The mountain mahogany vegetation type occurs mainly on rocky ridges and other areas that provide protection from fire. Although mountain mahogany has expanded into other vegetation types because of fire suppression in those areas, range expansion of this species has not been as extensive as that of western juniper.

Conifer Woodland and Forest Biomes

Currently, about 8% of the Refuge is wooded. Most of this consists of western juniper that has invaded other vegetation types. There are three types of woodland and forest habitats: western juniper, ponderosa pine, and white fir.

The western juniper vegetation type supports old-growth juniper, and occurs on rocky ridges and other areas that provide protection from fire. The present distribution of juniper includes trees of mostly less than 100 years old.

Terrestrial Non-vegetated Biome

The cliff and talus habitat running the length of the Refuges' western boundary comprise the bulk of the terrestrial non-vegetated vegetation type. Talus slopes on the east side of Hart Mountain comprise most of the remainder. The terrestrial non-vegetated type comprises about 2% of the Refuge.

Deciduous Forest and Riparian Shrub Biomes

These habitats comprise less than 1% of the Refuge. The main riparian vegetation types are quaking aspen, mixed deciduous shrub, and willow. Most of these habitats are found along streams, aside from quaking aspen. Although quaking aspen grows along many Refuge streams in headwater areas, much of it occurs in snowpockets.

About 20% of the area occupied by these vegetation types is characterized as having healthy stands of deciduous trees or shrubs and an understory of sedges, rushes, grasses, and a large variety of forbs. Vegetation diversity in these stands is high. These characteristics represent the potential of the aspen, willow, and mixed deciduous shrub vegetation types.

Marsh Biome

Meadow habitat comprises nearly 2% of the Refuge. Sedge-rush-bluegrass, and bluegrass-ryegrass are the two types that compose meadow habitat. Most meadow habitat is associated with stream floodplains. Meadows also occur in basin bottoms, such as Big Flat. Sedge-rush-bluegrass produces wet meadow habitat along the stream corridor and dry meadow habitat along the edges of floodplains under natural conditions. Bluegrass-ryegrass naturally supports dry meadow habitat.

Playas, or lakebeds, occupy about 3% of the Refuge, and nearly half of wetland habitats. They are scattered throughout the extensive tableland of the Refuge. Playas support three vegetation types depending on the amount of moisture that drains into basins, and the distribution of moisture over the playa. In general, drier sites support the silver sagebrush type, and wetter sites support the rush-spikerush-arnica type. Intermediate areas support poverty weed-primrose. Although moisture level is the main factor that influences vegetation on lakebeds, grazing by cattle and horses can have an effect also.

Aquatic Biomes (Open Water of Lakes and Streams)

Aquatic habitats on the Refuge consist of pondweed and aquatic non-vegetated vegetation types. The pondweed type occurs on open water portions of Big Flat and the Shirk Ranch area (during wet periods), and Jacob's Reservoir. The aquatic non-vegetated type occurs on Poker Jim Lake, Petroglyph Lake, and in streams.

Noxious Weeds

There are four noxious weed species known to exist on the Refuge: Canada thistle, Mediterranean sage, white top and Cheatgrass. On the Refuge, these four species occur in small patches around headquarters, along roads, in meadows, and around old homesteads. All are very aggressive and have the capability to dominate entire plant communities if left unmanaged.

FISH AND WILDLIFE

The higher elevations of Hart Mountain NAR are typified by several steep canyons, rock bluffs, and cliffs with snowbrush, wild gooseberry, chokecherry, juniper, and aspen thickets. This is preferred habitat for mule deer, bighorn sheep, golden eagles, prairie falcons, and numerous smaller bird species.

In contrast, the lower country to the east with the shallow intermittent lakes, is the preferred area of the antelope, kangaroo rats, burrowing owls, and sage sparrows, and such reptile as rattlesnake, bull snakes, yellow-bellied racers, and sagebrush lizards.

Between these extremes, among the big and short sage, mountain mahogany, and numerous kinds of bunch grasses, are the animals for which the mountain is so well known. Bands of antelope roam the gently-sloping east face. California bighorn sheep have been reestablished along the steep and rugged west wall and nearby Poker Jim Ridge. Also living in this vast area are mule deer, coyotes, bobcats, jackrabbits, cottontails, marmots, ground squirrels, night-hawks, northern flickers, and many other species of mammals and birds.

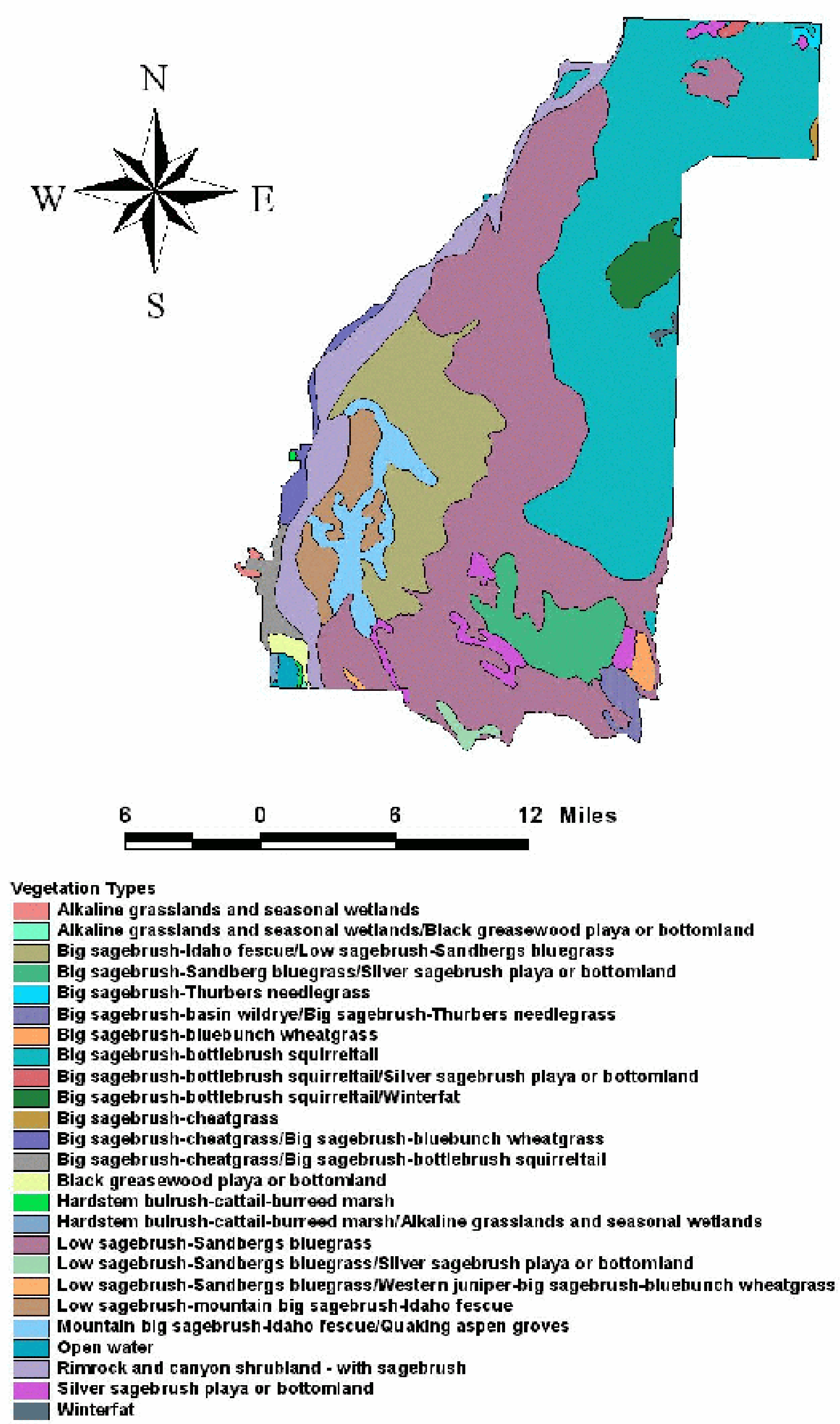
There is only one transitory vertebrate currently listed as threatened or endangered on the refuge, Bald Eagle (*Haliaeetus leucocephalus).*

STRUCTURES AND FACILITIES

Values at risk from fire suppression and prescribed burning operations include the headquarters complex, valued in excess of $2 million. A new bunkhouse facility is scheduled for completion in the summer of 2001, and a fire cache/vehicle storage facility has been proposed. The Hotsprings Campground facility has several outhouses and multiple unimproved campsites. The overflow campground at Guano Creek has an outhouse. Numerous historic homestead and more recent ranch sites exist as well. Other cultural resources include subsurface and surface artifact scatter sites and rock art sites. In addition, an antelope bitterbrush community located between Headquarters and the Hot Springs Campground is considered critical habitat and therefore a value at risk. Similarly, the unique 60 acre ponderosa pine stand located at Blue Sky is also high value.

Approximately 26,598 acres within the Refuge boundary are owned by the State Of Oregon and private land owners.

Figure 3: Vegetation



WILDLAND FIRE MANAGEMENT SITUATION

HISTORIC ROLE OF FIRE

Pre-settlement fires

Free-burning fire was a constant ecological presence on the American landscape prior to Euro-American settlement (Pyne 1997). Agee (1993) states that ecosystems with substantial presence of fire almost always contain species that are able to take advantage of fire effects to survive as a species. Such was likely the case in the presettlement shrub steppes of the western Great Basin and specifically Hart Mountain NAR. Pre-settlement fire occurrence in the Great Basin shrub steppe has received relatively little study compared to other plant communities in the West. However, Fire Ecologists have believed that prior to Euro-American settlement, fires occurred in the western Great Basin sage steppe every 20 to 100 years (Burkhardt and Tisdale 1976, Miller et. al. 1994), a key factor in maintaining and shaping the plant communities.

Miller and Rose (1998), after extensive research of eastern Oregon, northwestern Nevada, and northeastern California, coupled with examination of other research projects, refined fire return intervals for western Great Basin shrub steppes. The more productive mountain big sage (*Artemisia tridentata* spp. *vaseyana*) burned more frequently with fire return intervals typically ranging between 12 and 25 years. Fire return intervals in less productive Wyoming big sage (*Artemisia tridentata* spp. *wymingensis*) likely ranged between 25 to 100 years. In low sage (*Artemisia arbuscula*) fire return intervals range between 100 and 200 years.

Fire history studies based upon analysis of fire-scarred trees sampled at Blue Sky, a relic 60-acre Ponderosa Pine stand on Hart Mountain NAR, have produced quantitative information on past fire events.

Gruell (1995), using limited sampling, established a mean fire return interval of 13 years for this stand. Additional fire history study by Sheldon-Hart Mountain NAR fire staff has lowered this interval to 10 years, with fire-free intervals ranging from 2 to 19 years (Refuge Files 2000). Seasonality identification using microscopic examination of fire scars also showed that fires burned almost exclusively in the late summer/fall. The vast majority of identified fire scars were small, indicating probable low intensity , ground fires, although infrequent scars were large and wide spread, indicating probable high intensity, larger fires. These fire return intervals compare favorably with other studies in semi-arid regions of the Intermountain West which show that fires were frequent , mostly low intensity events with pre-1900 fire return intervals of 4-20 years in ponderosa pine dominated forest.

Although lightning was likely the primary ignition source for fires on Hart Mountain NAR, anthropogenic-set fires should not be discounted. Ignitions can likely be attributed to Native American peoples (Gruell 1985, Rose and Miller 1998). The reasons for Native American burning include forage enhancement, food gathering, and to clear dense vegetation. Examination of the archaeological record of the prehistoric sites on Hart Mountain NAR and the surrounding area shows extensive fire usage for cooking/camping and it is likely that numerous fires escaped control to burn as wildfires.

The true frequency and size of pre-settlement fires on Hart Mountain NAR is unknown. They likely were varied, depending on topography, potential ignition source, weather, and fuels. Pre-settlement fires likely burned as a mosaic creating multiple aged communities. Gruell (1994) speculated that pre-settlement mountain and shrub steppe in the western Great Basin supported a high complement of perennial grasses and forbs rather than shrubs. These highly flammable fine fuels would have contributed to close fire return intervals, which in turn would have perpetuated a predominance of herbs and grass over woody vegetation (shrubs). Fire likely restricted the development of juniper, curlleaf mountain mahogany, and antelope bitterbrush (Young and Evans 1981, West, 1988, Gruel 1994). With Euro-American settlement came disruptions to the natural processes. Given a disruption in natural fire regimes due to fire suppression/exclusion and intensive livestock grazing, shrubs have been allowed to dominate at the expense of herbaceous species. An absence of fire or other disturbance since Euro-American settlement has allowed formation of vast monotypic stands of late succession shrubs and wide expansions of those species of limited historic population size and distribution such as western juniper, antelope bitterbrush, and curlleaf mountain mahogany.

Post-settlement Fire History

Prior to the establishment of the Refuge in late 1936, it is unknown if fire suppression activities took place on Hart Mountain NAR. Records simply do not exist for the time period before 1937. However, during this time period it was a generally held belief by the U.S. public that wildfires were “bad” and fire was vigorously suppressed all across the U.S.. By the mid-1930's, particularly with the establishment of the CCC camp in Warner Valley, fire suppression became a reality. From the time period 1937 to the early 1980's, partial/incomplete records on file in the Lakeview Complex office and the FWS Regional Office in Portland suggest that all wildfires were as aggressively suppressed by Refuge staff as possible with assistance from cooperating agencies (BLM, State of Oregon, the CCC’s, and U.S. Forest Service). Agreements signed with the Lakeview BLM to provide fire protection/suppression services on the Refuge were formalized at least by the late 1960's. BLM continued these services until 1985 when a fire management program was established at Hart Mountain NAR.

By the mid-1950's the biological staff on Hart Mountain NAR Refuge had noted a drastic reduction in native grasses and associated range carrying capacity. A limited prescribed burn program was instituted under the guise of range improvement. In the next 25 years a half dozen prescribed burns were carried out. By the early 1980's the consideration for burning had gradually changed from range improvement to benefit the existing grazing program to an habitat management/restoration emphasis.

Typically, the majority of all wildfires occur during the driest period of the year; mid-June through early November. Lightning accounts for 59% of all wildfire starts, with the other 41% human caused. The lightning season is typically from June through September. Thunderstorms tracking across Hart Mountain NAR are generally wet, and, as a result, fires set by lightning most often are fairly small with limited spread and intensity. Fire crews on the Refuge have been effective in suppressing these fires soon after ignition, keeping the average lightning fire to under 15 acres. Human-caused fires on the other hand are often set under more extreme conditions. They have been set in every month of the year except the most extreme winter months (December - February) when snow is on the ground. Human-caused fires can be characterized as of two types; escaped prescribed burns (33%) or carelessness (67%), and average 1800 acres per incident. These fires usually burn with rapid spread and high intensity, requiring aggressive initial attack and mobilization of off-Refuge resources.

Seventeen years (1984-2000) of available fire history is summarized in tables 1 through 3. The Refuge Fire History Files of historic fires is not complete for the years prior to 1984. Lakeview District BLM provided a great deal of information to complete the records from 1984 to 1988.
Table 1: Summary of wildland fire history by ignition source

Year	# Human Fires	# Lightning Fires	Total Fires	#Human Acres	#Lightning Acres	Total Acres
1984	1	3	4	20	9	29
1985	1	0	1	11,391	0	11,391
1986	0	3	3	0	3	3
1987	0	0	0	0	0	0
1988	0	2	2	0	1	1

1989	0	0	0	0	0	0
1990	2	0	2	6	0	6
1991	0	1	1	0	5	5
1992	0	1	1	0	1	1
1993	0	0	0	0	0	0
1994	0	0	0	0	0	0

1995	1	0	1	800	0	800
1996	0	1	1	0	1	1
1997	1	0	1	640	0	640
1998	0	1	1	0	1	1
1999	1	1	2	3275	20	3295
2000	1(8)*	1	2(8)*	70(.8)*	160	230(.8)*
Total	8(8)*	14	22(8)*	16,206(.8)*	199	16,401(.8)*

*Numbers in parenthesis reflects actions taken on unauthorized and unattended fires started in dispersed camp sites during fire restriction period brought about by extreme fire danger. Prior to 2000 no records were kept for this information.

Table 2: Summary of 17 years of fire history by fire type

Year	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
1984	3	n/a	0	0	0	0
1985	2	n/a	2	0	3	0
1986	2	n/a	0	0	0	0
1987	0	n/a	0	0	4	0

1988	2	n/a	0	0	4	0
1989	0	n/a	0	0	0	0
1990	3	n/a	0	7	0	0
1991	2	n/a	0	5	2	0
1992	1	n/a	0	11	4	0
1993	0	n/a	0	1	1	1

1994	0	n/a	2	4	9	0
1995	1	n/a	1	6	8	0
1996	1	n/a	0	13	4	2
1997	1	n/a	0	3	9	0
1998	1	n/a	0	5	9	1
1999	2	n/a	0	7	2	1

2000	2	8	0	5	7	0
Total	18	8	5	67	66	5

Fire Type Key:

Type 1 - Fire Suppressed by FWS
Type 2 - Abandoned campfires
Type 3 - Natural Outs
Type 4 - Support Actions
Type 5 - Prescribed Fires
Type 6 - False Alarms

Prescribed fire history
Currently the Refuge has a very active prescribed fire program. The role of prescribed fire on Hart Mountain NAR has been outlined in the Hart Mountain NAR Comprehensive Management Plan to; use fire as a management tool to improve ecological condition of the Refuge, to promote greater diversity within plant communities on the Refuge, to re-introduce fire in natural ecosystems, and to reduce hazardous fuels levels. In effect, prescribed fire is being used as a tool to mimic the natural fire regimes which were present prior to Euro-American settlement.

Table 3: Summary of Prescribed Fire (PF) History

Year	# of PF	PF Acres
1984	1	20

1985	2	1316
1986	0	0
1987	4	2
1988	4	2
1989	0	0
1990	1	683

1991	2	340
1992	4	776
1993	1	211
1994	9	2861
1995	8	1783
1996	4	2110

1997	9	2381
1998	9	3321
1999	2	405
2000	7	1696
Total	67	17907

RESPONSIBILITIES

Regional Director

Approves Fire Management Plan. Approves complex-rated prescribed fire plans. Approves wildland fire Rehabilitation Plans.

Regional Fire Management Coordinator

Fire program review leader. Leads review teams for escaped prescribed fires. Provides Refuges with budget and technical leadership.

Project Leader

Supervises the complex fire management program. This position approves Refuge Prescribed Burn Plans, selects and certifies the preferred alternative for the Escaped Fire Situation Analysis and approves the Delegation of Authority. Validates prescribed fire status daily.

Deputy Project Leader

Supervises Fire Management Officer. Coordinates Refuge and complex programs to ensure personnel and equipment are made available and utilized for fire management activities including fire suppression, prescribed burning and fire effects monitoring. Ensures that fire management program has access to Refuge and complex resources when needed. Ensures that Refuge Managers and complex Staff consider fire management program during Refuge related planning and implementation.

Refuge Manager
Identifies prescribed burn units and biological objectives to Fire Management Officer (FMO). Notifies FMO of prescribed fire project constraints. Ensures that Refuge resources are available to accomplish prescribed fire and fire suppression objectives. Acts as the primary Refuge Resource Management Specialist during fire management planning and operations. Ensures fire effects monitoring is being implemented. Drafts wildland fire Rehabilitation Plans for Deputy Project Leader. Responsible for posting and enforcing fire restriction regulations.

Fire Management Officer
Responsible for all fire related planning and implementation for the complex. Supervises Assistant Fire Management Officer, Prescribed Fire Specialist, and Lead Range Technicians. Integrates biological Refuge objectives into all fire management planning and implementation. Proactively solicits program input from Refuge Managers and Biologists. Supervises prescribed fire planning. Coordinates fire related training. Coordinates with cooperators to ensure adequate resources are available for fire operational needs. Determines when ecological and political triggers are reached for wildland fire and prescribed fire implementation purposes. Fiscal control of pre-suppression and prescribed burning budgets.

Assistant Fire Management Officer
Responsible for assisting the FMO in all aspects of the fire program. Performs as the acting FMO in the absence of the FMO. Interacts closely with Refuge personnel in the planning and implementation of the Refuge fire program. Supervises Refuge fire crews. Coordinates fire related training. Coordinates with interagency partners.

Prescribed Fire Specialist
Performs prescribed fire planning. Interacts closely with Refuge Managers and Biologists to identify prescribed burn projects, establish burn units and resource objectives, and eliminate resource conflicts. Coordinates Live Fuel Moisture program. Designs and leads implementation of fire behavior monitoring and Level 1 fire effects monitoring. Coordinates prescribed fire project documentation process and maintains files. Coordinates fire research projects with researchers.

Biologists
Coordinate through Refuge Managers and Deputy Project Leader to provide biological input to the FMO. Design and lead implementation of fire effects monitoring, with input from FMO. Participates as requested in prescribed burning and wildland fire suppression.

Incident Commander
Chris Farinetti FMO and Tom Romanello AFMO are assigned as Incident Commander of all Type III Incidents on Sheldon-Hart Mountain NAR Complex for the U.S. Fish and Wildlife Service, effective January 1, 2001.

Incident Commanders (of any level) use strategies and tactics as directed by the Project Leader and WFSA where applicable to implement selected objectives on a particular incident. A specific Limited Delegation of Authority (Appendix D) will be provided to each Incident Commander prior to assuming responsibility for an incident. Major duties of the Incident Commander are given in NWCG Fireline Handbook, including:

- < Brief subordinates, direct their actions and provide work tools.
- < Ensure that safety standards identified in the Fire Orders, the Watch Out Situations, and agency policies are followed at all times.
- < Personally scout and communicate with others to be knowledgeable of fire conditions, fire weather, tactical progress, safety concerns and hazards, condition of personnel, and needs for additional resources.
- < Order resources to implement the management objectives for the fire.
- < Inform appropriate dispatch of current situation and expected needs.
- < Coordinate mobilization and demobilization with dispatch and the Collateral FMO.
- < Perform administrative duties; i.e., approving work hours, completing fire reports for command period, maintaining property accountability, providing or obtaining medical treatment, and evaluating performance of subordinates.
- < Assure aviation safety is maintained to the highest standards.

Initial attack teams

Initial attack teams will consist of firefighters and qualified leadership. Teams will be prepared and equipped with hand and power tools as needed and will be dispatched with a day's supply of food and water, so they can continue work for 24 hours without additional support.

Employees participating in any wildland fire activities on Fish and Wildlife Service or cooperator’s lands will meet fitness requirements established in PMS 310-1, except where Service-specific fitness requirements apply.

Exceptions to fitness requirements on Initial attack activity are available from the Regional Fire Management Coordinator per guidelines in Chapter 1.5-7 of the Fire Management Handbook (USFWS 2000).

FIRE MANAGEMENT STRATEGIES

The Comprehensive Management Plan for the Refuge includes managing significant land areas as Recommended Wilderness Areas, Potential Wilderness Study Areas, Research Natural Areas, and Potential Research Natural Areas. Fire history has been reconstructed using all available resources, including records of cooperators and oral interviews. This information has been used to determine burn block locations, suppression strategies, burning prescriptions, and monitoring plot locations.

Based on the management objectives of the refugeand the best available science, the following strategies will be used to manage fire at Hart NAR:

- < All wildland fires will be suppressed. The full spectrum of suppression strategies ranging from aggressive control to the least possible acres, to containing fires with control lines at planned locations, to confining fires to broad, defensible boundaries will be used. The appropriate suppression strategy will be selected in an Wildland Fire Situation Analysis. Recommended strategies will be developed from current and forecasted weather and fire behavior, values at risk, safety, fuel conditions and available resources.

- < The Control, Contain and Confine fire suppression strategies provide flexibility that allow managers to analyze values at risk, ecological effects of fires and impacts and costs associated with suppression operations. This analysis should provide the most cost effective suppression strategy that meets the following:

1. The cost of the suppression strategy implemented must be less than the value at risk.
2. The cost of the suppression strategy should be the least costly alternative in the Wildland Fire Situation Analysis.

< Fire management strategies for each area will be formulated during Prescribed Burn Plan preparation and Wildland Fire Situation Analysis strategy selection. A resource management specialist will be involved in all phases of fire management planning and implementation.

< Prescribed fire will be used to promote diversity in late succession shrub communities resulting from overgrazing and half a century of fire exclusion. Hazard fuel reduction burning will be conducted along transportation corridors and around values at risk to reduce unnaturally high fuel loadings. Resource management prescribed burning will be conducted to encourage recovery of riparian areas, improve grass and forb production, and generally improve wildlife habitat.

< The judicious use of Prescribed Fire (PF) is the most cost effective and ecologically sound means available to convert late succession woody shrubs stands to more productive early succession communities that promote biological diversity and improved habitat condition. The Comprehensive Management Plan for the Refuge clearly outlines the PF use decision.

< Significant cultural sites are also present on the Refuge. These sites include standing and fallen homestead sites, lithic scatter and rock art sites. Because of the diversity of site location, type and resultant fire effect, strategies will be developed during Prescribed Burn Plan preparation and Wildland Fire Situation Analysis strategy selection. Heavy equipment will not be used indiscriminately during fire management activities. However, heavy equipment and aerial retardants will be used during initial attack of wildland fires that threaten life and/or property.

< No currently listed threatened or endangered plants are known to exist on the Refuge. A list of sensitive and endemic plants can be found in Appendix C. Primary and secondary effects of fire on these populations are expected to be short term only. Strategies for individual fires will be developed during Prescribed Burn Plan preparation and Wildland Fire Situation Analysis strategy selection.

< Heavy equipment will only be used to improve the fire holding capability of existing roads. No new mechanical line will be constructed in the Refuge, unless life or property is threatened, or is approved by the Refuge Manager. Mechanical line may be constructed to protect structures and improvements.

< The use of aerial retardants will be determined on a case-by-case basis, and only after careful analysis of the cost of retardant use against the values at risk. Aerial retardants may be used to protect structures and improvements regardless of cost.

< Off road driving will be restrained to the absolute minimum necessary for fire management operations. Fragile dry soils can be severely disturbed by rubber tired vehicles.

INTERAGENCY OPERATIONS
Cooperative agreements with various federal, state and local agencies (Appendix E) generally provide that resources of each agency are available to assist in initial attack efforts. These agreements have detail payment among cooperators, list of response areas, communications frequencies, and have been reviewed by a contract specialist and/or solicitor.

Hart Mountain NAR will use the Incident Command System (ICS) as a guide for fireline organization. Qualifications for individuals is per DOI Wildland Fire Qualifications and Certification System, part of NIIMS and the National Wildland Fire Coordination Group (NWCG) Prescribed Fire Qualification Guide. Depending on fire complexity, some positions may be filled by the same person.

The Lakeview Interagency Fire Center (LIFC) is the servicing dispatch center for all public land management agencies in south central Oregon. LIFC provides the following services to Hart Mountain NAR through the authority of a Memorandum of Understanding (Appendix E):

< Collection and dissemination of fire weather forecasts and observations.
< Mobilization of suppression forces as instructed by the FMO for complex.
< Aircraft scheduling and flight following for fire related aircraft use.
< Incorporating Refuge detection needs into cooperator detection flights.
< Situation reporting.
< WIMS Daily Inputs.
< Expanded Dispatch.
< Coordinates Local Training.

LIFC is staffed by all local agencies, including USFWS, and operates to service all local agencies. The primary employees of the Center are the Center Coordinator and 2 Assistant coordinators. All local public land agencies with fire management responsibilities can be mobilized through LIFC. The Refuge FMO sits on the LIFC Oversite Committee. The Dispatch Plan is located in Appendix F.

Cooperators for Wildland fire operations on Hart Mountain NAR are as follows; Burns District BLM, Vail District BLM, Lakeview District BLM, Cedarville District BLM, Winnemucca District BLM, Modoc National Forest, and the Fremont National Forest.

Agreements and operating plans currently require annual renewal. Cooperating agencies are looking at a five year renewal process starting in FY 2002. Agreements can be found in Appendix E.

PROTECTION OF SENSITIVE RESOURCES
Wildland fires, whether prescribed burning operations or suppression activities, will follow service guidelines set within their specific plan; Prescribed burn plan or Wildland Fire Situation Analysis process. The refuge manager, biologist, FMO type and project leader will determine if dozer line is allowed or necessary on a case by case basis. In cases of immediate threat to life and/or property, the IC on a wildfire may use discretion in use of dozer line. Resource advisors are required for dozer use or any ground disturbing activities required in fire suppression.

All visiting resources will be throughly briefed prior to working on the refuge regarding ground disturbance activities such as off road driving, ATV use, etc. A fire crew handbook is being developed in order to thoroughly brief firefighters visiting the refuge.

There are numerous prehistoric sites located on Hart Mountain NAR. The effects of fire on these sites is not easily measured or mitigated. The fire return interval for much of the area has been estimated to be less than 100 years. As such, these sites have most likely experienced fire and in part are in their current condition as a result of fire. Fire suppression operations using mechanized equipment will have a much greater impact on these sites than fire itself, and disturbance should be avoided (Valentine). Whenever possible during wildland fire events, resource advisors will be utilized in conjunction with suppression activities to identify and avoid impacts to sites. In the event sites are located during fire management operations, the sites will be avoided as much as possible and the Regional Archeologist notified.

Wooden structures remaining at post-European settlement sites are at considerably more risk from fire. These structures are considered values at risk from wildland fire. Hazardous fuels reduction projects (removal of encroaching sage and grass) are performed yearly by Refuge fire crews at the beginning of summer to minimize risk from wildland fires. In addition, prescribed fire operations are planned and conducted to avoid impact to these sites.

The Regional Archaeologist and/or his/her staff will work with fire staff, project leaders, and incident commanders to ensure that cultural resources are protected from fire and fire management activities. The "Request For Cultural Resource Compliance" form (RCRC, Appendix R) will be used to inform the Regional Archaeologist of impending activities, thereby meeting the regulations and directions governing the protection of cultural resources as outlined in Departmental Manual Part 519, National Historic Preservation Act (NHPA) of 1966, Code of Federal Regulations (36CFR800), the Archaeological Resources Protection Act of 1979, as amended, and the Archaeological and Historic Preservation Act of 1974. The NHPA Section 106 clearance will be followed for any fire management activity that may affect historic properties (cultural resources eligible to the National Register of Historic Places).

Impacts to archaeological resources by fire resources vary. The four basic sources of damage are (1) fire intensity, (2) duration of heat, (3) heat penetration into soil, and (4) suppression actions. Of the four, the most significant threat is from equipment during line construction for prescribed fires or wildfire holding actions (Anderson 1983).

The following actions will be taken to protect archaeological and cultural resources:

Wildland Fires

- Minimum impact fire suppression tactics will be used to the fullest extent possible.
- Resource Advisors will inform Fire Suppression personnel of any areas with cultural resources. The Resource advisor should contact the Regional Archaeologist and/or his/her staff for more detailed information.
- Foam will not be used in areas known to harbor surface artifacts.
- Mechanized equipment should not be used in areas of known cultural significance.
- The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.
- Rehabilitation plans will address cultural resources impacts and will be submitted to the Regional Archaeologist using the RCRC.

Prescribed Fires

- The Refuge Fire staff will submit a completed RCRC to the Regional Archaeologist and/or his/her staff as soon as the burn area is identified (i.e., as soon as feasible).
- Upon receipt of the RCRC, the Regional Archaeologist and/or his/her staff will be responsible for consulting with the FMO and evaluating the potential for adverse impacts to cultural resources.

$ When necessary, the Regional Archaeologist and/or his/her staff will coordinate with the State Historic Preservation Officer (SHPO). The SHPO has 30 days to respond. The Refuge will consider all SHPO recommendations.

$ Mechanized equipment should not be used in areas of know cultural significance.

$ The location of any sites discovered as the result of fire management activities will be reported to the Regional Archaeologist.

WILDLAND FIRE ACTIVITIES

Fire program management describes the operational procedures necessary to implement fire management at Hart Mountain NAR. Program management includes: fire prevention, preparedness, emergency preparedness, fire behavior predictions, step-up staffing plan, fire detection, fire suppression, minimum impact suppression, minimum impact rehabilitation, and documentation.

All fires not classified as prescribed fires are wild fires and will be appropriately suppressed.
There are 2 engines (Type-4) and (Type-6) with a total of eight crewmembers stationed on the refuge from approximately June 15 - September 30. These crews are the primary initial attack fire suppression resources for the refuge and adjacent federal and state lands, closest resource concept applies to all fires. Should additional resources be necessary, agreements exist for the use of cooperating agencies. See Appendix E for existing agreements. The primary cooperators are the USFS, BLM and Oregon Department of Forestry. In the event a fire escapes initial attack efforts, local type 3 teams may be utilized or an area Type 2 team may be mobilized. It is unlikely that a Type 1 team would be utilized on the refuge given the remoteness, fuel types and lack of urban interface. The Lakeview Interagency Fire Center (LIFC) is the primary dispatch center for refuge fire activities.

Records show that fire season is typically from June - September.

PREPAREDNESS

Preparedness is the work accomplished prior to fire occurrence to ensure that the appropriate response, as directed by the Fire Management Plan, can be carried out. Preparedness activities include: budget planning, equipment acquisition, equipment maintenance, dispatch (Initial attack, extended, and expanded), equipment inventory, personnel qualifications, and training. The preparedness objective is to have a well trained and equipped fire management organization to manage all fire situations within the refuge. Preparedness efforts are to be accomplished in the time frames outside the normal fire season dates.

ANNUAL ACTIVITIES

The following flow of activities will guide the Refuge fire program during fire readiness preparations:

January	Seasonal Fire Crew hiring begins Supervisory technicians inspect cache and engines to determine procurement needs AFMO attends LIFC Operations Group Meetings Training as scheduled PFS, LFM sampling as needed Fire Management Plan reviewed
February	Seasonal Fire Crew hiring completed AFMO provides input to FMO as to procurement needs AFMO attends LIFC Steering Group Meeting AFMO orders necessary basic training materials from NIFC Training as scheduled PFS conducts LFM sampling as needed
March	FMO attends LIFC Oversite Group Meeting AFMO coordinates with LIFC to reserve slots in basic fire schools if available Range Technician begins employment period Training as scheduled PFS conducts LFM sampling regular program begins

	All fire radios are serviced by Interagency Communications Unit locally
April	Last minute hiring changes completed Supervisory technicians ensure all fire equipment is serviced Training/Pack-Test for permanent employees completed PFS conducts LFM program LIFC Operations Committee Meeting
May	LIFC Operations Committee Meeting Basic training for regular employees PFS conducts LFM program Step-up plan and Refuge dispatch plans reviewed
June	Seasonal Fire Crew on board All basic training/Pack-Test is completed Engine crews go through engines, bring to NUS Cache items checked out Last minute changes to equipment completed. PFS conducts LFM program Seasonal Fire Crew goes to Refuges LIFC Operations Committee Meeting Fire effects monitoring
July	July 4th weekend Order of the Antelope extended staffing if indices warrant. PFS conducts LFM program LIFC Operations Committee Meeting Fire effects monitoring
August	LIFC Operations Committee Meeting Fire Budget reviewed, balanced and zeroed PFS conducts LFM program Fire effects monitoring
September	LIFC Operations Committee Meeting Budget for next fiscal year drafted. Summer seasonals evaluated and terminated if appropriate (may need for RX burning) PFS conducts LFM program Fire effects monitoring
October	Equipment refurbished and winterized PFS conducts LFM program Fire effects monitoring AFMO annual training nominations due FMO/AFMO Firebase inputs due
November	Fire history for year reviewed and updated in GIS PFS conducts LFM program Lead Technicians in non-pay status
December	PFS conducts LFM program Fire history project completed for year

Historical weather analysis

The current wildland fire season for Hart Mountain NAR is set in the FIREBASE system from June 1-September 30. Sixty-eight % of all wildfires on Hart Mountain NAR have occurred during the listed fire season, with the month of August the most active fire month. Analysis of 16 years of weather data from the Rock Creek RAWS station show that the month of August averages the lowest relative humidity, highest mean temperature, lowest fuel moistures, highest burn index (BI), and highest energy release component (ERC), all factors which influence the start, behavior, and spread of wildfires. Correspondingly, August has the highest percentage of fire occurrence of any month of the year, accounting for 45% of all wildfires. Additionally, a record search of the Lakeview Complex fire records shows that on average, wildland fires burn 1,020 acres per year. 75% percent of all acreage burned on Hart Mountain NAR has occurred during the month of August.

Appendix H references historical weather data from the Rock Creek RAWS station. A weather station catalog of Rock Creek is also included.

Staffing Priority Levels

The National Fire Danger Rating System (NFDRS) is the process by which relative fire danger indices are assigned and corresponding staffing priority levels assessed. Fire weather information is integrated with refuge specific fuel and topographic information to determine various fire danger indices. This system is operated through the Weather Information Management System (WIMS) using archived historical weather data stored in the national depository in Kansas City. Hart Mountain NAR weather data from the Rock Creek/Fish Fin/Catnip Remote Automated Weather Station (RAWS) is collected daily by LIFC and has been archived for the past 16 years. Using historic data and the FIREFAMILYPLUS computer program, predictions based upon historic weather data and fire occurrence can be made. Refuge fire season and abnormal fire danger is annually predicted.

Staffing priority levels are designed to direct incremental prepardness actions in response to increasing fire danger. Staffing levels describe escalations in prepardness activities and staffing. These are approved, predetermined responses to increased fire danger for a burn burning period, which is defined as the period of the day when fire burns most actively in a given fuel type. Five staffing levels (1-5) have been determined, with level 1 reflecting limited need for staffing due to a potential to limit fire starts to very small size and level 5 to high prepardness and increased staffing due to a potential for any fire start to grow rapidly to project-sized wildfires. Of utmost importance is the Burning Index (BI) and, to a lesser degree, Energy Release Component (ERC), which are used as the basis to determining and ranking fire danger and increased or decreased prepardness. The BI, in particular, is designed to reflect the difficulty in controlling a new fire start. Break points between staffing levels are determined by the cumulative percentages of occurrence of the BI during the fire season. For fire management purposes, the most critical break points occur at the 90^{th} and 97^{th} percentile break points. These two points define staffing classes 4 and 5, the classes reflecting the most fire potential and most need for increased staffing. The Hart Mountain NAR RAWS, using an NFDRS fuel model T (sagebrush with grass), collects the daily data necessary to determine all WIMS inputs and NRFDS outputs. LIFC, analyzing this data, provides daily updates in predicted BI's and ERC's, and associated staffing levels.

FIREFAMILYPLUS computer program runs determining 90^{th} and 97^{th} percentile breakpoints for Hart Mountain NAR BI's and ERC's using NFDRS Fuel Model T (sagebrush with Grass) are shown in Appendix H.

Training

Departmental policy requires that all personnel engaged in suppression and prescribed fire duties meet the standards set by the National Wildland fire Coordinating Group (NWCG). Hart Mountain NAR will conform strictly to the requirements of the wildland fire management qualification and certification system and USFWS guidelines.

Basic wildland fire training refreshers are offered annually for red-carded firefighters and records kept in a centralized database. Additional training is available from surrounding agencies in pump and engine operation, power saws, firefighter safety, fire weather and fire behavior, helicopter safety and prescribed fire objectives and activities. On-the job training is encouraged and will be conducted at the field level. Whenever appropriate, the use of fire qualification task books will be used to document fire experience of trainees. The FMO will coordinate fire training needs with those of other nearby refuges, cooperating agencies, and the RO.

The refuge supports the development of individual Incident Command System (ICS) overhead personnel from among qualified and experienced refuge staff for assignment to overhead teams at the local, regional, and national level.

Fire suppression is an arduous duty. On prescribed fires, personnel may be required to shift from implementation/monitoring activities to suppression. Poor physical condition of crew members can endanger safety and lives during critical situations.

Personnel performing fire management duties will maintain a high level of physical fitness. This requires successful completion of a fitness pack test. Personnel must complete a three mile hike with a 45 pound pack in less than 45 minutes.

Fire training is a primary responsibility of the Assistant Fire Management Officer. Minimum acceptable training is included in Table 4.

Table 4: Minimum training

S130, S190, Standards for Survival and I220	All seasonal fire crew members
Standards for Survival, Annual Refresher	All employees engaged in fire suppression.
S290, S390, S230, S260, S270, S205, S211,	Lead Technicians and potential
S212, S215 and I200	assistant engine operators
I300 and above position training	Lead Technicians, AFMO and FMO

Every opportunity for employee career development beyond the above listed minimum standards will be taken advantage of as funding permits.

Supplies and Equipment

The Sheldon 30-person cache is located in Lakeview. The AFMO issues equipment and NUS to firefighters prior and during fire season (this may be delegated to Station Managers). The station manager outfits the engines with enough supplies to make it through a 48 hour shift. Due to inadequate storage space, re-supply of engines must be done in Lakeview. If multiple fires dictate immediate re-supply a truck can be sent from Lakeview with requested supplies. Additional equipment and supplies are available through cooperators and the Interagency cache system in Redmond. Requests for additional personnel and equipment are made through the servicing Dispatch Centers. Type 4 and Type 3 Incident

Commanders place resource orders through dispatch via radio, cell phone or fax machine. Dispatch then contacts the duty officer for appropriate approvals for the order.

Basic equipment needs the cache will supply include: Personal protective equipment and basic firefighter equipment needs for up to 30 people, equipment necessary to outfit 3 heavy and 1 light engine, prescribed fire equipment necessary to maintain an active prescribed fire program and miscellaneous equipment common to basic fire suppression needs.

A listing of the current NUS for the cache can be viewed in Appendix I.

Detection

Fire detection strategy for the Refuge is generally tied to the Interagency Partnership Operations Committee (OPS). The OPS committee members routinely determines priorities for detection flight routes during periods of high fire danger. Cost-sharing for flights are is alternated between the Partnership members.

During lightning activity, Refuge personnel will implement fire patrols.

Communications

Lakeview Interagency Fire Center (LIFC) provides daily communication and dispatch functions for all fire related activities i.e., initial attack, prescribed burning, aviation flight following, daily availability of engines and personnel. Communication support falls under the South Central Oregon Fire Management Partnership(SCOFMP) MOU. See Appendix J for shared frequency list.

The complex utilizes 3 frequencies on a daily basis for all fire management activities. Fish and Wildlife Direct is a line of sight frequency used on most prescribed burns and smaller type 4 incidents. The solar repeaters are located on mountain tops and serviced by the BLM/FS radio shop in Lakeview. Warner Peak on Hart Mt. and Badger Mountain on the Sheldon are the USFWS repeaters. BLM owns a repeater on Hart Mt. which is co-located next to the USFWS repeater. Hart Mountain NAR has 2 base stations, one in the fire bunkhouse the other in the headquarters office.

FWS Direct------ RX 168.575	TX 168.575	Code 0	Guard-------
FWS Badger-----RX 168.575	TX 168.650	Code 6	Guard 123.0
FWS Warner-----RX 168.575	TX 168.650	Code 3	Guard 107.2

FIRE MANAGEMENT UNITS

Three Fire Management Units (FMU) adequately associate the relationship that fire has to the Refuge. These FMUs were designed by differences in management objectives rather than vegetation type. Refer to figure 3.

FMU I: Escarpment and higher elevations

Fire Management Unit I is located on the highest topographical features of the Refuge. It lies on the western escarpment of the Hart Mountain Range (from 4,500 feet to 8,000 feet elevation), and includes Hart Mountain, Warner Peak and Poker Jim Ridge. In addition, the west slopes of these features (from 6,000 feet to 8,000 feet) are also incorporated in the 98,575 acres of FMU I. This area is remote, rugged and natural in character. The Warner Research Natural Area, Hart Mountain NAR Wilderness Study Area, Cooper Research Natural Area, Poker Jim Research Natural Area and Poker Jim Recommended Wilderness Area all fall within FMU I.

Vegetation type

The vegetative makeup of FMU I includes native species: white fir, ponderosa pine, quaking aspen, willow, western juniper, mountain mahogany, mountain big sagebrush, bitterbrush, low sagebrush, rabbitbrush, wheatgrass, bluegrass, fescue, and squirrel tail. Cheatgrass and Mediterranean sagebrush are also present, but represent a small percentage of the total composition of species.

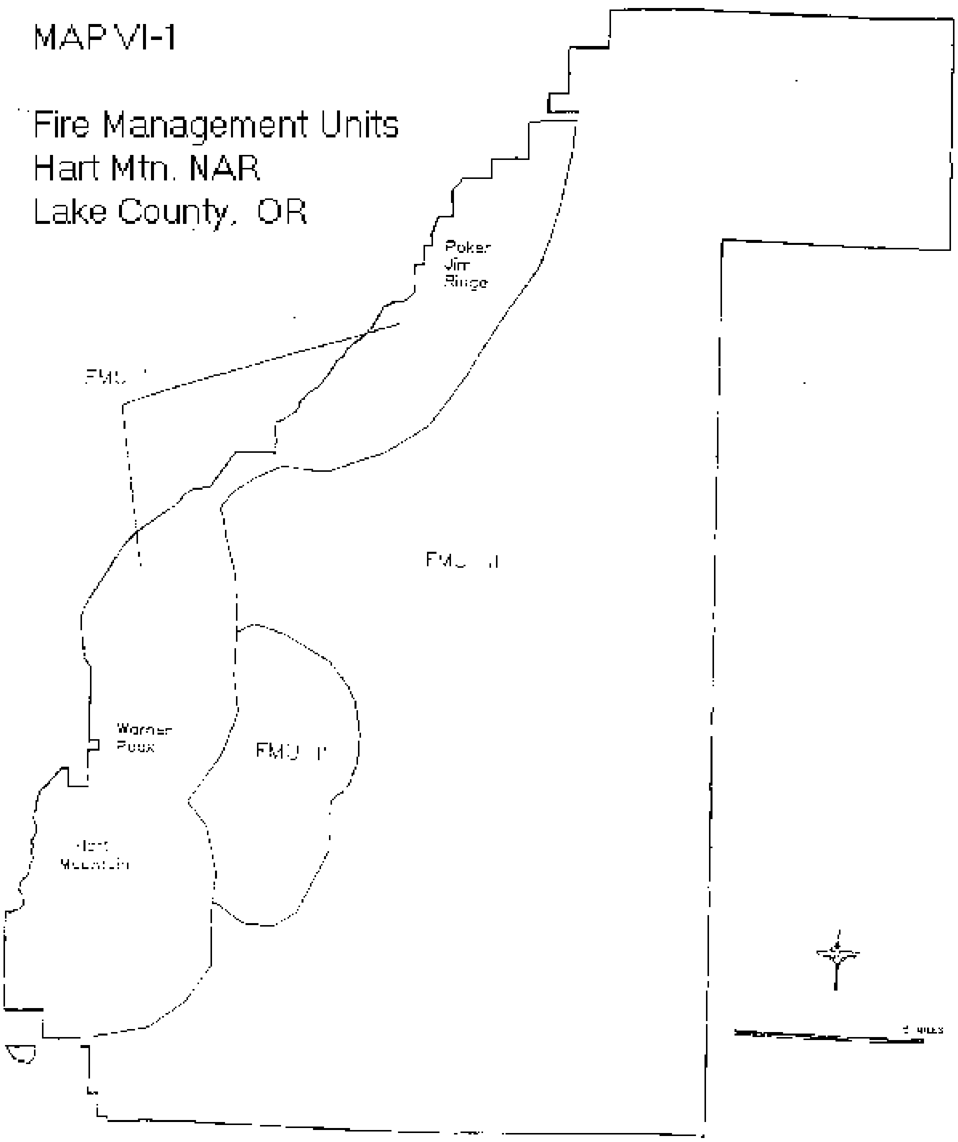
Strategies
Wildland fire suppression strategies implemented in FMU I will compliment the natural characteristics of the area. Incident Commanders will consider confinement as the primary suppression strategy for FMU I. No mechanized fireline or off-road driving will be allowed in this FMU, unless included in the approved strategy of an Wildland Fire Situation Analysis and Delegation of Authority. Use of "light hand on the land" tactics will produce minimal surface disturbance from fire suppression. Acceptable fire suppression resources include handcrews and all handtools, helicopters, light vehicles on roads only, aerial retardants and foam. Utilization of indirect attack suppression tactics should be considered as a primary tactic in this FMU. All firelines and associated surface disturbances will be rehabilitated as soon as possible following suppression activities.

Fire history
Although the definitive fire record doesn’t exist for FMU 1, evidence gathered through fire history studies on Hart Mountain NAR (Gruell 1995, Refuge Files 2000) and Lakeview Complex fire files suggests a fire history typified by periodic low intensity, surface fires which burned in a true mosaic pattern. Most of these fires are believed to have been fairly small acreage, but occasionally large acreage, more intense fires burned, particularly during periodic drought cycles or under extreme weather conditions (high wind events, extremely low relatively humidity, etc.).

Wildlife
FMU I is considered suitable habitat for the featured species of the Refuge. Most notable in this area is the California bighorn sheep and mule deer. The majority of wildlife diversity on the Refuge occurs here. Fire management strategies in this FMU are to improve habitat through prescribed fire and to suppress wildland fires that would, if allowed, degrade the current condition of the habitat. In addition, all fire management activities will be consistent with the wilderness characteristics of the area.

Fuels
Fuels are generally represented by NFDRS model T and FBPS models 5 and 6, depending on the season of the fire event (Anderson). Some areas of Poker Jim Ridge may be better represented by NFDRS model F. Live fuel moisture is an important fire behavior, intensity and severity indicator in this fuel complex. When live fuel moistures (LFM) are above 120%, fires generally require moderate to high wind speeds to carry. When LFM is below 100%, rapid rates of spread, spotting and flame lengths in excess of 20 feet can be anticipated. Important fire indicator species include the presence of large stands of young juniper, aspen suckers, rabbit brush and cheatgrass. Juniper presence indicates fire exclusion (Gruell, 1994), aspen suckers may indicate fire occurrence (Gruel), and rabbit brush and cheatgrass are both fire adapted species that quickly reoccupy burned areas.

Figure 4: Fire Management Units



Fire Behavior
Fire Behavior in FMU I is dependent on slope and wind speed and direction. The boundaries of the unit consist of slopes in excess of 70%, and exposure to wind can vary depending on local and free air wind directions, which change quite frequently. Generally, rapid upslope, cross slope and downslope runs can be anticipated. Flame lengths in excess of 20 feet are frequently observed during upslope runs. Duration of fires is usually less than three burning periods, and more often than not limited to one burning period because of cold night time temperatures (35-40 degrees f.) and relative humidity recovery (35-50%). However, actively spreading fires can become quite large in this fuel type in one burning period, especially during drought periods and during high wind events. Three large fires on record for this FMU (Blue Joint, 1995, DeGarmo, 1954, and De Garmo 1999), burned under such conditions. All were wind-driven events which burned with high intensity, rapid rates of spread, and long flame lengths until the winds died. Fire behavior nearly ceased with lack of wind. Interestingly, the De Garmo Fire of 1999 started under the same conditions as the 1954 De Garmo fire (human-caused during a high wind event) in just about the same isolated location, and burned across similar drainages with a replication of over 90% of an identical burn pattern. Both 1954 and 1999 fires ceased when the wind event which was driving them ceased. Fuel availability seems to be also a factor in determining eventual spread of sire starts. On the majority of the steep escarpment face, the vast plurality of historic fires have been limited to single juniper trees fires on rocky, fuel-free ridges, many of which were natural outs (reported fires which went out on their own before suppression occurred).

Fire effects
Late winter, spring and fall prescribed burning in this FMU have resulted in a range of fire effects that are acceptable and meet Refuge management objectives. The target species for burning, shrubs and western juniper, are easily killed by fire regardless of season.

However, successful burns must be conducted during windows of opportunity that include such factors as live fuel moisture below 120%, fine fuel moisture 3-10%, dry bulb temperature greater than 35 degrees f. and relative humidities below 30%.

Plants physiological condition at the time of burning is really the single most important factor to consider when determining burning prescriptions. As a result, all prescribed burning in this FMU will be conducted during the phase of dormancy of perennial grasses, generally speaking after summer cure and prior to green-up.

Late winter and spring burning windows of opportunity are short, inconsistent and easily missed. Late summer and fall burning windows are by far the longest and most consistent.

The annual fire weather cycle for this FMU is extremely sensitive to drought conditions. During normal snow years, snow covers most of FMU I above elevations ranging from 5,000 to 6,000 feet. In cold drainages and northern aspects, snow pockets may remain until well into late summer.

At elevations of 5,000 feet and below, on the western escarpment of Hart Mountain, green up will begin February-March. Green up at higher elevations is dependent on the melt of snow cover and can be expected to occur during the early months of summer. Annual grasses are usually in the purple stage by late June and begin to cure by mid-July. Most grasses are cured and readily available as fuel by the end of July.

Most sagebrush species come out of winter dormancy late in the spring and begin to put on new growth in April-May. Live fuel moistures are well above 100% during this period of time. Live fuel moisture generally drops below 100% in the first weeks of August, and continues to drop through the fall, until the plant reaches winter dormancy.

Drought conditions play a significant role in live fuel moistures and affect the amount of moisture the plants can accumulate and successfully store during the dry summer months. As such, curing of grasses and drop in shrub live fuel moisture can be accelerated during drought summers.

The Keetch-Byram Drought Index (KBDI) is used to monitor drought conditions through the Weather Information Management System (WIMS), a commonly used tool of fire managers. Observed conditions indicate that a KBDI value of 200 or greater indicates drought conditions on the Refuge (including all FMU's).

FMU II: Intermediate Hills

FMU II lies below the eastern slopes of the Hart Mountain and Warner Peak landforms between the elevations of 6,000 and 7,000 feet. The Intermediate Hills form the head of the Rock Creek and Guano Creek water sheds. The diversity of the area includes perennial stream riparian areas, the last remaining contiguous stand of bitterbrush on the Refuge, aspen meadows and the Blue Sky ponderosa pine stand. This FMU is dominated by steep slopes of every aspect, associated wet drainages and snow pockets.

Vegetation type

The vegetative makeup of FMU II includes native species: ponderosa pine, quaking aspen, willow, mountain mahogany, mountain big sagebrush, Wyoming big sagebrush, basin big sagebrush, bitterbrush, low sagebrush, rabbitbrush, annual and perennial grasses. Cheatgrass is also present but represents a small percentage of vegetative cover.

Strategies

Fire suppression strategy in this FMU will be characteristic of the values at risk. Incident Commanders should consider containment as the preferred suppression strategy with the exception of the Hot Springs Campground, the Blue Sky ponderosa pine stand and the Deer Creek drainage, which are discussed below in detail. Loss of bitterbrush should be held to a minimum, using the numerous natural barriers and roads as containment lines. No new mechanized fireline will be constructed in this FMU unless life or property are threatened or use is approved in an Wildland Fire Situation Analysis and Delegation of Authority. Heavy equipment should be restricted to improvement of existing roads. Use of "light hand on the land" tactics will produce minimal surface disturbance from fire suppression. Acceptable fire suppression resources include handcrews and all handtools, helicopters, light vehicles on roads only, aerial retardants and foam. Utilization of indirect attack suppression tactics should be considered as a primary tactic in this FMU. All firelines and associated surface disturbances will be rehabilitated as soon as possible following suppression activities.

Fires that occur in the vicinity of the Hot Springs Campground and Blue Sky ponderosa pine stand will be suppressed at the least number of acres using control strategy and direct attack (when safe) with all available resources. Incident Commanders may also construct mechanized line where necessary to protect life, property and the unique natural values at the sites.

The Deer Creek drainage is the site of the Order of the Antelope annual meeting, and during the middle of July experiences a significant increase in visitation. The group meets and camps at the site. Because of the presence of this group, the Deer Creek drainage assumes the same strategic value and tactical implementation as the Blue Sky and Hot Spring sites.

Wildlife

FMU II is considered suitable habitat for the featured species of the Refuge. Most notable in this area, are mule deer and sage grouse. As such, the area is key to wildlife diversity. Fire management strategies in this FMU are to improve habitat through prescribed fire and to suppress wildland fires that would, if allowed, degrade the current condition of the habitat.

Fuels
Fuels are generally represented by NFDRS model T and FBPS models 5 and 6, depending on the season of the fire event (Anderson). Live fuel moisture is an important fire behavior, intensity and severity indicator in this fuel complex. When live fuel moistures (LFM) are above 120%, fires generally require high wind speeds to spread. When LFM is below 100%, rapid rates of spread, spotting and flame lengths in excess of twenty feet can be anticipated. Important fire indicator species include mountain mahogany, rabbitbrush, and cheatgrass. Mountain mahogany growth on deep soils indicates fire exclusion (Gruell), and cheatgrass and rabbit brush are both fire adapted species that quickly reoccupy burned areas.

Fire behavior
Fire Behavior in FMU II is dependent on slope, wind speed, and direction. The boundaries of the unit consist of slopes in excess of 50%, and exposure to wind can be either 100% exposed or 100% sheltered, depending on local and free air wind directions, which change quite frequently. Generally, rapid upslope, cross slope, and downslope runs can be anticipated. Flame lengths in excess of 20 feet are frequently observed during upslope runs. Duration of fires is usually less than three burning periods, and more often than not limited to one burning period because of cold night time temperatures (35-40 degrees f.) and relative humidity recovery (35-50%). However, actively spreading fires can become quite large in this fuel type in one burning period. This FMU has historically experienced fires that originated from the low lands and spread upslope into the intermediate hills. Such was the case with both the Hammersley Spring fire (1972) and the Hart Mountain fire (1985), both large, multi-thousand acre wildfires.

Fire effects
Fire effects in FMU II are similar to those in FMU I, except that because FMU II is lower in elevation, it will also be warmer and dryer. FMU II contains the largest concentration of bitterbrush on the Refuge and so fire effects on this species must be closely monitored.

The annual fire weather cycle for this FMU is also sensitive to drought conditions. During normal snow years, snow covers most of FMU II. In cold drainages and northern aspects, snow pockets may remain until well into late spring. Prior to green up, shrubs and grasses are available fuels as a result of their dormant physiological conditions.

Green up will become noticeable as early as February in areas free of snow. Most grasses are cured and readily available as fuel by July. Generally, sagebrush species come out of winter dormancy early in the spring and begin to put on new growth in May. Live fuel moisture are well above 100% during this period of time. Live fuel moisture generally drops below 100% in the first weeks of August, and continues to drop through the fall, until the plant reaches winter dormancy.

Drought conditions play a significant role in live fuel moistures and affect the amount of moisture the plants can accumulate and successfully store during the dry summer months. As such, curing of grasses and drop of shrub live fuel moistures can be accelerated during drought summers.

FMU III: Tableland
Fire Management Unit III consists of the eastward sloping tableland of the Refuge, ranging in elevation from 4,700 to 6,000 feet that includes 147,863 acres. The area is nearly flat and rolling with the exception of a few low remnant lava formations. This rocky, high table consists of poorly developed soils

and associated vegetation cover types. The area is rugged and natural in character and the East Wilderness Study Area, South Wilderness Study Area and Pronghorn Research Natural Area are located here. Rock and Guano Creeks dissect this table to the north and south respectively. Wet and dry meadows are associated with the flood plains of these perennial creeks. In addition, numerous natural playa lakes are also present. Most of the developed structures on the Refuge are located in this FMU, including the Headquarters Complex and Flook Ranch site. The back country by-way between the villages of Plush and Frenchglen falls within FMU III.

Vegetation type
The vegetative makeup of FMU III includes a vast majority of low sage. Other species include basin big sage, bitterbrush, Wyoming big sage, mountain big sage, snowberry, rabbitbrush, and annual and perennial grasses. Emergent grasses, rushes and sedges, are associated with seasonally wet areas and riparian areas.

Cheatgrass is also present, primarily in disturbed or degraded areas, and is becoming more common every year. Western juniper is also encroaching out of the Poker Jim Ridge area of FMU I into FMU III.

Strategies
Prescribed burning will continue to be implemented with the primary objective of reducing shrub cover and promotion of perennial herbaceous plants. Serious consideration will also be given to juniper reduction projects in areas experiencing juniper encroachment (Poker Jim Ridge). Sites will be selected for burning which contain little or limited cheatgrass incidence which is consistent with all FMU's.

Wildlife
FMU III is considered suitable habitat for the featured species of the Refuge. Most notable in this area are pronghorn antelope, sage grouse and trout. Fire management strategies in this FMU are to improve habitat through prescribed fire and to suppress wildland fires that would, if allowed, degrade the current condition of the habitat. In addition, all fire management activities will be consistent with the wilderness characteristics of the area.

Fuels
Representative NFDRS fuel models for FMU III include T and A. FBPS fuel models include 1 and 5.

Fire behavior
Fire behavior in FMU III is determined by a combination of wind speed, relative humidity, fine fuel moisture relationships, and live fuel moisture content in the shrub component. Under severe burning conditions, fires can be expected to make fast runs through light, flashy fuels. Fire perimeters will be jagged and broken due to areas of discontinuous fuels, burning often in a true mosaic pattern. Cured cheatgrass in the fuel bed will be receptive to spotting, and could contribute to fire control problems. Fire behavior in cured, dry fuels will exhibit flame lengths in excess of 10 feet, rapid spread, and high fireline intensities. Once established in the height of the burn period (1200 - 1500 hours) fires may show intensity during the summer months which would preclude direct suppression tactics.

The annual fire weather cycle for FMU III is similar to FMU II.

PRE-ATTACK PLAN
The following Pre-planned dispatch plan will be used by Fire Management Unit and Staffing Class to provide effective and adequate initial attack on the Refuge. The Duty Officer may reduce or increase response levels commensurate with local and regional fire activity, drought conditions, and observed and forecasted weather conditions.

Table 5: Pre-planned Dispatch Plan

Staffing Class	FMU I	FMU II	FMU III
1/2/3	Engine	Engine	Engine
4	Engine	2 Engine	2 Engine
	FWS Duty Officer	FWS Duty Officer	FWS Duty Officer
	Resource Advisor	Resource Advisor	Resource Advisor

	Interagency Helitack Crew in Lakeview	Interagency Helitack Crew in Lakeview	Interagency Helitack Crew in Lakeview
5	Engine	2 Engine	2 Engines
	Same as 4 with the addition of FMO notification	Same as 4 with the addition of FMO notification	Same as 4 with the addition of FMO notification

Resource advisors for project fires on the refuge are the Hart Refuge Manager and the Biologist.

FIRE BEHAVIOR

The fuel conditions on the Refuge are easily grouped into grass, shrub and timber associations. In addition, some slash exists as a result of mechanical treatments to juniper.

Fire behavior in grass types is strongly linked to fine dead fuel moisture (DFM) and wind speed. Fires generally occur after annuals and perennials have cured. High probability of ignition and rapid rates of spread can be expected when fine DFM is below 10%. Topography will also support rapid, intense runs upslope. Under these conditions, fires are generally not severe, leaving patches of unburned fuels. The moisture of extinction in this fuel type is 12-25% (Anderson 1982).

Fires in the shrub group require moderate to high surface winds, slope, and moderate to low live fuel moisture (LFM) to promote fire spread. When LFM drops below 100%, high probability of ignition and rapid rates of spread can be expected. Fire severity is dependent on fire residence time. Upslope runs and rapid rate of spread can be expected. Difficulty in suppressing fires in these fuels can be expected, especially with direct attack at the height of the burn period. The moisture of extinction in these fuels is 20%. This fuel association represents most of the Refuge area.

Less than one percent of the Refuge is represented by the timber fuel type. Fires in this type are strongly influenced by duff moisture, ladder fuels, topography and foliar moisture. While flame lengths are most often not as great as other fuel types, fire severity is an important element of the fire management decision process because of the extended duff burnout time. In general this is true, but the exception to this generalization is during stand-replacement fire events, where crown fire can eliminate an entire stand of mature trees. Severe fires will damage fragile root systems and may cause girdling and cat-facing along the tree bases, especially in the limited number of old growth trees in the stand. The moisture of extinction in these fuels is 25%.

Fire behavior in the shrub-grass models is extremely dynamic and dependent on live fuel moisture (LFM), mid-flame wind speed (MFW) and dead fine fuel moisture (DFM). Slope interacts within the prediction model similarly to wind (increasing slope will generally speed the model up). A live fuel moisture sampling project has been in place since 1993 and will continue in the future to aid fire managers in critical fire suppression decisions.

The impacts of drought on this fuel complex directly affect the live and dead fuel moisture available in the plants. Drought years accelerate the physiological processes so that grasses and shrubs flower and enter dormancy earlier in the summer. The Keetch-Byram Drought Index (KBDI) is calculated daily through WIMS to provide drought indices. The KBDI value of >200 seems to indicate the trigger for drought conditions on the Refuge.

The key LFM value for shrubs in terms of a trigger to extreme fire behavior is 100%. Resulting fire behavior below 100% LFM can be extreme, including such activities as spotting and plume dominated fires. Shrubs with LFM between 100 and 125% will also readily burn, but require higher MFW speeds, greater slope and/or higher grass loadings in the understory to sustain a free-burning state.

Fires that occur on the Refuge could exhibit extreme fire behavior under favorable conditions. Dependent and independent crown fires will be experienced when fires are burning through dense stands of aerial fuels located on slopes over 20% with upslope winds and unstable atmospheric conditions. Ladder fuels must also be present.

Fire whirls can be anticipated on flatter terrain when surface winds are over 10 mph and unstable atmospheric conditions exist. The period of time immediately following the breakdown of a stable atmospheric event is especially likely to promote fire whirls (Werth and Ochoa, 1991).

Spotting can be expected to occur when high temperatures, low relative humidities, high wind, and highly convective fire fronts occur to produce firebrands and transport mechanisms. Probability of ignition above 50% will increase fuel availability.

The Refuge falls into the Haines Lower Atmospheric Stability Index (LASI) moderate elevation regional zone. As a result, fires occurring during LASI values of 5 or 6 forecasted days should be considered as high potential for plume dominating fire conditions.

SUPPRESSION TACTICS

Wildland fires will be suppressed in a prompt, safe, aggressive, and cost-effective manner to produce fast, efficient action with minimum damage to resources. Suppression involves a range of possible actions from initial attack to final suppression. All wildland fires will be suppressed.

Personnel and equipment must be efficiently organized to suppress fire effectively and safely. To this end, the FMO assumes the command function on major or multiple fire situations, setting priorities for the use of available resources and establishing a suppression organization.

There will be only one Incident Commander responsible through the FMO or Designee. The Incident Commander will designate all overhead positions on fires requiring extended attack. See Appendix D for Delegation of Authority.

For additional information regarding suppression procedures, see the Incident Management Team Transition Guidelines in the 6/1/2000 release of the Fire Management Handbook (3.2-12).

Suppression Conditions
The primary objective of fire suppression operations on the Refuge will be to reduce risk to human life and property. The strategies of confine, contain and control will be used to achieve this objective. In addition, long term disturbance such as mechanical fireline is to be avoided whenever possible as long as the primary objective can be met during fire suppression operations.

Minimum impact suppression tactics will be used whenever feasible. This means that confinement and containment strategies will be implemented when conditions allow. Large expanses of natural fuel breaks and the Refuge road system will be used as containment and confinement boundaries. Exceptions include using mechanical equipment to protect structures and private property, and along boundaries to prevent fires from escaping onto neighboring lands.

The use of heavy equipment may be authorized in an Wildland Fire Situation Analysis. However, use of heavy equipment should be limited to existing disturbed sites, such as improving the Refuge road system. Counter firing operations should always be considered as the preferred suppression tactic when possible, using existing fire breaks. The decision to use aerial retardants will be made by the Initial Attack Incident Commander. However, values at risk and the costs of retardant use should be weighed to ensure suppression costs do not exceed resource values.

Delegation of Authority
Full authority and responsibility for managing the fire suppression activities within the framework of the law and Fish and Wildlife Service policy and direction as provided by the Sheldon/Hart Mountain NAR Complex must be authorized for all Incident Commanders at the Type III or above level. Effective January 1, 2001, the Complex FMO and AFMO have been pre-selected for delegated authority to manage Type III incidents on Hart Mountain NAR.

See Appendix D for an example of Delegation of Authority.

Wildland Fire Situation Analysis
For fires that cannot be contained in one burning period, a WFSA must be prepared. In the case of a wildland fire, the Incident Commander, in conjunction with the FMO, will prepare the WFSA. Approval of the WFSA resides with the Refuge Manger.

The purpose of the WFSA is to allow for a consideration of alternatives by which a fire may be controlled. Damages from the fire, suppression costs, safety, and the probable character of suppression actions are all important considerations.

Public safety will require coordination between all refuge staff and the IC. Notices should be posted to warn visitors, trails may be closed, traffic control will be necessary where smoke crosses roads, etc.

Where wildland fires cross roads, the burned area adjacent to the road should be mopped up and dangerous snags felled. Every attempt will be made to utilize natural and constructed barriers, including changing fuel complexes, in the control of wildland fire. Rehabilitation efforts will concentrate on the damages done by suppression activities rather than on the burned area itself.

See Appendix K of an example WFSA .

Format changes adhere to Service policy and direction from the Fire Management Handbook (release date 6/2000). The 1995 National Fire Policy has been addressed and updated throughout the document. The 2000 FWS prescribed burning policies and direction have been implemented and updated accordingly.

Aircraft Operations

Aircraft may be used in all phases of fire management operations. All aircraft must be Office of Aircraft Services (OAS) or Forest Service approved. An OAS Aviation Policy Department Manual will be strictly adhered to for all Fire Management activities. In addition all Helicopter operations will follow the 1998 Interagency Helicopter Operations Guidelines IHOG. The Services 2000 Fire Management Handbook is a reference for additional aviation regulations and requirements.

All aviation resources are ordered and tracked by the LIFC Aviation desk. MTR's, flight following services and TFR's for larger incidents are all handled by dispatch.
Helicopters may be used for reconnaissance, bucket drops and transportation of personnel and equipment. Natural helispots and parking lots are readily available in most cases. Clearing for new helispots should be avoided where possible. Improved helispots will be rehabilitated following the fire.

REHABILITATION AND RESTORATION

Rehabilitation plans will be prepared for all fires where mechanized equipment has been used during suppression activities, vulnerability to erosion and water quality is increased, invasion of unacceptable plant species is likely and where protective structures such as fences have been damaged by suppression actions.

Rehabilitation site selection and planning will be accomplished through recommendations of staff biologists, Cultural Resources Staff, the Refuge Manager and the Fire Management Officer. Rehabilitation plans under $250,000 will be submitted to the Regional Director for approval. Plans over $250,000 require approval from Washington DC. Rehabilitation will be directed toward minimizing or eliminating the effects of the suppression effort and reducing the potential hazards caused by the fire. These actions may include:

1. Consultation with Regional Archaeologist and/or cultural resources surface inventory by qualified staff.
2. Backfill control lines, scarify, and seed.
3. Install water bars and construct drain dips on control lines to prevent erosion.
4. Install check dams to reduce erosion potential in drainages.
5. Restore natural ground contours.
6. Remove all flagging, equipment, and litter.
7. Completely restore camping areas and improved helispots.
8. Consider and plan more extensive rehabilitation or revegetation to restore sensitive impacted areas.
9. New guidance for FY 2001 allows for total restoration of the burned area. Please refer to the guidance in the 2000 Fire Management Handbook 3.2 17-19 for detailed information.

If emergency rehabilitation measures are needed or if rehabilitation is needed to reduce the effects of a wildland fire then the refuge can request appropriate funding through the Burned Area Emergency Rehabilitation (BAER) fund. EFR planning will begin with the Incident Commander and may continue by convening a multi-disciplinary team requested by the Refuge Manager.

If revegetation or seeding is necessary, only native plant species will be used.

REQUIRED REPORTING

The DI-1202 Individual Fire Report has become an integral component of each fire events fire history file. Each fire event file will contain at the minimum the DI-1202, RAWS observation data for the fire day, a map of the fire perimeter, general weather forecast for the fire day, fire weather and behavior data, and an approved prescribed burn plan, as appropriate.

Daily situation reporting and ICS-209 Incident Status Report forms will be completed by the IC and Lakeview Interagency Fire Center dispatch personnel for all fire activity on the Refuge. This information will be forwarded to NWCC as required.

FIRE INVESTIGATION

Fire management or Law Enforcement personnel will attempt to locate and protect the probable point of origin and record pertinent information required to determine fire cause. They will be alert for possible evidence, protect the scene and report findings to the fireline supervisor.

Prompt and efficient investigation of all suspicious fires will be carried out. However, fire management personnel should not question suspects or pursue the fire investigation unless they are currently law enforcement commission qualified.

Personnel and services of other agencies may be utilized to investigate wildland fire arson or fire incidents involving structures. A resource order will be processed by LIFC Dispatch for a qualified fire investigator ASAP. Refer to 4.1-2 of the Fire Management Handbook (2000) for additional details.

PRESCRIBED FIRE ACTIVITIES

PRESCRIBED BURN PROGRAM OBJECTIVES

The Comprehensive Management Plan for Hart Mountain NAR identifies the use of prescribed fire (PF) as the preferred vegetation management technique over the course of the 15 year plan life span, burning a range of area between 22,500 to 39,900 acres. In order to accomplish this primary management objective, between 1,500 to 2,660 acres must be burned annually.

The total 15 year treatment acres are separated by unique vegetation types and are summarized below in table 6.

Table 6: Number of acres to be treated by vegetation type

Vegetation Type	Acres/annually	Acres/15 years
UPLANDS		
Wyo. Big Sagebrush	400-800	6,000-12,000
Low Sagebrush	533-1,000	8,000-15,000
Mtn. Big Sagebrush	300-800	4,500-6,000
Sagebrush-Bitterbrush	33-53	500-800
Wheatgrass	40-80	600-1,200
Mountain Shrub	27-40	400-600
Ponderosa Pine	1.6	25
RIPARIAN		
Aspen	20-33	300-500
Mixed Deciduous Scrub	15	100
Willow	7-13	100-200
Meadow	133-200	2,000-3,000
Silver Sagebrush	13-33	200-500

The prescribed treatment of these acres by vegetation type is designed to promote wildlife habitat richness by diversifying sucessional stages of all habitat types commonly found on the Refuge. It should be noted that wildland fire acres will also be counted towards acres treated with fire, by vegetation type. Generally, the minimum treatment objective for PF will be a 50% reduction of target species within a prescribed burn unit, emphasizing mosaic pattern burning.

In addition, a hazard fuel reduction objective is realized during implemention of these projects. When dense, woody fuels are burned on the Refuge, the are replaced by lighter fuels that promote less severe subsequent fires and easier to suppress. As such, all prescribed burn plans that are written and executed on the Refuge will have a hazard fuel reduction objective.

A formalized process for determining appropriate burn units is in place on the Sheldon-Hart Mountain NAR Complex. The process is as follows. In January of each year the Complex Deputy Project Leader, Refuge Managers, biologists, and fire staff meet in the Lakeview Office to review all potential prescribed burn projects which any of the Complex staff has suggested. Each potential project is reviewed and discussed in detail, with its merits minutely examined. All potential conflicts are discussed and any with unresolved conflicts are eliminated, leaving only those projects which can meet Refuge goals, CMP objectives, and fire managements concerns. Those projects exhibiting potential merit are then visited on the ground by the Refuge Manager and/or Biologist, and either eliminated or recommended as a result of their analysis. Plausible projects with inputs from Refuge staff (resource objectives of the burn, maps, concerns, etc.) are forwarded to the Complex Staff by June for starting the process of planning the project for eventual implementation. The FMO delegates responsibility for planning the project to the Prescribed Fire Specialist or competent designee. The PFS examines the potential project area, identifies any cultural or fire management conflicts, lays out units, determines a fire prescription, and writes a burn plan. This process is completed in close conjunction with the Refuge Biologist. Written plans are then sent through a review process with (at minimum) review by the FMO, Refuge Biologist, Complex Biologist, and Refuge Manager. Any and all conflicts, potential problems, and revisions necessary are resolved during this review process. When the plan reflects a positive view by all reviewers, the plan is sent to the Lakeview Complex Project Leader for review and ultimate approval. At any time prior to the Project Leader approval, the project can be eliminated in problems/conflicts arise which cannot be resolved. This planning process is designed to determine and plan projects a year out. This gives ample time to choose only those projects which most effectively meet refuge and management needs.

Prescribed fires involve the use of fire as a tool to achieve a wide range of management objectives. Research burning may also be conducted when determined to be necessary for accomplishment of research project objectives. Actions included in the prescribed burn program include: the selection and prioritization of prescribed burns to be carried out during the year, prescribed burn plans, burn prescriptions, burn operations, documentation and reporting, and burn critiques.

Complexity Analysis from FIREBASE is used to determine fire complexity.

The refuge reserves the option to utilize an interagency team approach for complex burns carried out on the boundaries and close to developed areas or burns of large acreage. The most highly qualified and experienced personnel in the regional interagency community would be requested to serve on this team.

FIRE MANAGEMENT STRATEGIES

Prescribed fire will be used to reduce hazard fuel accumulation, restore fire to fire-dependent ecological communities, improve wildlife habitat, and to maintain cultural/ historic scenes where appropriate. All prescribed fire activity will comply with applicable Federal, state, and local air quality laws and regulations.

All prescribed fire projects will have a burn plan approved by the Sheldon-Hart Mountain NAR Complex Project Leader. Each burn plan will be prepared using a systematic decision-making process, and contain measurable objectives, predetermined prescriptions, and using an approved environmental compliance document. Appropriate NEPA documentation (Appendix L) exists for this Fire Management Plan. Therefore, additional NEPA documentation will be necessary only for prescribed fire projects not meeting the criteria outlined in this Plan.

Prescribed Fire Burn Plans must include components such as a Go/ No-Go Checklist, contingency actions to be taken in the event the prescription is exceeded, and the need for alerting neighbors and appropriate public officials to the timing and the planing of the burn. A burn plan format meeting all required needs is located in Appendix M.

Fire monitoring will be used to evaluate the degree to which burn objectives are accomplished. Monitoring can assist managers in documenting success in achieving overall programmatic objectives and limiting occurrence of undesired effects. Level 1 monitoring (establishing and maintaining photo points as well as collecting first effects fire information) will be accomplished by the Lakeview Complex fire management staff. Level II monitoring (Vegetative studies/plots) will be accomplished by Hart Mountain NAR Refuge biological staff. Any monitoring at levels above II will be accomplished through agreements or contracts with universities, researchers, or competent contractors.

ANNUAL PRESCRIBED FIRE PLANNING ACTIVITIES

The FMO will be responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary, personnel utilized, and fire effects.

Prescribed Fire activities will be reviewed annually by Lakeview Complex management in conjunction with the Complex fire staff. Necessary updates or changes to the Fire Management Plan will be accomplished prior to the next fire season. Any additions, deletions, or changes will be reviewed by the Refuge Manger to determine if such alterations warrant a re-approval of the plan.

Preparation for prescribed fire operations includes the following:

January	Proposed burn sites submitted to Complex review team for evaluation
April-June	FMO/ PFS visits burn sites and makes recommendations to Refuge Manager. Refuge Manager/Biologist visit burn sites and makes recommendations, assesses feasibility, and formulates resource objectives. Pre-burn monitoring completed as scheduled. (Complex fire Staff, Level II - Hart Mtn. Biologist) FMO distributes annual burn schedule to Refuge Staff. Post-burn growing season monitoring implemented.
July	Post-burn monitoring completed as scheduled.
August-September	Late summer burning begins.
October-November	Fall burning.
December-February	Winter burning.
March-April	Spring burning.
January-December	PFS/FMO's or competent designee completes burn plans for the complex.

Prescribed Burn Plan

A prescribed burn plan will then be developed that addresses all aspects of ignition and control and prescribes conditions that will meet biological objectives as well as support managing the resulting fire within predetermined boundaries. The fire staff-person responsible for developing the burn plan will work closely with Refuge biological staff in all aspects of the planning process.

The objectives for each prescribed burn unit need to be consistent with the overall objectives of implementing PF on the Refuge. The defined seasons for PF are opportunistic and generally encompass that part of the year when preferred species are in dormancy, while target species are vulnerable to fire. The burning season is therefore established based on the physical condition of the plants rather than a calendar season. Generally, this will occur begin in late summer and carry through spring prior to forb and grass green up. Drought winters also offer a window of opportunity.

After proposed projects have gone through a process designed to eliminate potential projects lacking merit, the Refuge Manager/Biologist forwards the proposal to the Complex fire staff. The FMO, AFMO, PFS, and/or Burn boss will conduct a field reconnaissance of the proposed burn location to discuss objectives, special concerns, and gather all necessary information to write the burn plan. After completing the reconnaissance, the FMO will designate a lead who will write the prescribed burn plan.

All prescribed fires will have approved prescribed burn plans. The prescribed burn plan is a site specific action plan describing the purpose, objectives, prescription, and operational procedures needed to prepare and safely conduct the burn. The treatment area, objectives, constraints, and alternatives will be clearly outlined. No burn will be ignited unless all prescriptions of the plan are met and the appropriate management signatures have been affixed to the Go/No-Go checklist. Fires not within those parameters will be suppressed. Prescribed Burn Plans will follow the format contained in the 2001 Fire Management Handbook. The term “burn unit” refers to a specific tract of land to which a prescribed burn plan applies.

Strategies and Personnel
Execution of the prescribed fire plan will involve only qualified individuals on the burn site. A qualified Burn Boss will lead implementation, and may have a trainee assigned as well. Most PF that will be implemented on the Refuge fall within the "normal" complexity score range. However, maintenance of Burn Boss I qualification is necessary. In addition, the positions of Holding and Ignition Specialists are required because most burn organizations exceed five or six resource types (engines, ignition, helicopter, etc.). As a result, a suitable training and qualifications level for the Refuge is three qualified Burn Boss II, one qualified Burn boss I, and two Single Resource Boss personnel. In addition, a Fire Weather and Behavior Monitor will be used routinely to make fire weather and behavior observations during burn implementation. All personnel listed in the burn plan must be available for the duration of the burn or the burn will not be initiated.

Weather and fuel moisture conditions must be monitored closely in planned burn units to determine when the prescription criteria are met. A belt weather kit may be utilized to augment monitoring. A portable FTS weather station on project site may be used to assess long-term weather data. Additionally, a permanent RAWS station at Rock Creek provides Refuge-wide daily weather observations on a yearly basis which gives valuable data necessary in analyzing long-term weather trends. Live fuel moisture samples will be collected weekly in the shrub component of the Refuge and trends of LFM content assessed to further help determine when the prescription criteria are met. Site-specific LFM samples will be collected and analyzed as need arises.

Late summer and fall burning generally is more complex in terms of holding and threat of Wildland fires. As such, the normal complexity organization will be used during implementation. Winter and spring burning is much cooler, as days are shorter, temperatures are lower and relative humidities are higher. As a result a typical winter burn organization may be comprised of a team with as few as three to five people.

Prior to ignition of any prescribed burn, LIFC will contact all local cooperators in the burn area to inform them of the Refuge's burning plans. Signs will be posted along main roads to inform the public and Refuge visitors of prescribed burn projects and smoke hazards.

No air quality or burn permits are required for burning on the Refuge at this time. Voluntary compliance with guidelines issued by the state of Oregon and overseen by the Lake District State Forester in Lakeview, Oregon will be undertaken. Daily monitoring of smoke management forecasts issued by the state of Oregon will occur.

Fire effects monitoring intensity level I is the implementation of photo point records. Level I is the least intense monitoring at the Refuge and will be conducted by the Complex fire staff.. Level II includes all inventory of vegetation before and after burning and will be conducted by Refuge biological staff. In addition to the above listed Refuge fire effects monitoring strategies and intensities, academic and research entities are continually collecting data for research at the Refuge. Every effort will be made to enlist research and academic entities to perform Level III and IV monitoring strategies.

The PF implementation strategy at the Refuge has been controversial with ranchers and local citizens, and is viewed with tremendous skepticism. It is only a matter of time before one of these groups questions the results of PF on the Refuge. A strong fire effects monitoring program will be the only viable mechanism the Refuge will have to defend landscape level PF.

The complexity of the PF program at the Refuge generally falls within the normal range with an occasional complex score using the 1992 Prescribed Fire Complexity Rating System. Most fires will rate within the following point categories of the analysis:

Potential for escape	1-9
Values at risk	1-7
Fuels/fire behavior	5-7
Fire duration	1-7
Smoke/Air quality	1-5
Ignition method	1-9
Management team size	1-9
Treatment objectives	1-9

The total ranges from 70 to 382 points. The break between normal and complex prescribed burns is 281 points. The occasional use of multiple ignition sources; Primo Mark III, Terra Torch will drive the score up, but the project may remain in the normal score range if all other complexity elements remain in the normal range.

No new PF will be initiated under national and regional preparedness level V. PF that are ongoing when preparedness levels move to level V will be declared wildland fires, if actively burning, and suppressed accordingly. In addition, local fire activity will also be analyzed. No PF will be initiated if LIFC is supporting one or more project fires on the Fremont National Forest or Lakeview District BLM. Initial attack actions are more random, require fewer resources and will not impact Refuge PF implementation.

Any number of active fires may be present in all of the FMUs on the Refuge at one time as long as sufficient resources are on site to manage the fires. Fuels and terrain conditions on the Refuge promote this type of PF activity. The extent of natural barriers and sparse fuels on the Refuge precludes the need to limit numbers of active fires during PF implementation as long as sufficient resources are on site to staff them.

Potential impacts of this plan have been examined in great detail in the Refuge Environmental Impact Statement and Comprehensive Management Plan. The most controversial socio-economic impact of the prescribed actions of this plan are the exclusion of cattle grazing on the Refuge and the use of fire as the subsequent vegetation management tool for the 15 year plan life span.

Pre-burn documentation requirements, including NEPA and public review have been completed in the Refuge EIS and Comprehensive Management Plan.

Monitoring and Evaluation
A long term fire effects monitoring program coincides with the prescribed burning program on the Refuge. The focus of fire effects monitoring is to ensure that the long term changes affected through PF

meet the goals and objectives of the Refuge Comprehensive Management Plan. The strategies and methodology are outlined in the monitoring plan in Appendix N.

In addition to fire effects monitoring, a program of monitoring Live Fuel Moisture (LFM) has been implemented at the Refuge. These LFM values are used in all aspects of fire management decision making, including measuring fire danger potential and subsequent staffing class, fire suppression strategies and tactics, PF prescriptions, and contingency plans. The methodology for monitoring LFM content is outlined in the Live Fuel Moisture Monitoring Plan in (Appendix O).

Prescribed Burn Required Reports

All prescribed burn forms will be completed as outlined by the Prescribed Burn Boss under the guidance of the PFS. A monitor will be assigned to collect all predetermined information and complete all necessary forms prior to, during, and after the burn. All records will be archived in the refuge's fire records for future use and reference.

The Prescribed Burn Boss will prepare a final report on the prescribed burn. Minimum project documentation includes a DI-1202 Individual Fire Report, a map of the completed project, fire weather and behavior observation forms, the prescribed burn plan, pre-burn and post-burn photos and the spot weather forecast for the project site. The project map and observed burning conditions will be digitized into the complex geographic information system (GIS) as time and expertise permits. This fire history data will be used in the future to refine burning prescriptions based on actual conditions and resulting fire effects.

A post fire critique should be held for each burn completed. The critique should be held as soon as possible after the burn has been completed. At a minimum, the following elements should be discussed:

1. How well were the basic burn objectives/resource objectives met?
2. Were there any safety related concerns? If so, how can these be mitigated in the future?
3. What prescription related information was gathered in order to refine future prescriptions?

Any Wildland PF will be reviewed in accordance with the Fire Management Preparedness and Planning Handbook. The Regional Fire Management Coordinator may lead a review team that examines the planning and implementation of the Wildland PF, and makes recommendations to the Refuge in terms of how to avoid escapes in the future.

AIR QUALITY / SMOKE MANAGEMENT GUIDELINES

The National Environmental Protection Agency requests a seven point analysis be completed regarding protecting air quality standards when prescribed burning is addressed in an agency planning process that advocates the use of fire. The following analysis was completed during the NEPA planning process for the Refuge; listing alternative methods and reasons why they are not appropriate, quantifications of the amounts and types of material to be burned, description of the burn type proposed, measures to reduce emissions, quantification of emissions of regulated pollutants, applicable regulatory requirements, description of air quality impacts, and smoke vector modeling.

This analysis indicates that no significant impact to local or regional air quality will be encountered by the use of prescribed burning as listed in the Fire Management Plan.

Alternatives to prescribed burning include biological, mechanical, and chemical applications to shrub management. Biological techniques include the use of animals that use shrubs for forage but in all probability are not compatible with the current management of the Refuge. Mechanical methods include disking and roto-beating. Large scale surface disturbances, reduced effectiveness because of slope, rocky and timbered areas, and long term impacts to vista quality make large scale mechanical treatments unsuitable. Additionally, any surface disturbing projects require strict adherence to applicable Federal cultural resource statues, necessitating that surface cultural resources inventories need to be accomplished prior to project work. Chemical methods include aerial applications of herbicides such as Picloram and Roundup. Widespread use of herbicides will not only control shrubs, the target species, but may also have undesirable effects on forbs, grasses, and wildlife species as well. In addition, the public has expressed growing dissatisfaction with the widespread use of herbicides on public lands. Large scale use of these alternatives is impractical for the above reasons, however, small scale site specific areas may be found suitable for these treatments.

An average of 3,000-5,000 acres per year will be targeted for prescribed burning on the Refuge.

Broadcast burning natural fuel beds from multiple ignitions is the most effective method used to create patchy, mosaic burn patterns. Most acreage on a given burn day will be treated with quickly moving head fires, allowing for the most efficient combustion which produces the least amount of particulates.

The most commonly experienced weather patterns in southeastern Oregon are stable continental air masses and marine frontal weather conditions. Common transport wind (free air) direction during stable continental air mass conditions is southwesterly. Typical transport wind (free air) direction during marine frontal passage is generally northwesterly. These two climactic conditions comprise the greatest percentage of upper air movement days. However, changes are abrupt and transitioning conditions can be from any direction. Special attention and assistance from the National Weather Service is required to obtain the most current condition and forecast information to ensure that downwind smoke plume vectors do not cause smoke intrusions into sensitive areas. Additionally, Oregon Department of Forestry regularly issues smoke management forecasts during the traditional prescribed burn seasons (spring and fall). These forecasts offer detailed information on transport winds, smoke dispersion, and mixing heights. Compliance with these forecasts is voluntary but efforts will be made to burn when the forecast is favorable to minimize smoke management problems. Spot weather forecasts will be obtained for every burn unit prior to any ignition through LIFC. Firing technique and timing also work to mitigate smoke impacts. The predominate use of head fires will produce the most efficient method of combustion. Burning late in the day during the period of greatest atmospheric instability will loft smoke into layers of air turbulence and transport winds. This works to dilute smoke and move it downwind. In addition, burning during low fuel moisture conditions will reduce the amount of smoke produced from combustion of wildland fuels.

The amount of material to be burned averages 3.5 tons per acre and emits roughly 87 lbs. of particulates per acre. On an average burn day, 500 acres will be burned, emitting 297 lbs. of particulate matter per hour, for roughly five hours. In addition to particulates, wildland fuels emit a variety of compounds as gases during combustion. While the research does not quantify amounts, it is known that carbon monoxide, oxides of nitrogen and sulfur, and other gases are present in smoke. It should be noted that water vapor comprises the greatest percentage of wildland fuels smoke.

Smoke management plans currently in place in the State of Oregon do not apply to burning of non-forested areas. Two PM-10 non-attainment areas exist east of the Cascade Mountains; Klamath Falls and LaGrande. The remoteness and absence of sensitive downwind smoke targets in southeastern Oregon have contributed to the liberal requirements of local smoke management.

The following Class I Airsheds exist within 200 kilometers of the Refuge; the Gearhart Wilderness Area, 50 miles due west, and Lava Beds National Monument, 90 miles due west-southwest. Other Class II sensitive smoke targets include the settlement of Plush, OR, seven miles west; Lakeview, OR, 30 miles west-southwest; State Highway 395, 25 miles west; State Highway 140, 25 miles south; and Burns, OR, 60 miles north. The use of southerly, westerly and northerly transport winds, in addition to the overall distance from targets, will minimize smoke impacts to these areas. Transport winds from these directions would avoid smoke intrusions in Plush, Lakeview, Highway 395, and Class I airsheds. The smoke impact to Burns would be minimal because of the distance, dilution of smoke, short duration smoke production, and efficient combustion.

The Refuge experiences frequent public recreational use. A backcountry byway links paved roads near Lakeview with Frenchglen. Campgrounds, trails, and roads are all subject to smoke intrusion. Signs along travel corridors will be posted during burning operations to advise individuals of burning operations and smoke hazards.

Drift smoke from the Refuge is not anticipated to create significant impacts when combining with drift smoke from forestry management burning in other parts of the state. Average burn acres per day will be 500 acres or less for 15 days per year. When compared to other areas using prescribed burning, this represents an insignificant addition to the smoke load of Class II Airsheds. In addition, distance, smoke dilution and short duration will minimize cumulative effects of smoke originating from the Refuge.

FIRE RESEARCH

The Refuge also supports fire related research when budgets and staff time allows. Partnerships with universities and researchers focused on conducting specific fire-related research projects is key to assessing how fire, particularly prescribed fire, should be managed on Hart Mountain NAR. The Sheldon-Hart Mountain NAR Complex Biological Investigation Unit is also deeply involved in conducting research which is strongly fire-related. A number of studies involving pronghorn, sage grouse, and small mammals (in conjunction with coyote research) are currently being conducted by Complex/Refuge staff. The Complex fire staff is also conducting studies to reconstruct fire history data. The chief purpose of all of these studies is to determine the effects of fire, either directly or indirectly, on key wildlife species and habitats. Results from a number of these studies have been published or are in the manuscript preparation process.

SAGE GROUSE RESEARCH

A number of sage grouse research projects are currently under way at Hart Mountain NAR. The Game Bird Research Program of Oregon State University, Corvalis and the Refuge have embarked in long-term sage grouse research. Funded, at least in part, by the Sheldon-Hart Mountain NAR Complex, university researchers and graduate students have for the past five years collected and analyzed data on Sage Grouse response to prescribed burning. This study has focused upon grouse habitat needs and response of key habitat components to prescribed fire. Much of this work is being performed in cooperation with the Lakeview District, BLM, and ODFW.

Primary researcher Mike Gregg, in conjunction with Sheldon-Hart Mountain NAR Complex and Oregon State University, Corvallis, has instituted a multi-year study entitled; “Survival of Sage Grouse Chicks in the Northern Great Basin”. While this particular study does not specifically focus upon the direct effects of fire, much information on the effects of fire on sage grouse in general can be gleaned from the analyzed data. This information will include the effect of fire on insect populations, chick survival, nesting areas, brood rearing areas, etc..

On-going research by Dr. Mike Dunbar continues through the study of pre-laying nutrition of sage grouse hens on Hart Mountain NAR. This study should give some insight into the effects of fire on nutrition and subsequence production in sage grouse. A manuscript is currently in preparation (Dunbar et al) and will be published upon completion and review.

Research on sage grouse leks and inferred population sizes is on-going as a joint project between Hart Mountain NAR Biologist Marty Bray and ODFW biologists. This project has been studying long-term use of leks and how environmental factors, including prescribed fire, affect utilization.

PRONGHORN RESEARCH

A long-term research project to evaluate the effects of fire on nutrition of pronghorn on Hart Mountain NAR has been in progress since 1999. This research began with establishment of baseline physiological nutritional parameters in pronghorn populations, leading to publication of the results (Dunbar et al 1999), and has continued by using physiological parameters from pronghorn in control areas including unburned areas on the Refuge and adjacent BLM lands. This research is scheduled to continue, using fecal indicies (%FN, DAPA) to compare nutrition of pronghorn in the north (burned) and the south (unburned) areas of Hart Mountain NAR.

SMALL MAMMAL RESEARCH

A more recent research project is a study to determine the effects of fire on abundance and species diversity of small mammals in burned verses un-burned areas of the Refuge. This research is being carried out in conjunction with research to determine the factors affecting predation rates of coyotes on pronghorn fawns. Live trapping of small mammals in various burns (recent and old) and unburned ares of Hart Mountain NAR can be compared to determine if burning changes small mammal abundance or diversity on the Refuge. This project will help in the determining whether or not prescribed fire can be used effectively to reduce predation rates on pronghorn fawns by altering the prey base of coyotes. A final report is in the final stages of preparation and should be published in the near future (Dunbar and Giordano 2001).

FIRE HISTORY RESEARCH

A fire history research project, carried out by Complex fire staff, is also underway at Hart Mountain NAR. Samples of burn scars are collected from ponderosa pine and juniper to reconstruct pre-Euro-American settlement fire return intervals. Working with the fire return intervals established by Gruell in 1995, this project is refining the fire return intervals, and establishing seasonality of historic fires, fire-free intervals, and fire/drought interrelationships.

FIRE-EFFECTS RESEARCH

Rick Miller from the Eastern Oregon Agricultural Research Center and Oregon State University, has directed a number of researchers and coordinated research on both Hart Mountain NAR and Sheldon NWR's. The focus of his studies has been to determine of temporal and spatial dynamics following fire in various sage communities. Through a 5-year program this program has collected and analyzed data documenting plant and animal response in these important communities.

Another study carried out by Complex fire staff has been to assess the effects of fire on bitterbrush. This project assesses the re-sprouting abilities/survival rates, as well as re-establishment of bitterbrush stands on Hart Mountain NAR following fire. Plots have been established in burn units and read yearly for the past two years. The study is designed for long-term (5+) years of plot monitoring and should yield valuable information specific to Hart Mountain NAR bitterbrush strains.

A variety of additional fire-related research opportunities are present at the Refuge, and will be explored as funding and staff time allows.

PUBLIC SAFETY

Safety is of primary concern during the planning and execution of the fire management program. All documents associated with fire, incident action plans, Wildland fire situation analysis, prescribed burn plans, and project plans will address public and employee safety. The potential effects of all projects on public and employee safety will be considered.

Safety briefings will be conducted on all fire management projects. Monthly safety briefings are held at the Refuge. All vehicles and mechanical equipment will be properly maintained. All fire safety orders, situations that shout watchout, precautions, and guidelines will be followed without exception. Lead Technicians, the Assistant Fire Management Officer, and Fire Management Officer will ensure that personal protective and safety equipment is used and is in good condition.

The following specific areas will be considered on all fire management projects:

1. Potential for dehydration, heat exhaustion, and heat stroke.
2. Impacts of smoke and associated gasses on employees working on projects.
3. Poisonous snakes in project area.
4. Shift length, fatigue, and effects on employees.
5. Irregular terrain.
6. Potential for aviation related accidents on projects.
7. Effects of smoke on employees, visitors, nearby towns, roadways, and airports.
8. Potential of hazards to hikers, hunters, and other backcountry users during wildland fires and prescribed burns.
9. Hazards of working around equipment and roadways in smoke.
10. Hazards from firing devices and flammable materials.

All significant fire related accidents will be reviewed by the Regional Safety Officer.

PUBLIC INFORMATION AND EDUCATION

Hart Mountain NAR has implemented a public outreach program to provide public information and education regarding the implementation of the Fire Management Plan. This program includes speaking to private interest groups, non-profit local organizations, and county meetings to educate the public on the implementation progress of the Refuge Comprehensive Management Plan.

In addition, the local press is used to distribute this information on a wider scale. A press release will be completed prior to each PF implementation period which describes the general areas to be treated and treatment objectives. A post-fire press release will be completed which describes the success of the PF in terms of objectives outlined by the Comprehensive Management Plan.

Tours of the treatment sites are also employed and are designed to illustrate the long term change that the PF program is affecting on ground. While the tours are often the most powerful demonstration of how fire changes the structure of the vegetation communities of the Refuge, the most common participants are already proponents of the Refuge program, rather than the opponents, who would benefit the greatest from site visits.

A variety of visitor contacts are frequently made during PF implementation. These contacts are extremely important, and special emphasizes is made to ensure that visitors understand what the Refuge is doing with fire. Quite often, the initial response from the uninformed visitor is hostile, focusing on smoke or wildlife mortality. However, after a positive and informative contact with a Refuge representative, the visitor at least understands the objectives of the PF.

FIRE CRITIQUES AND ANNUAL PLAN REVIEW

FIRE CRITIQUES

Fire reviews will be documented and filed with the final fire report. The FMO will retain a copy for the refuge files. The participants will discuss the incident after it is controlled and mopped up during a "tailgate session". If any problems, comments and suggestions surface, these will be communicated to the FMO.

All extended attack incidents will receive an in Refuge review consistent with their complexity. Any significant comments will be included in the fire report. Multi-jurisdictional incidents will be reviewed by participants from involved agencies.

Any Incident Management Team used on Refuge fires will meet in a close-out critique with the Refuge Line Officer and FMO to review the incident and resolve all unfinished business. If regional or national review is warranted, it will be requested.

ANNUAL FIRE SUMMARY REPORT

The FMO will be responsible for completing an annual fire summary report. The report will contain the number of fires by type, acres burned by fuel type, cost summary (prescribed burns and wildland fires), personnel utilized, and fire effects.

ANNUAL FIRE MANAGEMENT PLAN REVIEW

The Fire Management Plan will be reviewed annually. Necessary updates or changes will be accomplished prior to the next fire season. Any additions, deletions, or changes will be reviewed by the Refuge Manager to determine if such alterations warrant a re-approval of the plan. Changes will be distributed as appendices.

CONSULTATION AND COORDINATION

The following agencies, organizations and/or individuals were consulted in preparing this plan. Additional consultation and coordination requirements for this plan have been satisfied during the NEPA review for the Environmental Impact Statement and Comprehensive Management Plan.

Jenny Barnett, Biologist, Sheldon NWR, USFWS, Lakeview, OR.
Roddy Baumann, Prescribed Fire Specialist, Pacific Region, USFWS, Portland, OR.
Martin Bray, Biologist, Hart Mountain NAR, Plush, OR.
Steve Clay, Deputy Project Leader, Sheldon-Hart Complex, Lakeview, OR.
Daniel Dearborn, Previous FMO, Region 3, Big Stone NWR, Odessa, MN.
Cris Dippel, Refuge Manager, Hart Mountain NAR, Plush, OR.
Andrew Goheen, Prescribed Fire Specialist, Nevada Zone, USFWS, Lakeview, OR.
Amanda McAdams, Fire Planner, Pacific Region, USFWS, Portland, OR.
Tom Romanello, AFMO, Nevada Zone,USFWS, Lakeview, OR.
Don Voros, Refuge Supervisor, Pacific Region, USFWS, Portland, OR.

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APPENDIX B: DEFINITIONS

Agency Administrator. The appropriate level manager having organizational responsibility for management of an administrative unit. May include Director, State Director, District Manager or Field Manager (BLM); Director, Regional Director, Complex Manager or Project Leader (FWS); Director, Regional Director, Park Superintendent, or Unit Manager (NPS), or Director, Office of Trust Responsibility, Area Director, or Superintendent (BIA).

Appropriate Management Action. Specific actions taken to implement a management strategy.

Appropriate Management Response. Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Appropriate Management Strategy. A plan or direction selected by an agency administrator which guide wildland fire management actions intended to meet protection and fire use objectives.

Appropriate Suppression. Selecting and implementing a prudent suppression option to avoid unacceptable impacts and provide for cost-effective action.

Bureau. Bureaus, offices or services of the Department.

Class of Fire (as to size of wildland fires):
Class A - ¼ acre or less.
Class B - more than ¼ but less than 10 acres.
Class C - 10 acres to 100 acres.
Class D - 100 to 300 acres.
Class E - 300 to 1,000 acres.
Class F - 1,000 to 5,000 acres.
Class G - 5,000 acres or more.

Emergency Fire Rehabilitation/Burned Area Emergency Rehabilitation (EFR/BAER). Emergency actions taken during or after wildland fire to stabilize and prevent unacceptable resource degradation or to minimize threats to life or property resulting from the fire. The scope of EFR/BAER projects are unplanned and unpredictable requiring funding on short notice.

Energy Release Component (ERC) A number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. It is generated by the National Fire Danger Rating System, a computer model of fire weather and its effect on fuels. The ERC incorporates thousand hour dead fuel moistures and live fuel moistures; day to day variations are caused by changes in the moisture content of the various fuel classes. The ERC is derived from predictions of (1) the rate of heat release per unit area during flaming combustion and (2) the duration of flaming.

Extended attack. A fire on which initial attack forces are reinforced by additional forces.
Fire Suppression Activity Damage. The damage to lands, resources and facilities directly attributable to the fire suppression effort or activities, including: dozer lines, camps and staging areas, facilities (fences, buildings, bridges, etc.), handlines, and roads.

Fire effects. Any consequences to the vegetation or the environment resulting from fire, whether neutral, detrimental, or beneficial.

Fire intensity. The amount of heat produced by a fire. Usually compared by reference to the length of the flames.

Fire management. All activities related to the prudent management of people and equipment to prevent or suppress wildland fire and to use fire under prescribed conditions to achieve land and resource management objectives.

Fire Management Plan. A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, preplanned dispatch plans, prescribed fire plans and prevention plans.

Fire prescription. A written direction for the use of fire to treat a specific piece of land, including limits and conditions of temperature, humidity, wind direction and speed, fuel moisture, soil moisture, etc., under which a fire will be allowed to burn, generally expressed as acceptable range of the various fire-related indices, and the limit of the area to be burned.

Fuels. Materials that are burned in a fire; primarily grass, surface litter, duff, logs, stumps, brush, foliage, and live trees.

Fuel loadings. Amount of burnable fuel on a site, usually given as tons/acre.

Hazard fuels. Those vegetative fuels which, when ignited, threaten public safety, structures and facilities, cultural resources, natural resources, natural processes, or to permit the spread of wildland fires across administrative boundaries except as authorized by agreement.

Initial Attack. An aggressive suppression action consistent with firefighter and public safety and values to be protected.

Maintenance burn. A fire set by agency personnel to remove debris; i.e., leaves from drainage ditches or cuttings from tree pruning. Such a fire does not have a resource management objective.

Natural fire. A fire of natural origin, caused by lightning or volcanic activity.

NFDRS Fuel Model. One of 20 mathematical models used by the National Fire Danger Rating System to predict fire danger. The models were developed by the US Forest Service and are general in nature rather than site specific.

NFFL Fuel Model. One of 13 mathematical models used to predict fire behavior within the conditions of their validity. The models were developed by US Forest Service personnel at the Northern Forest Fire Laboratory, Missoula, Montana.

Prescription. Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include safety, public health, environmental, geographic, administrative, social, or legal considerations.

Prescribed Fire. A fire ignited by agency personnel in accord with an approved plan and under prescribed conditions, designed to achieve measurable resource management objectives. Such a fire is designed to produce the intensities and rates of spread needed to achieve one or more planned benefits to natural resources as defined in objectives. Its purpose is to employ fire scientifically to realize maximize net benefits at minimum impact and acceptable cost. A written, approved prescribed fire plan must exist and NEPA requirements must be met prior to ignition. NEPA requirements can be met at the land use or fire management planning level.

Preparedness. Actions taken seasonally in preparation to suppress wildland fires, consisting of hiring and training personnel, making ready vehicles, equipment, and facilities, acquiring supplies, and updating agreements and contracts.

Prevention Activities directed at reducing the number or the intensity of fires that occur, primarily by reducing the risk of human-caused fires.

Rehabilitation (1) Actions to limit the adverse effects of suppression on soils, watershed, or other values, or (2) actions to mitigate adverse effects of a wildland fire on the vegetation-soil complex, watershed, and other damages.

Suppression. A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Unplanned ignition. A natural fire that is permitted to burn under specific conditions, in certain locations, to achieve defined resource objectives.

Wildland fire. An unwanted wildland fire.

Wildland Fire. Any non-structure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Situation Analysis (WFSA). A decision-making process that evaluates alternative management strategies against selected safety, environmental, social, economical, political, and resource management objectives as selection criteria.

Wildland/urban interface fire A wildland fire that threatens or involves structures.

APPENDIX C: COMPREHENSIVE LIST OF PLANTS AND ANIMALS

Classification of vertebrate wildlife species by status, breeding-feeding assemblage, range, abundance by season, and versatility index, Sheldon NWR.[a]

Assemblages	Abundance by season		Versatility index						
Status and species	Br-Fe	Range	Sp	Su	Fa	Wi	Br	Fe	To
Permanent residents									
Alvord chub	1-1	1	f	f	f	f	NE[b]		
Sheldon tui chub	1-1	1	u	u	u	u	10	10	20
Alvord cutthroat trout	1-1	1	u	u	u	u	NE		
Lahontan cutthroat trout	1-1	1	f	f	f	f	NE		
Rainbow trout	1-1	1	f	f	f	f	6	6	8
Guppy	1-1	1	u	u	u	u	NE		
Bluegill	1-1	1	r	r	r	r	NE		
Pumkinseed	1-1	1	r	r	r	r	NE		
Largemouth bass	1-1	1	f	f	f	f	NE		
White crappie	1-1	1	f	f	f	f	NE		
Yellow perch	1-1	1	f	f	f	f	NE		
Great Basin spadefoot toad	1-7	2	c	u	h	h	9	16	25
Pacific treefrog	1-7	2	f	c	u	h	10	21	31
Bullfrog	1-7	1	c	c	c	h	NE		
Desert collared lizard	3-2	1	f	f	f	h	NE		
Long-nosed leopard lizard	4-2	4	f	f	f	h	NE		
Western fence lizard	3-8	2	f	c	u	h	11	15	26
Sagebrush lizard	4-8	6	f	c	u	h	7	17	24
Side-blotched lizard	4-2	6	f	c	u	h	11	22	33
Desert horned lizard	4-2	4	x	r	x	h	8	8	16
Short-horned lizard	4-2	4	f	c	f	h	13	15	28
Western whiptail	4-2	4	u	u	u	h	NE		
Southern alligator lizard	4-8	1	x	x	x	h	NE		
Rubber boa	4-2	4	r	u	r	h	18	41	59
Racer	4-8	6	f	c	u	h	16	61	77
Striped whipsnake	4-8	6	r	u	r	h	28	48	76
Gopher snake	4-8	6	f	c	u	h	27	59	86
W. terrestrial garter snake	2-7	2	c	c	f	h	11	24	35
Night snake	4-2	4	u	u	u	h	NE		
Western rattlesnake	4-2	3	u	f	u	h	18	41	59
Northern harrier	4-2	5	c	c	c	u	13	44	57
Red-tailed hawk	5-2	5	c	c	c	r	17	42	59
Golden eagle	3-2	3	c	c	c	f	2	42	44
American kestrel	10-2	5	c	c	c	r	9	49	58
Prairie falcon	3-2	2	c	c	u	r	2	33	35
Chukar	4-2	4	f	f	f	f	10	20	30
Sage grouse	4-2	5	f	f	f	f	8	31	39
California quail	4-2	2	f	f	f	f	5	29	34
Common snipe	2-1	1	c	c	u	r	7	18	25
Western screech-owl	10-2	2	c	c	c	c	2	15	17
Long-eared owl	5-2	2	f	f	f	f	8	15	23
Short-eared owl	4-2	2	f	u	f	r	20	29	49
Great horned owl	5-2	2	c	c	c	c	11	29	40
Downy woodpecker	8-5	1	u	u	u	r	6	9	15
Hairy woodpecker	8-4	1	u	u	u	u	6	18	24
Northern flicker	8-8	4	c	c	c	f	11	36	47
Horned lark	4-2	6	c	c	c	u	26	40	66
Black-billed magpie	5-2	2	f	f	u	u	22	32	54
Common raven	3-2	3	c	c	c	f	2	55	57
Mountain chickadee	10-4	2	f	f	f	f	8	29	37
Plain titmouse	10-8	2	f	f	f	f	2	9	11
Bushtit	5-4	2	u	u	u	r	14	28	42
Marsh wren	2-7	1	f	f	f	x	2	4	6
Rock wren	3-2	6	c	c	f	x	2	36	38
Canyon wren	3-2	1	u	u	u	r	2	17	19

Status and species	Br-Fe Range	Assemblages	Abundance by season: Sp	Su	Fa	Wi	Versatility index: Br	Fe	To
American robin	5-8	2	c	c	f	u	19	45	64
Loggerhead shrike	5-8	5	f	f	u	r	25	43	68
European starling	10-2	2	c	c	r	r	5	12	17
Sage sparrow	4-2	6	c	c	u	r	9	24	33
Song sparrow	4-7	1	c	c	f	u	3	11	14
Western meadowlark	4-2	6	c	c	f	u	37	51	88
Cassin's finch	5-8	4	c	c	c	u	18	19	37
Merriam's shrew	9-2	6	u	u	u	u	30	58	88
Vagrant shrew	9-2	1	r	r	r	r	15	38	33
Preble's shrew	9-2	1	r	r	r	r	8	19	27
American pika	3-2	1	u	u	u	x	2	7	9
Pygmy rabbit	4-2	4	c	c	c	u	10	26	36
Mountain cottontail	4-2	6	c	c	c	f	28	42	70
Black-tailed jackrabbit	4-2	6	c	c	c	c	20	52	72
White-tailed jackrabbit	4-2	4	f	f	f	f	14	22	36
Least chipmunk	9-2	6	c	c	c	r	21	48	69
Yellow-bellied marmot	3-2	4	c	c	u	h	3	17	20
White-tailed antelope squirrel	9-2	4	c	c	u	x	4	6	10
Belding's ground squirrel	9-2	6	c	c	u	h	9	19	28
Golden-mantled ground squirrel	9-2	4	f	f	f	x	6	32	38
Townsend's ground squirrel	9-2	6	c	c	u	h	10	36	46
Northern pocket gopher	9-2	4	c	c	c	h	26	27	53
Great Basin pocket mouse	9-2	6	c	c	c	u	18	35	53
Dark kangaroo mouse	9-2	4	f	f	f	u	4	9	13
Chisel-toothed kangaroo rat	9-2	4	f	f	f	u	22	35	57
Ord's kangaroo rat	9-2	6	c	c	c	u	28	30	58
American beaver	2-3	1	f	f	f	r	6	7	13
Deer mouse	9-2	6	c	c	c	u	67	82	149
Pinyon mouse	10-8	1	u	u	u	r	6	23	29
Northern grasshopper mouse	9-2	4	r	r	r	r	22	35	57
Bushy-tailed woodrat	3-2	4	c	c	c	u	12	34	46
Desert woodrat	3-2	4	c	c	c	u	2	11	13
House mouse	3-2	1	u	u	u	r	NE		
Long-tailed vole	9-2	1	f	f	f	r	26	32	58
Montane vole	9-2	4	c	c	c	u	13	18	31
Sagebrush vole	9-2	6	c	c	c	r	16	35	51
Common porcupine	3-8	3	c	c	c	f	15	47	62
Coyote	9-2	6	c	c	c	c	25	82	107
Kit fox	9-2	4	u	u	u	u	NE		
Common raccon	3-7	1	r	r	r	x	2	12	14
Ermine	9-2	4	f	f	f	u	31	42	73
Long-tailed weasel	9-2	6	c	c	c	u	54	79	133
Badger	9-2	6	c	c	u	r	33	47	80
Western spotted skunk	3-2	3	u	u	u	r	7	31	38
Striped skunk	9-2	2	r	r	r	x	2	16	18
Mountain lion	3-2	3	x	x	x	x	2	34	36

Bobcat	3-2	2	f	f	f	f	2	53	55
Feral burro	4-2	4	f	f	f	f			
Feral horse	4-2	6	c	c	c	c	11	21	32
Mule deer	4-2	2	c	c	c	f	25	63	88
Pronghorn	4-2	5	c	c	c	f	6	42	48
California bighorn sheep	4-2	2	c	c	c	c	2	28	30
Summer residents									
Pied-billed grebe	2-1	1	u	r	u	-	8	10	18
Eared grebe	2-1	1	c	f	u	-	8	10	18
Western grebe	2-1	1	u	r	x	-	2	10	12
Clark's grebe	2-1	1	u	r	x	-	2	10	12

Status and species	Assemblages: Br-Fe	Assemblages: Range	Abundance by season: Sp	Su	Fa	Wi	Versatility index: Br	Fe	To
Black-crowned night heron	2-1	1	u	u	u	-	1	10	11
Canada goose	2-7	2	f	f	f	-	6	13	19
Green-winged teal	2-1	2	f	f	f	-	6	10	16
Mallard	2-7	2	c	f	c	-	6	10	16
Northern pintail	2-1	2	c	u	c	-	6	10	16
Blue-winged teal	2-1	2	f	r	u	-	6	10	16
Cinnamon teal	2-1	2	c	c	u	-	6	10	16
Northern shoveler	2-1	2	f	r	u	-	5	10	15
Gadwall	2-1	2	c	f	c	-	6	10	16
Canvasback	2-1	1	u	x	u	-	2	10	12
Redhead	2-1	1	u	r	u	-	6	10	16
Lesser scaup	2-1	1	u	r	r	-	0	10	0
Ruddy duck	2-1	1	u	u	r	-	5	10	15
Turkey vulture	3-2	3	c	c	f	-	2	59	61
Sharp-shinned hawk	5-10	2	f	r	f	r	13	27	40
Cooper's hawk	5-10	2	c	x	f	r	10	26	36
Northern goshawk	5-10	2	r	x	r	r	8	24	32
Ferruginous hawk	5-2	5	u	u	u	-	8	21	29
Virginia rail	2-1	1	u	u	u	-	2	8	10
Sora	2-1	2	c	f	f	-	6	10	16
American coot	2-1	1	c	c	c	-	6	8	14
Sandhill crane	2-7	2	u	u	u	-	8	13	21
Killdeer	2-7	4	c	c	c	-	10	17	27
Black-necked stilt	2-1	1	u	r	r	-	5	12	17
American avocet	2-1	2	f	f	u	-	3	12	15
Willett	2-1	2	c	c	u	-	9	14	23
Spotted sandpiper	2-1	2	u	u	r	-	5	13	18
Long-billed curlew	2-1	1	u	x	x	-	8	17	25
Wilson's phalarope	2-1	2	c	f	u	-	7	10	17
Mourning dove	4-2	4	c	f	r	-	21	33	54
Burrowing-owl	9-10	4	r	r	r	-	9	17	26
Northern saw-whet owl	10-2	1	r	r	r	-	1	21	22
Common nighthawk	4-3	6	r	c	r	-	23	55	78
Common poorwill	4-3	4	u	c	c	-	14	21	35
White-throated swift	3-3	1	c	c	r	-	0	42	0
Red-naped sapsucker	8-5	1	r	r	r	-	2	6	8
Dusky flycatcher	6-3	1	f	f	u	-	5	12	17
Gray flycatcher	5-3	4	c	c	u	-	16	21	37
Say's phoebe	3-3	2	f	f	r	-	2	7	9
Ash-throated flycatcher	10-3	2	r	r	r	-	2	3	5
Western kingbird	5-3	1	u	u	r	-	3	6	9
Tree swallow	10-3	1	x	x	x	-	2	29	31
Violet-green swallow	3-3	4	c	c	x	-	2	50	52
Cliff swallow	3-3	2	c	c	r	-	2	24	26
Barn swallow	3-3	1	u	u	r	-	2	20	22
Scrub jay	5-8	1	f	f	f	-	8	22	30
House wren	10-4	1	u	u	u	-	7	26	33
Blue-gray gnatcatcher	5-4	1	f	f	r	-	3	7	10
Mountain bluebird	10-8	1	u	u	u	-	6	26	32
Sage thrasher	4-2	6	c	c	u	-	26	37	63
Warbling vireo	6-5	1	u	u	r	-	3	9	12
Orange-crowned warbler	4-4	1	c	r	f	-	6	25	31
Yellow warbler	6-5	1	c	c	f	-	5	9	14
Black-throated gray warbler	5-4	2	c	f	u	-	10	25	35
Common yellowthroat	2-7	1	c	c	u	-	2	6	9
Lazuli bunting	6-8	1	f	c	u	-	2	13	15

	Assemblages		Abundance by season				Versatility index		
Status and species	Br-Fe	Range	Sp	Su	Fa	Wi	Br	Fe	To
Brewer's sparrow	4-8	6	c	c	u	-	27	44	71
Vesper sparrow	4-2	6	c	c	u	-	20	32	52
Lark sparrow	4-2	2	c	c	u	-	17	17	34
Black-throated sparrow	4-2	2	u	f	r	-	9	10	19
Savannah sparrow	4-2	1	c	c	f	-	14	23	37
White-crowned sparrow	4-2	1	c	r	c	-	19	50	69
Red-winged blackbird	2-2	2	c	c	u	-	11	17	28
Yellow-headed blackbird	2-2	1	u	r	r	-	2	8	10
Brewer's blackbird	2-2	2	c	c	u	-	16	27	43
Brown-headed cowbird	5-2	1	f	f	r	-	31	25	56
Northern oriole	6-6	1	f	u	r	-	2	9	11
House finch	5-2	4	u	r	r	-	5	15	20
Transients									
Horned grebe	0-1	7	r	-	x	-	0	8	0
American white pelican	0-1	7	x	x	x	-	0	10	0
Double-crested cormorant	0-1	7	r	r	r	-	0	8	0
Great blue heron	0-1	7	r	r	r	-	0	10	0
Great egret	0-1	7	x	r	x	-	0	10	0
Snowy egret	0-1	7	r	r	x	-	0	10	0
White-faced ibis	0-1	7	r	r	x	-	0	9	0
Tundra swan	0-1	7	u	-	u	-	0	10	0
Greater white-fronted goose	0-7	7	u	-	r	-	0	3	0
Snow goose	0-7	7	x	-	x	-	0	3	0
Wood duck	0-7	7	x	-	x	-	0	10	0
American wigeon	2-7	7	f	r	c	-	0	11	0
Ring-necked duck	2-1	7	u	r	r	-	0	10	0
Common goldeneye	0-1	7	f	-	f	-	0	10	0
Barrow's goldeneye	0-1	7	x	-	x	-	0	10	0
Hooded merganser	0-1	7	u	-	r	-	0	10	0
Common merganser	0-1	7	f	-	r	-	0	10	0
Bufflehead	0-1	7	f	r	f	-	0	10	0
Osprey	0-1	7	r	-	x	-	0	9	0
Bald eagle	0-7	7	r	-	r	-	0	15	0
Swainson's hawk	0-2	3	u	r	u	-	0	27	0
Merlin	0-10	8	r	-	r	-	0	16	0
Peregrine falcon	0-3	7	x	-	x	-	0	17	0
Greater yellowlegs	0-1	8	f	f	u	-	0	10	0
Lesser yellowlegs	0-1	8	f	f	u	-	0	10	0
Western sandpiper	0-1	8	f	f	u	-	0	5	0
Least sandpiper	0-1	8	f	f	u	-	0	5	0
Baird's sandpiper	0-1	8	-	r	-	-	0	5	0
Long-billed dowitcher	0-1	8	f	f	f	-	0	7	0
Red-necked phalarope	0-1	8	-	r	x	-	0	10	0
Ring-billed gull	0-7	7	r	r	x	-	0	11	0
California gull	0-7	7	r	r	x	-	0	11	0
Caspian tern	0-1	7	x	x	-	-	0	10	0
Forster's tern	0-1	7	x	x	-	-	0	10	0
Black tern	0-1	7	r	x	r	-	0	10	0
Calliope hummingbird	0-8	1	r	r	x	-	8	10	0
Broad-tailed hummingbird	0-8	2	u	x	x	-	0	17	0
Rufous hummingbird	0-2	8	-	c	-	-	0	9	0
Belted kingfisher	0-1	7	x	x	x	-	0	6	0
Lewis's woodpecker	0-9	7	r	r	r	-	0	16	0
Olive-sided flycatcher	0-3	7	u	x	u	-	0	18	0
Western wood peewee	0-3	7	u	x	r	-	0	18	0
Willow flycatcher	0-3	7	u	x	r	-	0	9	0

Status and species	Abundance by season: Br-Fe	Versatility index: Range	Sp	Su	Fa	Wi	Assemblages: Br	Fe	To
Bank swallow	0-3	7	r	r	-	-	0	16	0
American crow	0-2	7	x	x	x	-	0	16	0
Red-breasted nuthatch	0-4	8	c	r	c	-	0	27	0
Brown creeper	0-6	8	r	-	r	-	0	16	0
Bewick's wren	0-4	7	x	x	x	-	0	12	0
Winter wren	0-5	7	r	x	r	-	0	7	0
American dipper	0-1	7	x	x	x	-	0	2	0
Ruby-crowned kinglet	0-4	8	c	x	c	-	0	29	0
Western bluebird	0-8	7	u	x	u	-	0	16	0
Swainson's thrush	0-2	7	r	r	x	-	0	6	0
Hermit thrush	0-2	7	u	r	u	-	0	21	0
Varied thrush	0-2	7	r	-	u	-	0	15	0
American pipit	0-1	7	u	r	c	-	0	23	0
Solitary vireo	0-4	7	u	r	u	-	0	27	0
Nashville warbler	0-4	7	u	x	r	-	0	27	0
Yellow-rumped warbler	0-9	7	c	f	c	-	0	27	0
MacGillivray's warbler	0-5	7	f	c	f	-	0	10	0
Wilson's warbler	0-5	7	f	r	u	-	0	9	0
Western tanager	0-4	7	c	u	r	-	0	27	0
Black-headed grosbeak	0-5	7	f	u	r	-	0	8	0
Fox sparrow	0-2	7	f	f	u	-	0	17	0
Lincoln's sparrow	0-7	7	r	r	f	-	0	7	0
White-throated sparrow	0-2	8	x	-	r	-	0	41	0
Golden-crowned sparrow	0-2	8	r	-	u	-	0	49	0
Dark-eyed junco	0-2	8	u	x	f	u	0	31	0
Pine siskin	0-4	7	u	r	r	-	0	6	0
Lesser goldfinch	0-2	7	x	x	-	-	0	2	0
American goldfinch	0-2	7	x	x	x	-	0	9	0
Winter residents									
Rough-legged hawk	0-2	9	f	-	f	u	0	13	0
Golden-crowned kinglet	0-4	8	u	-	f	u	0	29	0
Townsend's solitaire	0-8	7	u	r	f	c	0	31	0
Northern shrike	0-10	9	r	-	u	u	0	25	0
American tree sparrow	0-2	7	-	-	x	r	0	7	0
Lapland longspur	0-2	7	-	-	-	r	0	15	0
Rosy finch	0-2	9	-	-	x	r	0	15	0

[a] Refer to legend for description of codes.
[b] Not estimated, incomplete analysis.

STATUS
Permanent resident: occurs on year-round basis;
Summer resident: breeds on Refuge; occurs as transient during spring and all;
Transient: does not breed on Refuge; occurs during spring and fall migration;
Winter resident: occurs during winter; may occur as transient in fall and spring.

BREEDING ASSEMBLAGES
(1) Breeds in water;
(2) Breeds on or near ground around water or on emergent vegetation;
(3) Breeds in cliffs, caves, rims, talus or man-made structures;
(4) Breeds on or near ground;
(5) Breeds in shrubs and trees;
(6) Breeds in deciduous shrubs and trees;
(7) Breeds in conifers;
(8) Excavates hole in tree for breeding;
(9) Breeds in an underground burrow;
(10) Breeds in hole made by another species or that has occurred naturally.

FEEDING ASSEMBLAGES
(1) Feeds in water;
(2) Feeds on or near ground;
(3) Feeds in air;
(4) Feeds in shrubs and trees;
(5) Feeds in deciduous shrubs and trees;
(6) Feeds in conifers;
(7) Feeds in water, or on or near ground;
(8) Feeds on or near ground, or in shrubs and trees;
(9) Feeds in shrubs, trees, and air;
(10) Feeds on or near ground, or in shrubs, trees, or air.

RANGE
(1) < 5% of Refuge area used for breeding and feeding;
(2) < 5% of area used for breeding; 5-20% of area used for feeding;
(3) < 5% of area used for breeding; > 20% of area used for feeding;
(4) 5-20% of area used for breeding and feeding;
(5) 5-20% of area used for breeding; > 20% of area used for feeding;
(6) > 20% of area used for breeding and feeding;
(7) < 5% of area used for feeding.
(8) 5-20% of area used for feeding.
(9) > 20% of area used for feeding.

ABUNDANCE BY SEASON

		a few individuals encountered on:	many individuals encountered on:
C	Common or abundant	> 90% of days	> 50% of days
F	Fairly common	50-90% of days	10-50% of days
U	Uncommon	< 10% of days	< 10% of days
R	Rare	< 10% of days	--
X	Extremely rare	10 or fewer records at that season	--
H	(aestivation/hibernation)	--	--

Abundance classes developed by DeSante and Pyle (1987) were modified to include representation of all taxonomic groups of wildlife that occur on the Refuge. Therefore, "encounter" refers to the expected rate of observation by an experienced individual of a species in its preferred succession and progression stages of vegetation type(s). Method of "observation" differs among species. It refers to observations made by sight or sound in the case of amphibians, birds, lizards and snakes. In the case of mammals of secretive,
nocturnal, and cryptic habit, a species presence and abundance may be detected by tracks, scat, or capture using the appropriate live-trap.

VERSATILITY INDEX

Br (Breeding versatility index). The sum total number of vegetation types and succession and progression stages of vegetation types preferred for breeding purposes. Includes species classified as permanent residents and summer residents that breed on the Refuge.

Fe (Feeding versatility index). The sum total number of vegetation types and succession and progression stages of vegetation types preferred for feeding purposes. Includes species of all residency categories.

To (Total versatility index). The sum total number of vegetation types and succession and progression stages of vegetation types preferred for breeding and feeding purposes. Includes species classified as permanent and summer residents that breed on the Refuge.

Versatility indices measure "...the sensitivity of each species to habitat change" to foster evaluation of wildlife in natural resource plans developed for the Great Basin of southeastern Oregon (Maser et al. 1984a, 1984b). At Hart Mountain NAR, indices were derived using computation methods of Maser et al. (1984a, 1984b) adapted to the 302 wildlife species and 101 structural stages of 31 vegetation types found on the Refuge. The versatility index for each species therefore consists of the sum total number of vegetation types and structural stages (i.e., succession stages) preferred for breeding, feeding, or combined use depending on a species' residency mode. In general, the larger the index, the greater the number of habitats used, and the lower the likelihood that alterations in composition of a single preferred habitat would influence the status of the species' population on the Refuge. Note that evaluation of a species' sensitivity to habitat alteration should account not only for size of versatility index but also the amount of area comprised preferred habitat on the Refuge, the status of a species' population on the Refuge, and the status of a species' population and preferred habitat in a biogeographic region.

Appendix D: Delegation of Authority

You have full authority and responsibility for managing the fire suppression activities within the framework of the law and Fish and Wildlife Service policy and direction as provided by this office. Resource Management Plans and other appropriate documents will be provided by the Resource Advisor.

Your primary responsibility is to organize and direct your assigned resources for efficient and effective suppression of the fire.

Refuge Managers, Biologist and other designated staff will be assigned to you as Resource Advisors. He/She or the Refuge Managers should be consulted in situations where natural resource decisions or tradeoffs are involved.

The Fire Management Officer should take appropriate suppression actions on all fires originating on Fish and Wildlife Lands.

The Incident Commander has full approval to issue press releases that are specific to the Fire. Approval and release authority for other public and fire information matters is reserved for the Project Leader or Designee.

Specific direction and fire suppression priorities for fire are as follows, and are in priority order:

1. Protect life, property, and resources from unwanted fire.

2. Firefighter safety.

3. Utilize natural barriers and roads if possible for burnout operations.

4. Use of dozers requires resource advisor approval prior to shift plan implementation. The widening of existing roads and two tracks is not restricted.

Project Leader,______________________________Sheldon-Hart Mtn. Complex, January 1, 2001

Hart Mountain NAR

APPENDIX E: COOPERATIVE AGREEMENTS

APPENDIX F: DISPATCH PLAN

Hart Mountain NAR
Pre-planned Dispatch Card
Key to Refuge FMU Map

Staffing Class	FMU I	FMU II	FMU III
1/2/3	Engine	Engine	Engine
4	Engine	2 Engine	2 Engine
	FWS Duty Officer	FWS Duty Officer	FWS Duty Officer
	Resource Advisor	Resource Advisor	Resource Advisor
	Interagency Helitack Crew	Interagency Helitack Crew	Interagency Helitack Crew
5	Engine	2 Engine	FWS Duty Officer

FWS Resource Advisors:

Cris Dippel - Refuge Manager - - -cell phone-219-0301–hm # 947-5229
Martin Bray - Biologist- - - - - - - -cell phone -219-1112–HM# 947-2097

APPENDIX G: PRE-ATTACK PLAN

Pre-Attack Guidelines for Initial Attacking Fires
On Hart Mountain NAR

One Mile Boundary N-E-S: Modified Control Strategy
Fires entering the Refuge - Fires entering the refuge should be managed as confinement actions. Suppression costs should be managed closely. Initial Attack Incident Commanders should consider indirect attack their primary tactic. Use existing roads, prescribed fire burn scars, and washes for burnout boundaries.

Fires leaving the Refuge - Fire spread threatening to leave the Refuge should be aggressively initial attacked to prevent fires from leaving the Refuge onto neighboring landowners. Initial Attack Incident Commanders using control strategy should consider direct attack when flame lengths are less than six feet. Frontal assault on head fires should not be attempted due to high probability of equipment being stuck in rocky areas or over-run by rapid fire advance. Order resources as needed.

Flook Homestead: Control Strategy
The Flook Homestead consists of a group of historic wooden structures. Historic importance places the site as a high value at risk. Initial Attack Incident Commanders should consider aggressive direct attack on fires that occur in the area when it is safe to do so. In the event of larger fires threatening the site from the Confinement Zone, or when flame lengths and rates of spread preclude direct attack, defensible lines should be burned around the structures and the structures themselves pre-treated with foam fire retardants. Aerial retardant should be considered as a last resort due to its physical impact that may further breakdown the structures. Order resources as needed. Mechanical line may also be employed to protect structures.

Headquarters: Control Strategy
The headquarters consists of numerous buildings, trailers and equipment. Most of the structures have wooden shake roofs that are extremely susceptible to ignition. Initial Attack Incident Commanders should take aggressive direct attack when safe to protect the area. Burning out should be considered when ever fire spread threatens the compound. Ensure that all HQ residents are informed of the fire threat and intended actions. Shake roofs and other flammable materials should be pre-treated with fire retardant foam. Attack lines supported from compound hydrants should be pre-positioned. Ladders should be placed against all buildings with flammable roofs. Traffic should be stopped on all roads until emergency passes. Order resources as needed. Mechanical line may also be employed to protect structures.

Hotsprings Campground and Deer Creek: Control Strategy
Ensure visitors have enough time to vacate area. Use direct attack if possible to do so safely, to prevent loss of life and property. Use aerial retardant to slow fire's advance to campground if visitors are present. Aerial retardants may also be used to pre-treat structures. Mechanical line may also be employed to protect life and property.

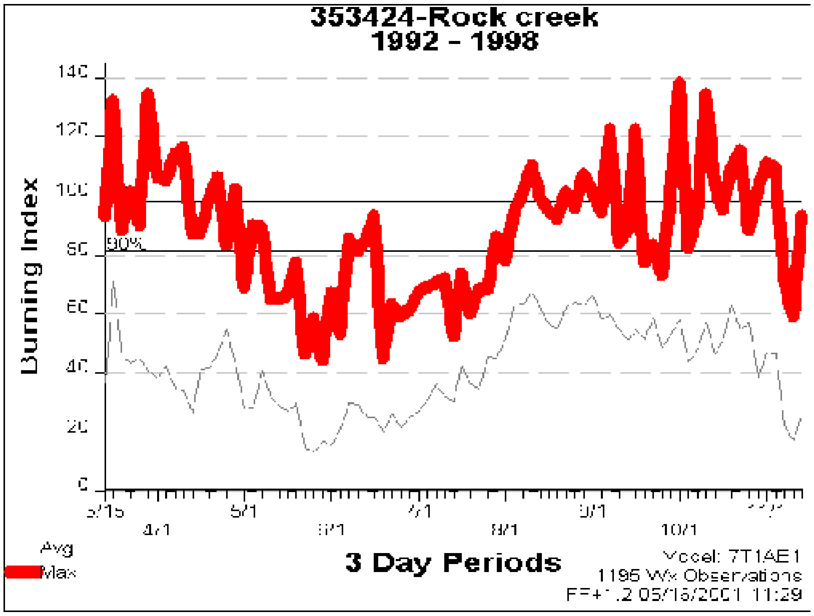
Blue Sky: Control Strategy
After ensuring that visitors are not in the vicinity, use aggressive direct attack when safely possible. If fire is threatening Blue Sky from either the confinement or containment zones, use aerial retardants to slow fire's progress and to pre-treat ponderosa pine sites. Mechanical line may also be employed to protect the unique values of Blue Sky.

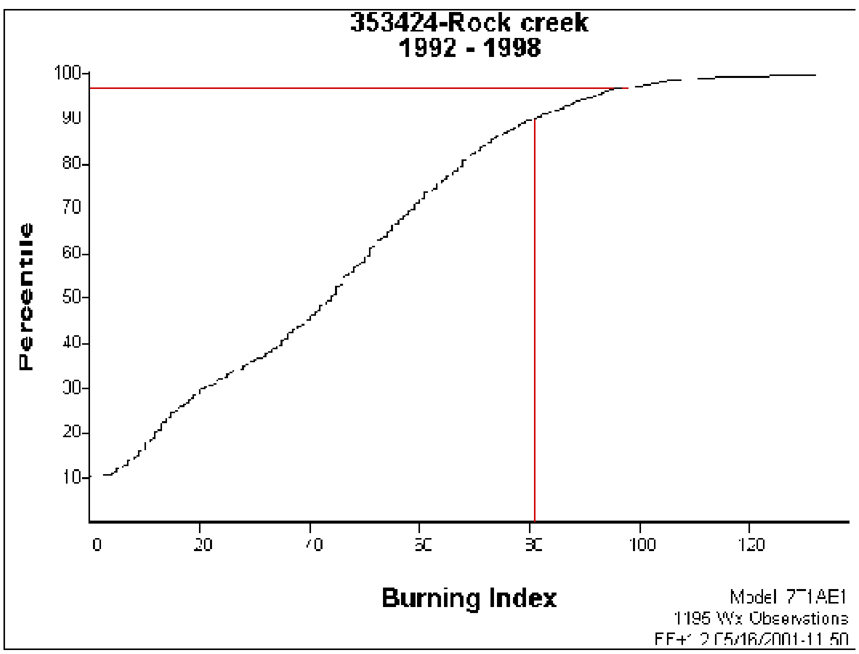
Escarpment, East Slopes and Intermediate Hills: Containment Zone
Initial Attack Incident Commanders should use natural and constructed fire breaks to contain fires to specific areas in the containment zone.   Drainages, talus slopes, roads, aerial retardant, and etc., can be used as containment zone boundaries. High value areas, including Degarmo Canyon, CCC Camp and the radio repeater site, should receive pre-treatment with foams and aerial retardants if they are threatened. Broad containment area boundaries can be considered to include up to three burning periods of fire spread. Any fire break can be improved and should be burned out if possible.

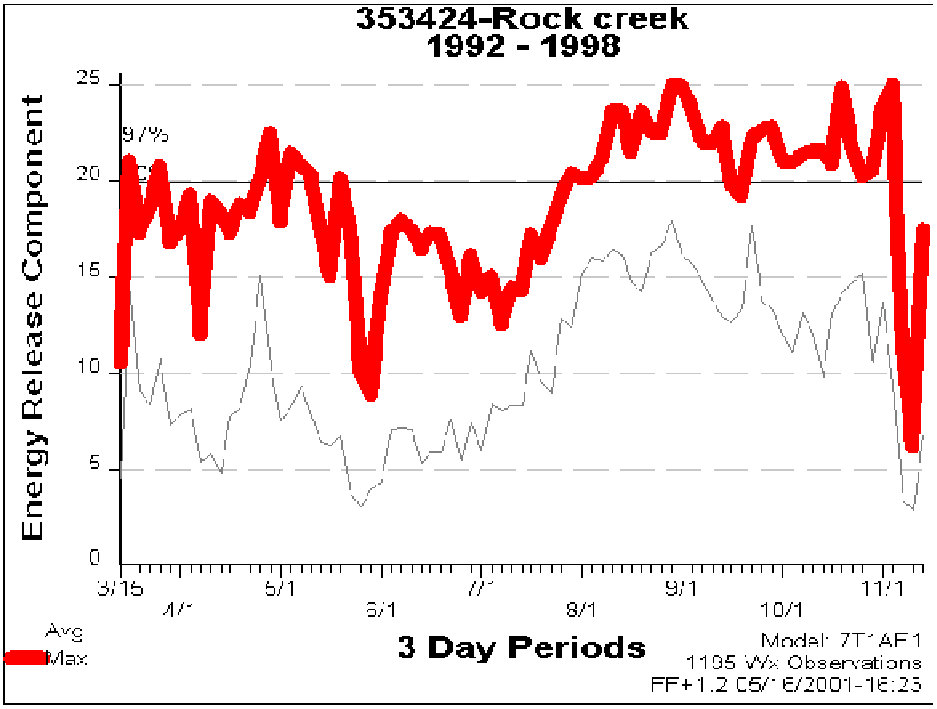
Tablelands: Confinement
Initial Attack Incident Commanders should use time and space to their advantage when suppressing fires in this zone. Management has accepted more burned acres in this zone as a trade-off to aggressive suppression actions. Initial Attack Incident Commanders should defend control zones through indirect attack rather than actively suppressing fires in the confinement zone. No direct attack is necessary in this zone.

APPENDIX H: HISTORICAL WEATHER DATA

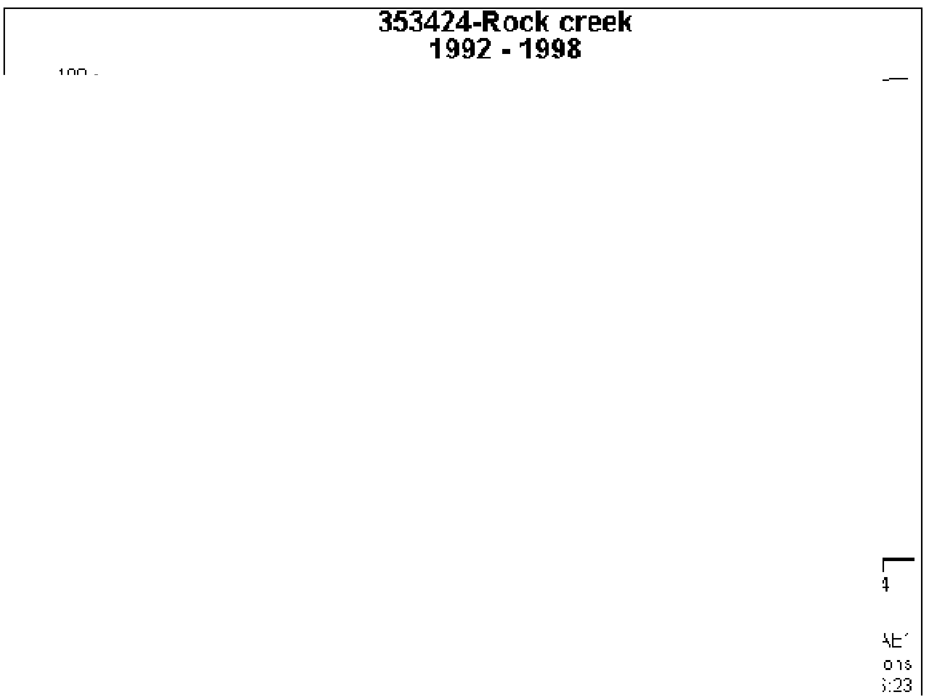
Rock Creek







353424-Rock creek
1992 - 1998
Energy Release Component
25
20
15
10
5
0
3/15
5/1
6/1
8/1
9/1
10/1
11/1
Avg
Max
3 Day Periods
1195 Wx Observations



353424-Rock creek
1992 - 1998

APPENDIX I: Normal Unit of Strength Inventory **(NUS)**

SHELDON/HART COMPLEX MINIMUM FIRE CACHE STOCKING			
DATE:			
Item Description	**Notes**	**Size**	**Minimum Stocking**
Back-pack pump		cloth	30
Brass, adapter		1 ½" NST - 1 ½" NH	10
Brass, Ball valve shutoff		1" NPSH	25
Brass, double female		1 ½" NH	10
Brass, double female		1" NPSH	10
Brass, double male		1 ½" NH	10
Brass, double male		1" NPSH	10
Brass, foot valve		1 ½" NH	10
Brass, foot valve		1" NPSH	2
Brass, foot valve		2" NPSH	10
Brass, Gated Y		1 ½" NH	40
Brass, Gated Y		1" NPSH	40
Brass, increaser		3/4" NPSH - 1" NPSH	10
Brass, pressure relief valve		1 ½" NH	8
Brass, reducer		1 ½" NH - 1" NPSH	50
Brief case (GSA grey)			10
Brush Jacket (Wajax)		L	15
Brush Jacket (Wajax)		M	5
Brush Jacket (Wajax)		XL	10
Canteen, 1 quart			100
Canteen, 4 quart			40
Fire shelter			30
Fire shelter (practice)			10
First aid, exposure			4
First aid, personal			30
Foam generator (FP-50)			2
Foam, Phos-check WD88		5 gallon tub	25

Gloves (GSA)		L	30
Gloves (GSA)		M	30
Gloves (GSA)		S	10
Gloves (GSA)		XL	20
Goggles			30
Hard hat		Blue	30
Headlamp			30
Hose (100 ft)		1 ½" NH	100
Hose (100 ft)		1" NPSH	100
Hose (100 ft)		3/4" NPSH (garden hose)	200
Hose (25 ft)		1 ½" NH	8
Hose (50 ft)		1 ½" NH	16
Hose (50 ft)		3" Hose with 2 ½" NH fitting	4
Hose (suction)		1 ½" NH x 8 ft	5
Hose (suction)		2" NPSH x 8 ft	12
Hose clamp			20
Hose pack (Cascade)			10
Hose pack (FSS, green)			40
Hydrant wrench			6
Line gear			30
MRE		case	10
Nomex pants		26-30 x 29	4
Nomex pants		28-32 x 29	4
Nomex pants		28-32 x 33	2
Nomex pants		30-34 x 33	10
Nomex pants		32-36 x 29	2
Nomex pants		32-36 x 33	16
Nomex pants		34-38 x 33	20
Nomex pants		36-40 x 33	4
Nomex, pant		34-38 x 29	1
Nomex shirt		L	30
Nomex shirt		M	10
Nomex shirt		S	5
Nomex shirt		XL	20
Nomex shirt		XL-L	5
Nomex, shrowd			30
Nozzle, adjustable		3/4" NPSH	25
Nozzle, foam (10 gpm)		1' NPSH	10
Nozzle, forester		1"	40
Nozzle, KK		1 ½" NH	20
Nozzle, KK		1" NPSH	20

Nozzle, KK (plastic)		1" NPSH	5
Pad, foam			30
Pad, therma-rest		Long	15
Pump, Hand primer		1 ½" NH	12
Pump, Homelite			2
Pump, Honda		Volume	1
Pump, Mini Mark			1
Pump, Wajax Mark III			5
Pump, Waterous Floto			1
Red bag (FSS)			30
Sleeping bag (Slumber-jack)			30
Spanner wrench		10"	10
Spanner wrench		5"	30
Tent			30
Tools, pulaski			20
Tools, shovel			20
Tools, McCleod			10
Tools, Flapper			10

APPENDIX J: COMMUNICATIONS

US Fish & Wildlife Service King EPH & LPH Frequency List
(Rev 3/00)

GROUP 1: **EPH and LPH**

CH#	ASSIGNMENT	NAME	RX	TX	Code	Guard	COMMENTS
1	FWS	FW DIR	166.575	168.575	0	---	Copper
2	FWS	FW RPT	168.575	168.650	3	107.2	Hart
			"	"	6	123.0	Badger
3	LV BLM	LV BLM	166.325	166.325	0	---	Direct
4	LV BLM RPT	LV RPT	166.325	166.925	1	100.0	Hart
			"	"	3	107.2	Yainax
			"	"	5	114.8	Green Mt
			"	"	6	123.0	Hamaker
5	Fremont NF	FS ORG	172.350	172.350	2	103.5	FS Fire
6	Fremont NF	FS GRN	170.500	170.500	0	---	FS SOA
7	Fremont NF	FS YEL	171.700	171.700	2	103.5	FS Admin2
8	Cederville BLM	CDV BLM	166.4875	166.4875	0	---	Direct
9	Cederville BLM	CDV RPT	166.4875	167.075	4	110.9	Fox Mt
			"	"	6	123.0	49 Mt
			"	"	7	127.3	Likely
			"	"	8	146.2	Yellow Pk
10	Winnemucca BLM	WIN SOA	171.675	171.675	0	--	SOA
11	Winnemucca BLM	WIN BLM	170.025	170.025	0	---	Direct
12	Winnemucca BLM	WIN RPT	170.025	168.375	5	114.8	Granite
			"	"	9	151.4	Blue Lake
13	Burns BLM	BURNS	166.350	166.350	0	---	Direct
14	Burns BLM	BRNS RPT	166.350	166.950	3	107.2	Wagontire
			"	"	5	114.8	Steens

GROUP 2: **EPH Only**

CH#	ASSIGNMENT	NAME	RX	TX	TONE	COMMENTS
1	FWS	FW DIR	168.575	168.575	---	Direct
2	FWS Hart	FW HART	168.575	169.650	107.2	
3	FWS Badger	FW BADGR	168.575	169.650	123.0	
4	LV BLM Direct	LKV BLM	166.325	166.325	--	White
5	LV BLM SOA	BLM SOA	166.775	166.775	---	Blue
6	Fremont NF	FS ORG	172.350	172.350	103.5	Orange
7	Fremont NF	FS GRN	170.500	170.500	---	Green
8	LV OSDF	OSDF LV	154.115	154.115	131.8	Gray
9	LV OSDF SOA	OSDF SOA	151.340	151.340	---	Red
10	USFS	TAC 2	168.200	168.200	---	Incident Tac
11		CH 11				
12		CH 12				
13		CH 13				
14		CH 14				

Note: Group 2 tones are dedicated to the associated channel.

Fremont N.F. King EPH and Midland Frequency List Rev 3/99

GROUP 1: FREMONT FREQUENCIES (FRE)

CH#	ASSIGNMENT	NAME	RX	TX	TONE	COMMENTS
1	FREMONT	ADMIN1	170.600	170.600	103.5>	CH's 1,2,3 direct
2	FREMONT	ADMIN2	171.700	171.700	103.5>>	to LIFC, mobiles,
3	FREMONT	FIRE	172.350	172.350	103.5>	district offices.
4	FREMONT	PROJCT	170.500	170.500		Scene Of Action
5	GRIZZLY	RPT 11	170.600	168.725	110.9	Admin Repeater
6	GRIZZLY	RPT 21	171.700	168.725	167.9	Admin Repeater
7	GRIZZLY	RPT 31	172.350	168.725	136.5	Fire Repeater
8	ROUND PASS	RPT 12	170.600	168.725	123.0	Admin Repeater
9	ROUND PASS	RPT 22	171.700	168.725	118.8	Admin Repeater
10	ROUND PASS	RPT 32	172.350	168.725	146.2	Fire Repeater
11	DEAD INDIAN	RPT 13	170.600	168.725	131.8	Admin Repeater
12	DEAD INDIAN	RPT 23	171.700	168.725	127.3	Admin Repeater
13	DEAD INDIAN	RPT 33	172.350	168.725	156.7	Fire Repeater

GROUP 2: SOUTHERN AREA AGENCIES (SAA)

CH#	ASSIGNMENT	NAME	RX	TX	TONE	COMMENTS
1	FREMONT	ADMIN1	170.600	170.600	103.5>	CH's 1,2,3 direct
2	FREMONT	ADMIN2	171.700	171.700	103.5>>	to LIFC, mobiles,
3	FREMONT	FIRE	172.350	172.350	103.5>	district offices.
4	FREMONT	PROJCT	170.500	170.500		Scene Of Action
5	USFS	TAC 2	168.200	168.200 L		INCIDENT TAC
6	BLM DIR	BLM	166.325	166.325	100.0	*
7	OSDF DIR	OSDF K	151.205	151.205	131.8	Klamath Unit *
8	MODOC	MODOC	168.750	168.750	110.9	*
9	WINEMA	WINEMA	169.925	169.925	103.5	*
10	DESCHUTES	DSCHTS	170.475	170.475		*
11	WLKR RG	WLKRRG	151.145	151.145		*
12	KRFD 911	KC 911	154.070	154.070	192.8	*
13	USFW DIR	FW DIR	168.575	168.575		*

GROUP 3: LIFC (LFC)

CH#	ASSIGNMENT	NAME	RX	TX	TONE	COMMENTS
1	FREMONT	BROWN	170.600	170.600	103.5>	CH's 1,2,3 direct
2	FREMONT	YELLOW	171.700	171.700	103.5>>	to LIFC, mobiles,
3	FREMONT	ORANGE	172.350	172.350	103.5>	district offices.
4	FREMONT	GREEN	170.500	170.500		Scene Of Action
5	USFS	GOLD	168.200	168.200 L		INCIDENT TAC
6	BLM DIR	WHITE	166.325	166.325	100.0	*
7	BLM SOA	BLUE	166.775	166.775		*
8	OSDF KLAMATH	SILVER	151.205	151.205	131.8	Direct *
9	OSDF LAKE	GRAY	154.115	154.115	131.8	Direct *
10	OSDF SOA	RED	151.340	151.340		*
11	NAT'L AIR	AIRTAC	169.150	169.150 L		FREMONT AIR TAC
12	GRIZZLY	RPT 31	172.350	168.725	136.5	Fire Repeater
13	ROUND PASS	RPT 32	172.350	168.725	146.2	Fire Repeater
14	DEAD INDIAN	RPT 33	172.350	168.725	156.7	Fire Repeater

GROUP 4: OTHER AGENCY REPEATERS (OAR)

CH#	ASSIGNMENT	NAME	RX	TX	TONE	COMMENTS
1	BLM HART	BLM HT	166.325	166.925	100.0	*
2	BLM YAINAX	BLM YX	166.325	166.925	107.2	*
3	BLM GREEN	BLM GN	166.325	166.925	114.8	*
4	OSDF KMTH YX	ODFKYX	151.205	151.475	131.8	Yainax-Klamath*
5	OSDF LAKE YX	ODFLYX	154.115	159.255	151.4	Yainax-Lake *
6	OSDF LAKE RP	ODF RP	154.115	159.255	179.9	Round Pass *
7	OSDF LAKE BC	ODF BC	154.115	159.255	131.8	Black Cap *
8	USFW HART	UFW HT	168.575	169.650	107.2	*
9	USFW BADGER	UFW BG	168.575	169.650	123.0	*
10	WLKR RG BALD	WR BLD	151.145	151.400	146.2	*

GROUP 5: NIRSC DEPARTMENT OF AGRICULTURE FREQUENCIES (DAF)

CH#	ASSIGNMENT	NAME	RX	TX	TONE	COMMENTS

CH#	ASSIGNMENT	NAME	RX	TX	TONE	COMMENTS
1	NIRSC USFS	TAC 1	168.050	168.050 L	110.9	1 -----
2	NIRSC USFS	TAC 2	168.200	168.200 L	123.0	2 |
3	NIRSC USFS	TAC 3	168.600	168.600 L	131.8	3 |
4	NIRSC USFS	C1 DIR	168.700	168.700 L	136.5	4 King EPH
5	NIRSC USFS	C1 RPT	168.700	170.975 L	146.2	5 tones
6	NIRSC USFS	C2 DIR	168.100	168.100 L	156.7	6 |
7	NIRSC USFS	C2 RPT	168.100	170.450 L	167.9	7 |
8	NIRSC USFS	C3 DIR	168.075	168.075 L	103.5	8 -----
9	NIRSC USFS	C3 RPT	168.075	170.425 L		
10		WEATHR	162.550			(See note below
11	GOV'T WIDE	TAC A	163.100	163.100 L		and instructions
12	GOV'T WIDE	TAC B	168.350	168.350 L		on last page.)
13		WEATHR	162.400			
14	GOV'T WIDE	AGUARD	168.625	168.625 L		Air Guard

GROUP 6: NIRSC DEPARTMENT OF INTERIOR FREQUENCIES (DIF)

CH#	ASSIGNMENT	NAME	RX	TX	TONE	COMMENTS
1	NIRSC USDI	TAC 1	166.725	166.725 L	110.9	1 -----
2	NIRSC USDI	TAC 2	166.775	166.775 L	123.0	2 |
3	NIRSC USDI	TAC 3	168.250	168.250 L	131.8	3 |
4	NIRSC USDI	C4 DIR	166.6125	166.6125L	136.5	4 King EPH
5	NIRSC USDI	C4 RPT	166.6125	168.400 L	146.2	5 tones
6	NIRSC USDI	C5 DIR	167.100	167.100 L	156.7	6 |
7	NIRSC USDI	C5 RPT	167.100	169.750 L	167.9	7 |
8	NIRSC USDI	C6 DIR	168.475	168.475 L	103.5	8 -----
9	NIRSC USDI	C6 RPT	168.475	173.8125L		
10		WEATHR	162.550			(See note below
11	GOV'T WIDE	TAC A	163.100	163.100 L		and instructions
12	GOV'T WIDE	TAC B	168.350	168.350 L		on last page.)
13		WEATHR	162.400			
14	GOV'T WIDE	AGUARD	168.625	168.625 L		Air Guard

Note: Group 5 and 6 frequencies match groups 1 and 3 respectively of the National Incident Radio Support Cache(NIRSC-Boise) VHF frequency scheme with the exception of channels 10 and 13.

GROUP 7: INITIAL MULTIPLE INCIDENT (IMI)

CH#	ASSIGNMENT	NAME	RX	TX	TONE	COMMENTS
1	FREMONT	BROWN	170.600	170.600	103.5	
2	FREMONT	YELLOW	171.700	171.700	103.5	
3	FREMONT	ORANGE	172.350	172.350	103.5	
4	FREMONT	GREEN	170.500	170.500		
5	USDA	TAC 1	168.050	168.050 L		
6	USDA	TAC 2	168.200	168.200 L		
7	USDA	TAC 3	168.600	168.600 L		
8	NAT'L AIR	AIRTAC	169.150	169.150 L		FREMONT AIR TAC
9	NIIMS	LOGIST	168.550	168.550		LOGISTICS

GROUP 8: AUTOMATIC NUMBER IDENTIFICATION (ANI)

CH#	ASSIGNMENT	NAME	RX	TX	TONE	COMMENTS
1	WEATHER	ANI	162.550	NONE		
2	USFS	COMM	164.9625	164.9625		

* For use only to communicate with the licensee in emergency situations.

Accessing NIRSC Tone Control Command Repeaters:

EPH King Radios:

Press the number on the keypad corresponding to the tone required in the incident plan to access the Command Repeater. Tones are listed under "TONE" in group 5 and 6. Does not affect other groups. The channel name of the tone selected will appear momentarily during transmit.

Midland Mobiles:

On the control head, press [FUNC], [1], then key in the desired code (see table below) and press [ENT]. This does affect the other groups. In order to use the Fremont radio system the radio must be reset to the original settings. To cancel the override code: press [FUNC], [1], then [DEL].

CODE	TONE
15	110.9
18	123.0
20	131.8
21	136.5
23	146.2
25	156.7
27	167.9
13	103.5

One of these tones will be stated in the incident frequency plan if the incident is using a tone protected Command Repeater.

Frequency List for BLM King LPH (14 Channel) Portable Radios
Rev 1/01

CH#	ASSIGNMENT	NAME	RX	TX	COMMENTS
1	BLM-OR-010	DIRECT	166.325	166.325	Direct also WHITE, Location: Round Pass
2	BLM-OR-010	----------	166.325	166.925	Repeater-Indicate which repeater*
3	BLM-OR-010	BLUE	166.775	166.775	Scene of Action
4	BLM-OR-010	VIOLET	166.150	166.150	Scene of Action
5	NIRSC-USFS	GOLD	168.200	168.200	Incident Tactical
6	FS FREMONT	BROWN	170.600	170.600	Administrative
7	FS FREMONT	YELLOW	171.700	171.700	Engineering, Secondary Fire
8	FS FREMONT	ORANGE	172.350	172.350	Fire
9	FS FREMONT	GREEN	170.500	170.500	Project, Scene of Action
10	OSDF KLAMATH	SILVER	151.205	151.205	Klamath County Unit
11	OSDF LAKE	GRAY	154.115	154.115	Lake County Unit
12	OSDF	RED	151.340	151.340	OSDF Scene of Action
13	USFW	DIRECT	168.575	168.575	Direct
14	USFW	----------	168.575	169.650	Repeater-Indicate which repeater*

*Press the number on the radio keypad corresponding to the tone assignment below to access base/repeater:

KEYPAD NUMBER	TONE	ASSIGNMENT
1	100.0	BLM Hart Mt
2	107.2	BLM Yainax Bt, USFW Hart Mt
3	114.8	BLM Green Mt
4	123.0	BLM Hamaker Mt, USFW Badger Mt
5	103.5	FS Fremont
6	131.8	OSDF Klamath and Lake Units

APPENDIX K: WFSA

APPENDIX L: COMPLIANCE

APPENDIX M: BURN PLAN TEMPLATE

PRESCRIBED FIRE PLAN

Refuge or Station

Unit

Prepared By:_________________ **Date:**
Prescribed Fire Specialist

Reviewed By: _________________ Date:
Refuge Biologist

Reviewed By: ________________ **Date:**
Prescribed Fire Burn Boss

Reviewed By:_________________ Date:
FMO/AFMO

Reviewed By:_________________ Date: _______ Biological Investigation Unit

Reviewed By: ________________ Date:
Refuge Manager

The approved Prescribed Fire Plan constitutes the authority to burn, pending approval of Section 7 Consultations, Environmental Assessments or other required documents. No one has the authority to burn without an approved plan or in a manner not in compliance with the approved plan. Prescribed burning conditions established in the plan are firm limits. Actions taken in compliance with the approved Prescribed Fire Plan will be fully supported, but personnel will be held accountable for actions taken which are not in compliance with the approved plan.

Approved By: ________________ Date:
Complex Project Leader

PRESCRIBED FIRE PLAN

Refuge:____________ Refuge Burn Number:

Sub Station: _________ **Fire Number:**

Name of Area: ____________ **Unit No.**

Acres To Be Burned:___ Perimeter Of Burn:

Legal Description: Lat. ___ Long. ___ T_ R_ S
County & State:

Is a Section 7 Consultation being forwarded to Fish and Wildlife Enhancement for review ? Yes__No__ (check one).

(Page 2 of this PFP should be a refuge base map showing the location of the burn on Fish and Wildlife Service land)

The Prescribed Fire Burn Boss/Specialist must participate in the development of this plan.

I. GENERAL DESCRIPTION OF BURN UNIT

Physical Features and Vegetation Cover Types (Species, height, density, etc.):

Primary Resource Objectives of Unit (Be specific. These are management goals):

1)

2)

3)

Objectives of Fire (Be specific. These are different than management goals):

1)

2)

3)

Acceptable Range of Results (Area burned vs. unburned, scorch height, percent kill of a species, range of litter removed, etc.):

1)

2)

3)

[*Attach Project Map Here*]

[*Attach Project Pre-Burn Photos Here*]

II. PRE-BURN MONITORING

Vegetation Type	Acres	%	FBPS Fuel Model
Total			

Habitat Conditions (Identify with transect numbers if more than one in burn unit.):

Type of Transects:

Photo Documentation (Add enough spaces here to put a pre-burn photo showing the habitat condition or problem you are using fire to change/correct. A photo along your transect may reflect your transect data.):

Other:

III. PLANNING AND ACTIONS

Complexity Analysis Results: (Attach a completed copy of the Complexity Analysis worksheet to this plan.)

Site preparation (What, when, who & how. Should be done with Burn Boss):

Weather information required (who, what, when, where, how, and how much):

Safety considerations and protection of sensitive features (Adjacent lands, visitors, facilities, terrain, etc., and needed actions. Include buffer and safety zones. Be specific, indicate on a burn unit map. Map should be a USGS quadrangle if possible, so ridges, washes, water, trails, etc. can be identified.)

Special Safety Precautions Needing Attention (Aerial ignition, aircraft, ignition from boat, etc.):

Media Contacts (Radio stations, newspaper, etc., list with telephone numbers):

Special Constraints and Considerations (Should be discussed with Burn Boss):

Communication and Coordination on the Burn (Who will have radios, frequencies to be used, who will coordinate various activities.):

IV. IGNITION, BURNING AND CONTROL

Planned or Proposed Actual

Scheduling: Approx. Date(s)

Time of Day

Acceptable Range

FBPS Fuel Model	Low	High	Actual

Temperature			
Relative Humidity			
Wind Speed (20' forecast)			
Wind Speed (mid-flame)			
Wind Direction			
ENVIRONMENTAL CONDITIONS			

Soil Moisture			
1 hr. Fuel Moisture			
10 hr. FM			
100 hr. FM			
Woody Live Fuel Moisture			
Herb. Live Fuel Moisture			

Litter/Duff Moisture			
FIRE BEHAVIOR			
Type of Fire (H,B,F)	B	H	
Rate of Spread (ch/hour)			
Fireline Intensity			
Flame Length			

Energy Release Component NFDRS Fuel Model __L_____			

<u>Note</u>: Attach BEHAVE Runs as an appendix to the end of this plan.

Cumulative effects of weather and drought on fire behavior:

Ignition Technique (Explain and include on map of burn unit. Use of aerial ignition must be identified in this plan. Last minute changes to use aircraft will not be allowed and will be considered a major change to the plan. This will require a resubmission):

Prescribed Fire Organization (See Section VII, Crew and Equipment Assignments. All personnel and their assignments must be listed. All personnel must be qualified for the positions they will fill.)

Other (If portions of the burn unit must be burnt under conditions slightly different than stated above, i.e., a different wind direction to keep smoke off of a highway or off of the neighbors wash, detail here.)

Prescription monitoring (Discuss monitoring procedure and frequency to determine if conditions for the burn are within prescription):

V. SMOKE MANAGEMENT

Make any Smoke Management Plan an attachment. Also attach pertinent smoke variances (if any) and all SASEM runs.

Permits required (who, when):

Distance and Direction from Smoke Sensitive Area(s):

Necessary Transport Wind Direction, Speed and Mixing Height (Explain how this information will be obtained and used):

Visibility Hazard(s) (Roads, airports, etc.):

Actions to Reduce Visibility Hazard(s):

Residual Smoke Problems (Measures to reduce problem, i.e., rapid and complete mop-up, mop-up of certain fuels, specific fuel moistures, time of day, etc.):

Particulate emissions in Tons/Acre and how calculated (This should be filled in after the burn so more precise acreage figures can be used):

VI. FUNDING AND PERSONNEL

Activity Code:

Costs

	Equipment & Supplies	Labor	Overtime	Staff Days	Total Cost
Administration (planning, permits, etc.)					
Site Preparation					
Ignition & Control					
Travel/Per Diem					
Total					

VII. BURN-DAY ACTIVITIES

Public/Media Contacts on Burn Day (List with telephone numbers):

Crew & Equipment Assignments (List all personnel, equipment needed, and assignments. The following is not an all inclusive list for what you may need.)

Crew Briefing Points (Communications, hazards, equipment, water sources, escape fire actions, etc. To be done by Burn Boss. Refer to Safety Considerations in Planning Actions and points listed below):

Ignition Technique (Methods, how, where, who, and sequence. Go over what was submitted in Section IV and any changes needed for the present conditions.) Attach ignition sequencing map if necessary:

Personnel Escape Plan:

Special Safety Requirements:

Go-No-Go Checklist:

GO-NO-GO CHECKLIST

____
Unit

_____ Is burn plan complete and approved?

_____ Are all fire prescriptions specifications met?

_____ Are all smoke management prescriptions met?

_____ Is the current and projected fire weather forecast favorable?

_____ Have all air quality considerations and smoke requirements been met?

_____ Have all required cultural resource protection objectives been met?

_____ Are all personnel required in the prescribed burn plan on-site and are they all qualified for their assigned duties?

_____ Have all personnel been briefed on the prescribed burn plan requirements?

_____ Have all personnel been briefed on safety hazards, escape routes, and safety zones?

_____ Is all required equipment in place and in working order?

_____ Are available (including back-up) resources adequate for containment of escapes under the worse-case conditions?

_____ Are answers to all of the above questions “YES”?

_____ In your opinion, can the burn be carried out according to the plan and will the burn meet planned objectives?

_____ Is there an adequate contingency plan developed and proofed?

All 14 questions have been answered “YES”.

________________________________ ______________
Burn Boss Date

________________________________ ______________
Refuge Manager or Designee Date

Holding and Control:

Critical Control Problems:

Water Refill Points:

Other:

Contingency Plan for Escaped Fire (Are there crews standing by to initial attack or will people doing other jobs be called upon to do initial attack, who must be called in case of an escape, what radio frequencies will be used, etc.)

Mop Up and Patrol:

Rehabilitation Needs:

DI 1202 Submission Date:

Special Problems:

VIII. CRITIQUE OF BURN

Were burn objectives within acceptable range of results? (Refer to Section I):

What would be done differently to obtain results or get better results?

Was there any deviation from plan?   If so, why?

Problems and general comments:

IX. POST-BURN MONITORING

Date:____________ Refuge Burn Number:

Length of Time after Burn:

Vegetative Transects:

Comments on Habitat Conditions, etc.:

Photo Documentation:

Other:

X. FOLLOW-UP EVALUATION

Date: ____________ Refuge Burn Number:

Length of Time after Burn:

Vegetative Transects:

Comments on Habitat Conditions, etc.:

Photo Documentation:

Other:

DAILY FIRE BEHAVIOR MONITORING SHEET

Refuge:

Project Name:____________________________ RX Fire Number:

Date of Burn:

Ignition Time: **Start:**________ **Finish:**

Weather Observations During Burn:
Time of Weather Observations

Dry Bulb Temp							
Wet Bulb Temp							
RH							
Wind Speed							

Wind Direction							
Cloud Cover %							

Comments Concerning Weather:

Last Live Fuel Moisture Measurement:________ **1-Hour Fuel Moisture:**

10-Hour Fuel Moisture (from fuel stick): ________ **Haines Index**:

Test Fire Results:

Firing Pattern:

Fire Behavior Characteristics (Rate of Spread, Flame Length, Fire Spread Direction, etc.)**:**

Acres Treated:

Smoke Dispersal Narrative (venting height, transport wind speed & direction, visibility, holding problems, problem spots, complaints, etc.)**:**

<u>Burn Severity</u>
Effects to Vegetation Narrative:

Ground Char (%): Unburned _____ Light_____ Moderate_____ Deep

Soil Moisture on Day of Burn:

Were Resource Objectives Met? (If burn was successful, what conditions made it possible, ie: low live fuel moisture, high winds, etc.)

Photos of Fire Area: **Preburn Yes _____ No**
During Burn Yes _____ No
Postburn Yes _____ No

Daily Burn Cost:

Personnel Cost: $________

Equipment Cost: $________

Fuel Cost: $________

Total: $________

Cost per Acre: $_________

Vehicles Used:

Burn Organization:

Burn Boss:

Ignition Specialist: _________________ **Holding Specialist: _________________** **Lighting Crew: _________________** **Holding Crew:**

Burn Evaluation Prepared By:__________________ **Date:**

**Attach pertinent Spot Weather Forecast,WIMS/NFDRS, Smoke Mgt Variance, etc. information for burn day to back of sheet.

APPENDIX N: RX MONITORING PROGRAM

LEVEL 1. Minimum Monitoring Standards (MMS) For Prescribed Burn Sites.

Monitoring objectives: To provide documentation and evaluation of area before, during and at periodic intervals after prescribed burning. Additionally, data will be collected and assessed on fire behavior and immediate fire effects. Level 1 monitoring will be carried out by the Complex Fire Management staff..

BEFORE BURNING

1. Complex Fire Management staff will generate fire/project number in SACS.
2. Maps that describe the geographic location, size, and vegetation types in that project area will be generated during the planning process.
3. On sites readily accessed from the ground, establish one or two permanent photo-points to describe change in aspect of vegetation and landscape in the project area. Establish permanent photo-points within dominant vegetation type and fuel type for which burn objectives were established. Photo points should be representative of the over-all characteristics of the project area.. Photographs should be taken during the time of day that avoids shadows and oriented parallel to slope in a direction that avoids glare from direct sunlight. Photographs taken during the peak of the growing season are preferred if the burn objective calls for change in forb cover. Photos taken out of the growing season are acceptable if burn objectives relate primarily to change in tree, shrub, or grass cover.
4. Establish a witness post at photo-point sites. Witness posts should be comprised of: (a). a five-foot steel fence post where late successional vegetation comprises tall shrubs and trees. (b). a four-foot re-bar section in vegetation types comprised of short stature. Mark witness with aluminum tags that indicate date of establishment and plot number, delineate plot locations on a map of the project area, take a GPS reading, and record the compass bearing of the photo to facilitate future monitoring. Photographic equipment should consist of a 35-mm camera fitted with a 50-mm lens and 64-ASA slide film. Take one picture from the witness post. As for technique, photos should capture a scene that consists of 2/3 land and 1/3 sky. To maximize depth of field, adjust to the largest possible f-stop number (smallest aperture) at 1/60th second shutter speed. All photographs except panoramic overview shots should include a cover-pole and photo-board marked with the project number, vegetation type, plot number, and date set about 5-m from the witness post. Photographs including cover-boards are optional. If they are used, place the 0.5 x 2.0-m board at a standard 10-m distance from the witness post. All photo points are to be mapped, a GPS location recorded, and included in the project file.

DURING BURNING

1. Use the standard fire weather and behavior monitoring sheet to record fire weather and behavior observations such as wind speed, wind direction, RH, and temperature, throughout the burn period. Try to attribute fire behavior to weather, topography, frequency of fuels, and fuel type. Be aware that fire behavior predictions and observations frequently cannot predict fire effects, (eg., a smoldering fire can generate considerable heat and significant fire effects but is not part of the fire behavior prediction system).

2. Observations should be recorded every 30 minutes during ignition and hourly after ignition. In addition an observation should be taken whenever there is an observable change of conditions on the burn site.

3. Estimate average rate of spread and flame-lengths where possible.

4. Take live fuel moisture samples following the standard methods and procedures for Sheldon and Hart Mt. Refuges.

5. Log this information into the project file for that burn site.

AFTER BURNING

1. Map the fire on mylar overlaid onto the appropriate four inch to the mile photo (1991) or 7.5" Quad. Detail in mapping is very important (e.g., include areas within the perimeter that did not burn; few fires burn completely. Maps will facilitate estimation of interspersion and monitoring using Global Information System technology. Mapping of prescribed burns on sites of uniform topography will be facilitated with use of aerial photography or a Global Positioning System. Consult with the Fire Management Officer about site-specific mapping protocol.
2. The following procedures should be used to determine frequency of photo-monitoring:
    A. Take pictures from photo-points before the next growing season initiates and preferably, within one week after the fire to describe fire severity, vegetation consumption, char level, and pattern of burn.
    B. Take pictures from photo-points at selected years post-burn at the same time of year that the pre-burn photo was taken. Frequency of sampling will depend on the length of succession development for a vegetation type (e.g., 30 years in mountain big sagebrush). As a guideline, take pictures that portray vegetation development during early, mid, and late succession stages. Consult with the Refuge biologist for information regarding site-specific monitoring schedules.
3. Log this information into the project file for that burn site.

LEVEL II.   Moderately Intensive Fire Effects Monitoring.

Monitoring objectives: A. To assess the area before and after prescribed burning and: B. To determine the relationship between site conditions (e.g., fuel load, fire behavior) before and during prescribed burning and vegetation response after prescribed burning.

BEFORE BURNING

1. Level I MMS.
2. Quantitative physical measurements; selection based on objectives of the project.
    An example includes: Flow rate of spring.
3. Quantitative vegetation measurements; selection based on vegetation management objectives of the project. Examples include:
    Fine fuel loading (immediately prior to burn).
    Cover and composition of herbaceous plants.
    Frequency of grasses and forbs.
    Intercept cover and composition of shrubs.
    Shrub and tree density.
    Vegetation density (cover-board).
4. As determined by Refuge biologist, establish plots/vegetation type for sampling vegetal characteristics.

DURING BURNING

1. Fire behavior monitoring will be accomplished by Complex Fire Management staff. At a minimum Burn Boss or designated Prescribed Fire Monitor will take on-site observations

AFTER BURNING

1. Measure consumption of shrub fuels by fire in time-lag classes. This entails randomly selecting burned shrubs and measuring the diameter of the smallest stems. Estimate level of ground char as low, moderate, and severe using the characteristics described (Ryan and Noste, 1985) in table XII-1.
2. Repeat Level I post-burn monitoring.

3. Repeat Level II physical and vegetation measurements at permanent plots.
4. Monitor post-fire management (eg., weather grazing pressure, etc.). Post-fire response of vegetation can be substantially influenced by drought or extensive grazing of the burn site.

PROTOCOL FOR MONITORING
FIRE EFFECTS IN DRAINAGES WITH TALL SHRUBS

Use for the following vegetation types:
- Basin Big Sagebrush (93)
- Black Greasewood (203)
- Degraded Dry Meadow (281-282)
- Degraded Wet Meadow (261-262)

1. Get map of project area.
2. Review habitat objectives for burn:
   a. Which principle vegetation types are being targeted for treatment?
   b. What are the most important variables to monitor?
3. Develop sample strategy based on assessment of response of the most important variables affected by prescribed burning (e.g., shrub cover of native grasses, etc.).
4. Get vegetation map of area:
   a. Make xerox copies of vegetation type map for the project area.
   b. Line out the perimeter of the project area with a highlighter on the xerox map.
5. Identify distribution of basin big sagebrush sites within project area.
6. Examine 4":1 mile photographs for small areas of basin big sagebrush (typically narrow corridors) that were not described on the vegetation map (intermittent drainages of low gradient).
7. Using a highlighter, describe as a line the unmapped areas on the xerox.
8. Find out from the FMO whether all or some of these sites are targeted for burning; exclude areas not targeted from further consideration for sampling.
9. Number the drainages in the project area consecutively (e.g., drainage 1 (1-25); drainage 2 (26-48); etc). Randomly draw 5-15 locations; in pencil, circle the sites.

```
             2   4   6   8  ...........
DRAINAGE -----------------------------------
            1   3   5   7   9 ..........
```

10. Drainages and habitat width vary from 5-150 meters, consequently, plots located in valleys <20m wide will have plots located within the vegetation type; in valleys >20m wide, randomly select a location along an imaginary line oriented at a right angle to the valley azimuth. Valley bottom edges can usually be identified by change in soil and vegetation.

PROTOCOL FOR MONITORING FIRE EFFECTS IN UPLAND VEGETATION TYPES

Use for the following vegetation types:
- Mountain Shrub (43)
- Mountain Big Sagebrush (73)
- Big Sagebrush-Bitterbrush (83)
- Low Sagebrush (103)
- Wyoming Big Sagebrush (123)

1. Get map of project area.
2. Review habitat objectives for burn:
   a. Which principle vegetation types are being targeted for treatment?
   b. What are the most important variables to monitor?

3. Develop sample strategy based on assessment of response of the most important variables to prescribed burning (e.g., reduce shrub cover, increase cover of native grasses, etc.).
4. Get vegetation map of area:
   a. Grid (UTM--km2) the project area in pencil on vegetation maps.
   b. Make copies of vegetation type map for the project area.
   c. Line out the perimeter of the project area with a highlighter on The map.
5. Find out from the FMO what specific geographic area is being targeted and has the highest probability of burning; draw this perimeter on the map.
6. Overlay map with vellum; number grids that fall within the target area in consecutive order.
7. Randomly select 15 km2 blocks in the principle vegetation type slated for burning. An individual square may be selected more than once.
8. Within selected squares randomly choose a coordinate on the vertical axis (00-10) of a UTM grid; repeat process for horizontal axis. Find the crossection of points and identify that point as a sample plot on the map.
9. Repeat the process for the remaining plots/vegetation type.
10. Important: Examine 4":1 mile photographs to verify occurrence of the target vegetation type in the vicinity of the sample plot. Reject plots where vegetation type does not exist.
11. Number sample plots (1-15) in pencil on map.

PROTOCOL FOR MONITORING FIRE EFFECTS IN ASPEN

1. Randomly select plots for sampling based on current and potential geographic distribution of stands (valley bottom, side-slope, etc.) or stand condition (eg., decadent, etc.). Using a flagged fence stake, toss stake over shoulder to randomize position of witness post.
2. Establish witness post (initially a wood lathe and stake) on edge of stand. Fasten an aluminum tag to post marked with plot number. At a later date, but before burning, replace wood posts with metal fence posts.
3. At witness post, select transect bearing that is perpendicular to the stand edge. Record compass bearing of transect.
4. Establish 2 transects, each 1 x 10 meters in length, two meters from the witness post, and and parallel to the transect bearing.
5. Measure shrub intercept-cover by species under the lines (10m) of both transects (measure from canopy edge to canopy edge; include gaps within shrub if gap <20cm). A total of 20-m transect will be sampled.
6. Measure aspen density by height class in a 1-m belt of each transect. Center the 1-m belt over the transect line and count only stems rooted within the belt. A total of 20-m transect will be sampled.
7. Measure aspen density by height class in 0.5 m quadrants systematically established on the right side of transect tapes at the following intervals: 1, 3, 5, 7, 9 m.
8. From the baseline of each transect, estimate how much vegetation obscures each interval of the cover-board held at a vertical angle 1.5 m away. Take the reading from a standard 1.5 m height.
   A. Map stands, number stands, randomly select stands for sampling.
   B. Number edge of stands selected, randomly select number along transect.
9. Take two photos from the witness post centered along the plot compass bearing. Establish header plaque and pole five steps from the witness stake. Record (1) area (2) plot #, and (3) date on header plaque. For the photo, frame land and sky at a 2/3 to 1/3 ratio. Back the focus down from infinity slightly to increase depth of field (make sure the header plaque is in focus).
10. Locate the next witness post and repeat measurements.

MATERIALS REQUIRED FOR FIRE EFFECTS MONITORING

1. Site map.
2. Compass.
3. Clipboard.
4. Pencils.
5. Data forms.
6. Waterproof marker.
7. Dry-erase marker and dry-erase board.
8. Cover board
9. Two 0.10m2 Daubenmire quadrate.
10. Range pole marked in decimeter increments and header plaque.
11. Flagging to temporarily mark plot location.
12. Two 15-meter tapes.
13. 35mm camera with 50mm lens.
14. 64 ASA film.
15. Four stakes for securing ends of tapes.
16. Rebar to mark permanent plot locations.
17. Metal fence post and post pounder.
18. Hammer for stake establishment.
19. 2m rod.
20. 1m stick.
21. Aluminum tags and wire for marking plot locations on metal stakes.
22. All wheel drive pickup.

Insert fire weather and behavior monitoring form.

Insert burn plot location data

pages 1 and 2

INFORMATION TO ENGRAVE ON ALUMINUM TAGS

Purpose (Fire Effects Plot)
Location (e.g., Project Name)
Vegetation Type (e.g., Mt. Big Sage)
Plot # (1,2,3,...)

LITERATURE CITED

Ryan, Kevin C.; Noste, Nonan V. 1985. Evaluating prescribed fires. In: Proceeding- symposium and workshop on wilderness fire; 1983 November 15-18; Missoula, MT. Gen. Tech. Rep. INT-182. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station: 230-238.

APPENDIX O: LIVE FUEL MOISTURE (LFM)

Measuring Live Fuel Moisture Content on Hart Mountain NAR Refuge - Standard Methods and Procedures

Introduction

The strong influence that variations in the moisture content of living material in shrubs has on fire behavior has long been recognized. Used in conjunction with the effects of other fire behavior influences (weather, topography, and fuel characteristics), the knowledge of the levels and trends of living fuel moisture can greatly improve the accuracy of appraisals of fire danger and predictions of fire behavior in shrub-dominated ecosystems. Live fuel moisture (LFM) content has often been one of the most important determining factor in assessing how and when fires will burn in Hart Mountain NAR sage fuels, particularly low sage and Wyoming big sage.

Invaluable information has been obtained from the measurement and analysis of LFM content over the past ten years on Hart Mountain NAR Refuge. This information is used to establish and monitor LFM trends. Close monitoring of these trends will assist in the planning and successful implementation of Rx burn projects as well as aiding in determining fire danger and severity during fire season. Live fuels are more volatile and likely to burn in the dormant stage than the growing stage. Naturally occurring changes in the moisture content of live plants is associated with physiological events in their annual life cycles. Noting the occurrence of these events each time a LFM sample is analyzed over a range of time establishes a trend for describing their flammability. It is vital when establishing LFM trends to collect and analyze data using standard procedures from samples collected at determined sites.

Sampling Protocol:

Time of Sample Collection

Weekly sampling for LFM content is adequate for shrubs due to the comparably slow changes in the moisture level of these fuels. Samples will be collected starting in early spring prior to green-up, extending through the summer, and ending in the fall when a baseline shrub dormancy has been established.

Samples will be collected as close to 1400 hours as possible during the spring and summer months, and at 1300 hours during the fall and winter months. This is regarded as the warmest time of the day for these seasons. Sample time will change accordingly with daylight savings time in the spring and fall.

Sample Sites:

Direct sampling of the fuels in specific burn sites would be the most accurate method possible. This is, however, not cost effective, convenient, or possible. It is impossible to predict when and where wildland fires will burn. For these reasons representative collection sites have been selected for sampling; on Hart Mountain NAR the Rock Creek RAWS station, and for Sheldon the Blizzard Gap area. These sites are believed to be similar in range of conditions, elevations, and positions, and resulting effects on LFM contents believed representative of most Refuge conditions. If possible, additional samples will be collected and analyzed from specific burn units to provide site-accurate LFM content.

Sample Collection:

To establish and maintain information necessary for trend analysis, samples will be collected from the big sage species which occur at both the Rock Creek and Blizzard Gap sites. Do not mix different species in the same sample bag. Label each bag with location, date, aspect, and bag number. Samples will consist of green leaves and stems from the end of shoots. No woody material, insects or their galls, dead vegetation, seeds, or flowers should be included in the sample. Cut or pull off the shoots and leaves from no less than three different shrubs of the same species at the collection site. This will give an average of the LFM content at the site. Place samples in a clean, dry zip-lock baggie and seal.

After collection, keep samples cool and dry until they can be processed. Process samples as soon as possible after collection. If immediate analysis is not possible, store samples in lunch cooler or refrigerator until they can be processed. If samples receive even moderate heat or direct sunlight, moisture will evaporate causing errors in analysis. Further, accuracy of analysis decreases as length of time between collection and processing increases. Samples should be processed the same day as collection.

Days with a threat of precipitation present are not good days to plan on collecting samples. Do not collect samples if water drops are present on leaves or stems. Free surface water will cause large errors in calculated values of moisture content. If rain prevents collection of samples collect them on another day.

Sampling for other species such as low sage, bitterbrush, etc. shall follow the same process as that for the big sage species.

Calculating LFM Content:
An Arizona Instrument Moisture Analyzer is located at the U.S. Fish and Wildlife Fire Cache in Lakeview for use in LFM analysis. This machine is expensive and fragile, and will be operated by trained and responsible Complex Fire Management. staff only. Samples will be processed following the proper operational procedures established by the machine manufacturer. Training in how to responsibly operate this machine before attempting to use it is necessary.

Guidelines For Operating the Moisture Analyzer:
1. Place the machine on a level surface free from vibrations. The proper settings have been pre-programed into the memory of the machine. DO NOT change settings.

2. Allow 15 minutes after turning power on before processing samples. A cold machine will not always give accurate results.

3. Calibrate machine and tier sample pan following instructions on digital screen. Press the start button on right-hand side of the screen.

4. After the machine gives the go-ahead message, lift the lid and load the sample onto the pan. Cutting the samples into 5 mm or smaller segments will speed time of analysis. Place only live green leaves and associated green shoots on the pan. Pull leaves from stems and spread them evenly over the entire pan. DO NOT include any dead, woody material, any seed pods, or any foreign material such as insects or galls in the sample. The machine will automatically weigh the sample and will give a message when the proper amount has been placed on the pan.

5. After the sample is loaded, closing the door will start the analysis process.

6. Allow the machine to complete the analysis process. The average time for this process is roughly 12-15 minutes. When analysis is completed the machine will beep three times and the results will display on screen. Do not be surprised if the LFM content is listed in excess of 100%. A measurement above 100% indicates that the moisture in the plant exceeds the dry weight of the plant.

7. Record the results of the analysis. Use the proper form. Additional copies of this form are on file in the Fire Management Office in the Lakeview Post Office.

8. Remove “cooked” sample from sample pan and carefully clean the pan of all moisture and organic material. Follow the above process to complete analysis of additional samples.

9. When finished with all samples, turn completed forms with analysis results in to the Fire Management office for our records.

Notes on LFM Content of Sheldon/Hart Mtn. Refuges Big Sagebrush Types

<95% LFM Sage is dormant and not growing or transpiring. The plant retains only enough moisture for survival. This occurs generally in late summer, persisting through fall and winter until warmer temperatures and higher ground moisture levels bring about green-up. Drought conditions can greatly contribute to earlier than average dormancy. Sage with this LFM burns very well, often with nearly complete plant combustion. Wildfires in sage with this LFM content exhibit extreme fire behavior, rapid growth, spotting potential, and will be difficult to suppress. Rx projects in big sage are not advisable, but projects targeting low sage get best results when burned within this LFM content range.

96-125% LFM Sage is dry but transpiring. Sage will burn well and sustain fire with little or no wind providing that fuels are continuous. Complete combustion of most stem wood and all leaves will occur. Wildfire will be difficult to control in-season, but good results for Rx burns in the fall and spring are achieved when relative humidity is higher, days shorter and cooler, and nights much colder. Most meadow and big sage Rx projects on the Refuge is best burned within this LFM content range.

126-140% LFM Sage will burn given one or more of the following; moderate winds, continuous grass/forb understory, a high percent of dead material in stand structure (as in case of many old\decadent stands), or steep elevational changes. Skeletons of plants left with leaf and twig consumption.

141-160% LFM New plant growth is equal to older plant growth. Generally sage will not burn very well, although fires may carry through the understory and burn dead material out of older stands, especially those stands with an understory grass component. High wind events will push fires through sage fuels with this LFM content. Generally however, without winds or on steep slopes, wildfires will be easy to control and will not spread rapidly.

>160% LFM New plant growth. Sage will not burn well. Wildfires will be small and easily controlled, if they burn at all.

Note: Most active burning on the Hart Mountain NAR Refuge has historically occurred when the LFM content was below 110%. Wind events combined with low LFM content has proven to be the most volatile combination contributing to large fire events.

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Norum, Rodney A.; Miller, Melanie. 1984. *Measuring Fuel Moisture Content in Alaska: Standard Methods and Procedures*. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; Gen.Tech.Rep. PNW-171. 34 pp.

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DATA SHEET FOR LFM SAMPLES

LOCATION:

SAMPLE DATE:

TIME COLLECTED:

DATE & TIME PROCESSED:

OBSERVER:

SAMPLE ID SPECIFIC LOCATION % LFM CONTENT

COMMENTS:

Hart Mountain NAR

Appendix K: Step-up Plan

Staffing Class	**BI**	**Step-Up Action**
SC-1	0-15	Normal tour of duty for fire crews. Open fires allowed on Refuges in campgrounds in fire pits only. Engine crews complete weekly engine checks. Engine crews begin daily in-service contacts to servicing dispatch offices.
SC-2	16-30	Same as SC-1. Engine crews begin daily engine checks.
SC-3	31-60	Fire suppression equipment maintained in a state of fire readiness. Fire crews not to leave Refuges or be split during normal tours of duty unless Duty Officer approves.
		FMO may override BI to SC-4 if significant human activity is anticipated. KBDI > 180 and LFM < 120% should also coincide with this decision.
		FMO may override BI to SC-4 without anticipation of significant human activity if KBDI >200 and LFM < 100.
		No open fires allowed and Refuge Manager will post signs. Visitors are required to carry shovels in all vehicles. To be enforced by Refuge LE Officers.
SC-4	61-78	Same as SC-3 with addition of:
		FMO may access emergency pre-suppression funds to extend staffing period of normal work day and week to cover burning period or forecasted lightning events where fire crew would normally be off shift.
		All red-carded Refuge employees will carry PPE and handtools in work vehicles.
		Fire crew may patrol Refuge campgrounds and major routes of visitor transportation.
		Aerial detection flights over Refuges should be incorporated into cooperator detection flights.

		Lists of issued Back Country Permits will be provided to Duty officer so that visitors in back country can be monitored in the event of a wildland fire.
		Refuge work projects involving heavy equipment such as road graders and/or welding at field sites will be monitored by Refuge Managers, and workers will take precautions against accidental ignitions. Fire crews with engines may be pre-positioned to mitigate accidental ignition hazard.
SC-5	79-114	All SC-4 actions as well as:
		Temporary closures may be imposed on sensitive areas of the Refuge at the discretion of the Refuge Manager and FMO.
		Cooperator engines may be pre-positioned on the Refuges if available.
		All red-carded employees may be required to work extended shifts and/or days off to augment initial attack forces during periods of forecasted lightning activity.
		The FMO may request that Refuge LE Officers patrol front country and back country areas to enforce open burning restrictions. These patrols may be extended beyond normal tours of duty and be paid for with pre-suppression funding.

APPENDIX P: FIRE EFFECTS

The following discussion addresses fire effects on soils, plants and animals of the Refuge.

Effects on Soils.

Prescribed burning may directly affect soil by altering soil physical properties, soil chemical properties, nutrient amounts, post-fire soil temperature, microorganism population, and erosion potential. Prescribed burning affects soil physical characteristics and processes (Blaisdell 1953, Wright and Heinselman 1973, Nimer and Payne 1978, DeBano 1990, Acker 1992). Nature and extent of fire effects on soil are specific to vegetation type, succession state, and fire regime (Kilgore 1981, Parsons and DeBenedetti 1979, Bunting et al. 1987, DeBano 1990). Vegetation type and succession stage influence the amount and distribution of nutrient pools in live and dead organic matter and, to a significant extent, fire regime (Parsons and De Benedetti 1979, Wright and Heinselman 1973, Kilgore 1981, Bunting et al. 1987).

Combustion of organic matter causes immediate, on-site reduction in total nitrogen and carbon through combustion, but increases short-term availability of nutrients to nitrifying bacteria and plants through deposition of nitrogen and phosphorus in ash and consequent leaching into upper profiles of the soil (Wright and Heinselman 1973, Nimer and Payne 1978, DeBano 1990, Acker 1992). Within vegetation type, the greater the severity of a fire, the greater the reduction of carbon and primary plant nutrients through combustion (DeBano 1990, Kilgore 1981).

Soil surfaces blackened by fire and charred organic matter increase soil surface temperature and therefore stimulate earlier plant growth over the short-term (Nimer and Payne 1978). Short-term decline in infiltration after fire is followed by a long-term increase in infiltration associated with change in ground cover and vegetation structure (e.g., shrub to grass dominated) (Tiedemann et al. 1990, Sturges 1993). Similarly, short-term increase in wind and water erosion potential after fire are followed by long-term decline in wind and water erosion associated with vegetation succession, enhanced vegetation vigor, increased vegetal cover, and enhanced ecological condition (Blaisdell 1953, Tiedemann et al. 1990, Sturges 1993).

Potential for cheatgrass invasion after burning is determined by the interaction of soil disturbance (i.e., consumption of organic matter, change in levels of micronutrients), occurrence and amount of cheatgrass seed in the post-burn seed pool, and cover and density of perennial bunchgrasses (Hedrick et al. 1966, Young and Evans 1974, Evans et al. 1978). Burned sites without a seed source of cheatgrass will maintain dominance of native herbaceous species, notwithstanding variation in burn severity and site ecological condition (Bunting et al. 1987, Refuge files, Rose and Miller 1999).

Sites with a source of cheatgrass seed react differently than sites devoid of the species (Young and Evans 1973, Bunting et al. 1987). On aridisol sites occupied by big sagebrush, pre-burn ecological condition and amount of cheatgrass in the seed pool are principal determinants of the post-burn composition of cheatgrass, burn severity notwithstanding (Young and Evans 1973, Young et al. 1976, Rose and Miller 1999). For example, probability of increased cheatgrass cover increases with increased amounts of cheatgrass seed in the post-burn seed pool (Young and Evans 1973, Young et al. 1976). However, potential for cheatgrass increase is diminished on aridisol sites rated in high to very high ecological condition because perennial bunchgrasses survive in sufficient densities to out-compete cheatgrass (Young et al. 1976, Bunting et al. 1987). Rose and Miller (1998) determined the frequency of cheatgrass on aridisol sites rated very high prior to the Badger and Catnip wildfires on Sheldon Refuge to be over six times greater in unburned than burned monitoring plots.

On mollisol sites dominated by basin big sagebrush and mountain big sagebrush, severe burns can lower ecological condition and reduce bunchgrass densities, which results in increased composition of cheatgrass in the post-burn community (Sapsis 1990). Re-seeding such sites with perennial grasses the year after burning may be appropriate if the site burned had low cover of perennial grasses before burning and after burning (<10%) (Evans and Young 1978, Bunting et al. 1987), but success is often very limited..

Adverse effects of prescribed burning on soil can be lessened by development of a burn prescription specific to the type of soils and vegetation, and evaluation of the relationship between burn parameters and habitat response after burning (Bunting et al. 1987). Prescription factors that will influence soil response to fire include: (1) ignition technique, (2) fuel, organic layer, and soil moisture at time of burning, (3) thickness and packing of litter layers, (4) depth and duration of heat penetration into organic and soil layers, (5) soil type, and (6) soil texture (Bunting et al. 1987, USBLM 1991:3-37).

Effects on Forbs.
Crawford (1999) studied habitat response to prescribed fire on Hart Mountain NAR in Wyoming big sage from 1996 to 1999. The focus of this study was to determine the effects of prescribed fire on sage grouse habitat, primarily cover and key feed species. Marked decrease in sagebrush cover occurred. Although there was little change in species composition between burned and unburned areas, forb cover and frequency showed increases. Rose and Miller (1998) found much the same results from study of burned and unburned plots in the Catnip and Badger wildfires of Sheldon Refuge. The focus of their project was to determine the response of mountain big sage and low sage to wildfire. Results showed increased forb cover and frequency.

Young and Evans (1978) examined response of forbs over four years after three late-July and early August wildland fires in Wyoming big sagebrush/Thurber's needlegrass habitats near Reno, Nevada. At one site, density of perennial forbs, including balsamroot and lupine, increased 100% between the first and fourth years after burning. Cover of perennial forbs, largely tap-rooted species, increased the second and third years after fire, but, declined in the fourth year. Four years after fire, annual forbs declined trace quantities. Forb richness declined 70% over three growing seasons after fire. Decline of annual forbs and limited response of perennial forbs were attributed chiefly to interspecific competition from cheatgrass (Young and Evans 1978). The authors inferred that fire in lowland communities with cheatgrass altered dynamics of plant succession, promoted dominance of cheatgrass, and thwarted survival of species intolerant of cheatgrass competition.

Peek et al. (1979) examined responses of vegetation for one year before and three years following September prescribed burns on seven study sites located within sloping terrain that comprised winter range of bighorn sheep and mule deer at east-central Idaho. Frequency of perennial forbs showed no significant change before and after fire. Significant increases in frequency of annual forbs the second year post-fire probably was a consequence of above-average fall precipitation and not burning.

Wambolt and Payne (1986) assessed basal cover and production of perennial forbs and production of annual forbs for ten years after five treatments (September) of Wyoming big sagebrush/bluebunch wheatgrass in southwestern Montana. Cover of perennial forbs was significantly greater 6-14 years after burning compared with cover on control plots. Burns yielded more cover of perennial forbs than all other modification techniques, including spraying, plowing, and roto-cutting, and rest from grazing (control).

Blaisdell (1953) and Harniss and Murray (1973) evaluated forb production 1, 3, 15, and 30 years after light, moderate, and heavy fires were conducted in mountain big sagebrush-grass during late summer in southeastern Idaho. Net fire effects were as follows:

(1) Forbs were most productive on sites subject to light burns (consumption of 1-hour woody sagebrush fuels) and moderate burns (consumption of 10-hour woody sagebrush fuels), and;

(2) Forbs maintained significantly greater productivity for 15 years after burning in 1 area and for 12 years on heavy burns (consumption of 100-hr woody sagebrush fuels) in another area. Thirty years after burning, forbs were still slightly more productive on the severely burned site.

Response in forb yield was evaluated one and three years after August burning, spraying, roto-beating, railing, and chaining in a mountain big sagebrush-grass habitat of southeastern Idaho (Mueggler and Blaisdell 1958). Forb production increased on all treatments and years except on the spray plot. Three years after treatment, forb production increased 61% on burned plots, increased 50% on beat plots, increased 20% on railed plots, and declined 39% on sprayed plots.

Blaisdell et al. (1982) reported forb response after April fires were prescribed in mountain big sagebrush-grass habitat of southeast Idaho. Forb production declined 43% in the first growing season, but almost tripled in the second growing season after fire.

Effects of spring burning were studied in mountain big sagebrush habitats in Montana by Nimir and Payne (1978). Forb basal cover slightly increased after low severity fires and significantly decreased after high severity fires. Regressions of basal cover against sampling date revealed that forbs initiated growth later, and maintained cover and green growth longer on burned than unburned study plots.

Long-term succession (1-90 years) after fire was evaluated at 21 pinyon-juniper stands in Nevada and California by Koniak (1985). Collectively, cover of annual forbs was significantly greater on (1) drier south and west aspects, and; (2) during early stages of succession. Cover of perennial forbs significantly differed between early, mid, and late succession stages on wetter slopes. Overall, cover of annual and perennial forbs seemingly diminished as succession progressed from early to later stages.

Long-term (2-36 years) succession after fire also was assessed for habitats dominated by big sagebrush-Utah Juniper in southeastern Idaho (Humphreys 1984). Cover and richness of perennial forbs were inversely related to shrub cover and time since a location had burned. Average cover of perennial forbs increased for 10 years after burning but then progressively declined.

Effects on Graminoids.
Grasses, rushes, and sedges (i.e., graminoids) are a critical component of the shrubsteppe ecosystem. They serve many functions including cover and forage for wildlife; a fuel component that determines the occurrence, intensity, and rate of fire spread; sources of litter and soil development; and management indicators of site potential (i.e., ecological condition). Outcomes of plant succession after burning are regulated primarily by the amount and type of graminoids and shrubs that occur on a site. Initial responses of grasses determines (1) the ability of a site to resist invasion of alien grasses over the course of fire-induced succession; (2) the rate of succession by shrubs; and (3) the amount of shrubs that will occur in late-successional communities (provided that the site is not re-burned or grazed intensively by livestock). Consequently, restoration of ecological condition, wildlife habitat, and ecosystem health depends substantially upon the amount of perennial graminoids in the post-burn community (Anderson 1982, Blaisdell et al. 1982, Winward 1991, USFWS 1994).

A diversity of native graminoids and alien grasses occur on Sheldon-Hart Mountain Refuges. Response of graminoids to prescribed burning is related to three key factors: (1) species composition; (2) ecological condition; and (3) fire severity.

Response of graminoids to fire is related to life history and growth form characteristics (Wright et al. 1979). Classes include (1) annuals, (2) rhizomatous perennials, and (3) tap-rooted perennials. Occurrence of taxa within classes is associated with variation in environmental factor gradients and site potential across the Refuge landscape. Introduced annuals, for example, occur mainly in association with Wyoming big sagebrush and salt desert shrub vegetation types with mesic and frigid soils and average annual precipitation of <30cm (12 in.)/year. Rhizomatous perennials consist of a larger group of species. Collectively, they are associated primarily with upland and wetland sites with deep soil, typically mollisols, and high annual soil moisture levels (USSCS 1993). They are a dominant component of meadows on both Refuges and mountain big sagebrush sites on top of Hart Mountain (USSCS 1993).

As a class, tap-rooted perennial grasses comprise a diversity of species that occupy the full range of environmental settings on the Refuges. The class consists mainly of perennial bunchgrass taxa that characterize the "steppe" component of shrubsteppe. Examples include widely distributed, ecologically prominent taxa in uplands such as bluebunch wheatgrass and Idaho fescue (Winward 1980, USSCS 1993). On the other hand, Nevada bluegrass and squirreltail are important species in upland and wetland vegetation types (Winward 1980, USSCS 1993). Among taxa with tap-roots, diversity of composition generally increases on a gradient of increased soil moisture (USSCS 1993). For example, upland and dry meadow sites of lower elevations support fewer species than upland and dry meadow sites of higher elevations (USSCS 1993).

The goal of fire management, in part, is to increase dominance of perennial graminoids on sites in good condition, restore perennial graminoids on sites in poor-fair ecological condition, and limit the increase in cheatgrass distribution and abundance on all sites (USFWS 1994). Cheatgrass, an introduced annual, poses a major challenge to long-term management of salt desert shrub, Wyoming big sagebrush, and frigid-soiled mountain big sagebrush types (Young and Evans 1973, Young et al. 1976, Evans and Young 1978, Young and Evans 1978, USSCS 1993). The challenge consists of maintenance and restoration of native plant communities where cheatgrass occurs (Evans and Young 1978). Substantial reduction in shrub cover by wildland fire, prescribed burning, or other means can vastly increase cheatgrass abundance and distribution, which can result in long-term degradation of site ecological condition and management potential (Young and Evans 1973, Young et al. 1976, Evans and Young 1978). Currently, a majority of acreage of these vegetation types is classified as poor-fair ecological condition characterized by (1) presence of cheatgrass; (2) low amounts of perennial grass; and (3) excessive amounts of shrubs (USFWS 1994).

Although cheatgrass is widely distributed on the Refuges, its abundance is limited on many sites because vegetation exists in a late succession shrub-dominated state where sagebrush is the main factor regulating the amount of annual and perennial grass in the understory (Young et al. 1976, Laycock 1991, USFWS 1994). This situation has resulted mainly from direct suppression of fire, indirect suppression of fire with livestock grazing (e.g., in mountain big sagebrush), reduction in fire spread because of depleted grass supplies on sites in poor-fair ecological condition, and the low incidence and area of vegetation types of the desert shrub biome affected by wildland fire and prescribed fire (Kauffman 1990, USFWS 1994, Gruell 1995).

The threat of increased cheatgrass abundance and distribution is well-documented for plant communities that occur in arid zones of the Intermountain Region (Evans and Young 1973, Young et al. 1976, Young and Evans 1978, Bunting et al. 1987). Additionally, results from these reports are consistent with field observations of response of vegetation to wildland fire and prescribed burning on the Refuges (Refuge files). For example, an August 1985 wildland fire expanded distribution and vastly increased cover of cheatgrass in low sagebrush (<5% to 40% in 10 years after burning) and mountain big sagebrush sites (<5% to 25% in 10 years after burning) at Hart Mountain NAR (Refuge files). Reduction in ecological condition on this wildland fire site was attributed mainly to the interaction of several factors including presence of a cheatgrass seed source, poor-fair ecological condition of pre-burn communities, and extreme loadings of shrubby fuels which fostered severe burns that resulted in high bunchgrass mortality (Refuge files).

On another site, a prescribed burn was conducted in Wyoming big sagebrush in fair ecological condition at Hart Mountain NAR in August 1985 (Refuge files). Field observations disclosed a substantial increase in cover of grass, mainly cheatgrass, during the first ten years post-fire (Refuge files). It is uncertain whether native perennial grasses will increase on this site with the advance of succession and the absence of further disturbance (B. Kauffman, pers. commun.). Contrastingly, cheatgrass has not undergone substantial increases in distribution and abundance on 2 Wyoming big sagebrush sites (e.g., Rodero and Badger Creek) prescribed burned at Sheldon NWR (Refuge files). This response is attributed mainly to an interaction between soil type and occurrence and abundance of cheatgrass in the seed pool (Young and Evans 1973). Although these burned sites were considered representative of fair-good condition Wyoming big sagebrush, soil composition differed substantially (e.g., lighter textured) compared with the wildland fire site burned at Hart Mountain NAR (Refuge files). Additionally, pre-burn sampling indicated that cheatgrass was not as uniformly distributed on the burn sites at Sheldon NWR compared with burn sites at Hart Mountain NAR (Refuge files).

The previous discussion discloses the importance of cheatgrass as a management factor. In summary, the presence of cheatgrass has increased the uncertainty of successional outcomes in vegetation types that characterize the desert shrub biome (Young and Evans 1973, USFWS 1994). Because fire management can control the distribution and severity of burning, it is suggested that prescribed burning be used to maintain and restore ecological condition (USFWS 1994). However, success of restoration will depend, especially on desert biome site, on intensive management and seeding of grasses immediately after fire to establish perennial grass in sufficient amounts to limit cheatgrass abundance (Evans and Young 1978, USFWS 1994)

Fire response of perennials relates to several factors including the vigor of individual plant, fire severity, growth form, and season of burning (Wright et al. 1979, Wright 1985). Vigorous plants have a higher probability of survival after fire than plants of low vigor (Conrad and Poulton 1966, Bunting et al. 1987). The greater the fire severity, which is related to season of burning, the more complete the consumption of the graminoid, and the greater the probability of mortality (Wright and Klemmedson 1965, Britton et al. 1990). Mode of rooting and type and leaf morphology are 2 growth form characteristics that differ among species and result in differential response to fire (Rowe 1983, Wright et al. 1979, Wright 1985). Collectively, species with rhizomes (e.g., Nebraska sedge, creeping wild-rye) interconnecting plants demonstrate high survival after fire, which contributes to their prominence in communities during early succession (Rowe 1983, Wright 1985).

Perennial graminoids with tap-roots are influenced differentially based on difference in leaf morphology (Wright 1985). Fine-leaved species such as Idaho fescue show greater consumption and mortality compared with coarse-leaved species such as squirreltail (Wright 1985). Field observations indicate that although most mature plants of fine and coarse-leaved species survive fires of low to moderate severity, fires of higher severity result in increased difference in mortality, with more coarse-leaved species surviving (Refuge files). Although the technical literature largely indicates that species such as Idaho fescue and Thurber's needlegrass are fire-sensitive (Young and Evans 1978, Wright et al. 1979, Wright 1985), few studies have compared mortality of these species among fires of different severity under field conditions (Sapsis 1990). Monitoring data collected by Refuge staff indicates that most mature Idaho fescue and Thurber's needlegrass plants not only survive fires of low to moderate severity, but also increase in abundance during early succession after burning, especially where cheatgrass is not present in the pre-burn community (Refuge files).

Ecological Condition

Ecological condition differs within and among vegetation types of the Refuges (USFWS 1994). Poor-fair ecological conditions are characteristic of most late-successional vegetation types in uplands (USFWS 1994). In riparian areas, erosion, channel deformation, and lowering of water tables have resulted in decline in prevalence of poor-fair ecological conditions on alluvial floodplains of low gradient (USFWS 1994). On most sites, response of vegetation to wildland fire and prescribed burning is closely associated with ecological condition of the site prior to burning, factors such as cheatgrass occurrence notwithstanding (Bunting et al. 1987).

All vegetation types with tall shrubs support higher fuel loadings than vegetation types with low shrubs and grass (Anderson 1982, Bunting et al. 1987). Consequently, tall shrub types are subjected to higher fireline intensities than types with low shrubs when they burn (Anderson 1982, Brown 1982, Bunting et al. 1987). Upland sites in poor-fair ecological condition may burn more intensely and severely than sites in good-excellent condition because of the greater prevalence of woody fuels on poor-fair condition sites and the more extreme fire behavior required for fire spread (Bunting et al. 1987). Survival of perennial herbaceous species, including bunchgrasses, usually is inversely related to fire severity (Blaisdell 1953, Wright 1985).

Field observations by Refuge staff indicate that fire type (wild vs. prescribed) and fire severity (moderate vs. high) can determine the difference between long-term restoration or degradation of site potential on sites in poor, fair, and good ecological condition (Refuge files). For example, response in perennial grasses and ecological condition differed between two wildland fires that occurred in sagebrush-bitterbrush of the same ecological condition, but slightly different geographic position (Refuge files). Twenty-two years after burning, ecological condition increased and a vigorous stand of perennial grasses and shrubs dominated one wildland fire site. At the other site, ecological condition declined after burning resulting in a stand dominated by a mixture of cheatgrass, perennial grasses, and shrubs. The difference in response is attributed to difference in fire severity as influenced by season of burning and fire weather (Refuge files). The implications of these observations are that the difference between success and failure in management of fire on some degraded sites with high fuel loadings is related to the ability to control fire severity (and season of burning) with prescribed burning (Wright 1985, Bunting et al. 1987, USFWS 1994).

Mountain big sagebrush on cryic soils is an exception to the example that response of a vegetation type to fire is related to site ecological condition (Refuge files, USSCS 1993). These sites, which occur above 1981m (6500 ft.) elevation (USSCS 1993), typically increase in ecological condition after burning no matter what the condition of the pre-burn site (at least for the range of conditions represented on the Refuges) (Refuge files). This consistent response is based on observations collected on a large variety of mountain big sagebrush sites subject to prescribed fire and wildland fire at Hart Mountain NAR in different seasons and years.

Fire Severity

Grass species are differentially influenced by the heat outputs associated with different fire types (Anderson 1982, Wright and Klemmedson 1965, Wright 1985). Given equal fuel loadings, fireline intensity and severity can be manipulated in a prescribed burn by selection of certain weather conditions during burning (e.g., light vs. moderate wind), alteration of ignition methods (e.g., handfire vs. heli-torch), and type of fire (e.g., backing fire vs. head-fire). Backing fires are generally more severe than head-fires and can result in greater consumption and mortality of perennial grasses because of increased residence time (Wright 1974, Brown 1982, Sapsis 1990).

Ecological Condition
Effects on Shrubs.
Knowledge of shrub response to fire is essential for understanding the dynamics of vegetation types, which is the focus of Refuge and fire management goals and objectives (USFWS 1994). The goal of maintenance and restoration of native plant communities seeks to strike a balance between (1) the amount of shrubs and herbaceous species within late-successional vegetation types and (2) relative proportions of different succession stages dominated by shrubs, herbs, or mixtures of both within and among vegetation types (Thomas et al. 1979b, Winward 1991, USFWS 1994). Because shrubs can dominate community interactions of uplands (Laycock 1991), fire management objectives usually specify reduction of shrub cover as a principal prescription objective (Bunting et al. 1987). For example, substantial reduction of sagebrush biomass, cover, and density on sagebrush-dominated sites induces successional response by herbaceous species (Wright et al. 1979, Bunting et al. 1987).

The following section reports the association between species and environmental settings, reviews the state of ecological knowledge for species, and describes the factors that regulate shrub response to fire.

A diversity of shrub species occur on the Refuges. Species include those that potentially dominate biomass and cover on a site, and, consequently, biomes and vegetation types are named for their cover and aspect dominance during late successional stages (e.g., mountain big sagebrush within the shrub-grassland biome) (Winward 1980, Blaisdell et al. 1982, Blaisdell and Holmgren 1984, USFWS 1994). Other species assume sub-dominant status in terms of biomass, cover, and density within plant communities (Blaisdell et al. 1982, Young 1983, Blaisdell and Holmgren 1984). These species function as a component of biodiversity and wildlife habitat, however, they do not assume the same importance in regulation of community interactions and succession dynamics (Young 1983). Knowledge of species response is sufficient to generalize response patterns for the majority of shrub species that occur on the complex. The following discussion focuses on the three primary factors that influence response of shrub species to fire including: (1) life history traits; (2) site ecological condition; and (3) fire severity.

Life History Traits
There are three primary life history strategies exhibited among shrub species, which determine their response to fires and their successional role in plant communities of the Refuges. The three strategies consist of (1) persistence on a site via resprouting after fire; (2) resprouting and establishment from seed after burning; and (3) establishment from seed

The majority of shrub species that occur on the Refuges respond to fire via resprouting and resprouting and seeding. Because these species are present after burning and reproduce soon thereafter, the post-burn response is characterized by an increase in their cover and density (Humphreys 1984). As a group, obligate resprouters are represented by species that occur in the full range of Refuge environments including uplands and wetlands (USFWS 1994). Those that occur in riparian zones (e.g., willow, currant, rose) have the greatest similarity of response, which is based primarily on field observations taken after wildland fires and prescribed fires (Refuge files). In uplands, the amount of re-sprouting shrubs in the post-burn community is largely determined by site ecological condition and, consequently, density of shrubs in the pre-burn community. Sites below 6000 ft. in poor-fair ecological condition typically have a greater proportion of resprouting shrubs (i.e., rabbitbrush) compared with sites in good-excellent condition (USSCS 1993, Refuge files). A few years after burning, resprouting shrubs increase in cover and assume cover dominance during early to mid stages of succession after fire (Humphrey 1984, Refuge files). The magnitude of cover increase is related primarily to density of shrubs in the pre-burn community and fire severity (Bunting et al. 1987).

Another class of species reestablishes by re-sprouting and/or development from seed to maintain and increase cover on burned sites. Fire severity tends to differentially influence mortality because species differ in susceptibility to damage from heat based on the location of perranating organs (i.e., root crown), which houses the living tissue required for plant regeneration and resprouting (Rowe 1983, Humphrey 1984). As a consequence, shrubs that resprout facultatively can be subdivided into groups based the in overall tendency for mature plants to survive fire. Species such as snowbush ceanothus demonstrate a high rate of resprouting and widespread establishment from seed (e.g., germination is induced by heat stratification) (Noste 1985). Contrastingly, species such as bitterbrush usually exhibit high mortality and a weak resprouting response (Bunting et al. 1985, Pyle 1993). Amount of bitterbrush mortality is related to fire severity and fuel loading (Bunting et al. 1985). Mortality decreases as site fuel loadings and fire severity are reduced. Bitterbrush of the Refuges on burned sites apparently maintains its populations primarily through establishment from seed, which develops from caches that survive fire and establish on burned sites after transport from unburned sites (Bunting et al. 1985, Pyle 1993). Because bitterbrush seed is readily killed by fire, response of bitterbrush to fire depends heavily on fire severity, characteristics of the seed pool, and growing conditions after burning (Bunting et al. 1985). Consequently, bitterbrush seldom represents a conspicuous element of early and mid succession stages after burning on sites where plants establish mainly from seed (Bunting et al. 1985, Refuge files).

A limited number of shrub species respond to fire completely by establishment from seed. Response of the group is best characterized by the suite of sagebrush species that occur in uplands (Winward 1980, Young 1983). None of the woody species that occur on the refuge demonstrate any propensity for resprouting, except silver sagebrush (Winward 1980, Young 1983).

Although seed is generally plentiful on sites prior to burning, most is killed by fire when sites burn (Wright et al. 1979, Young 1983). Colonization and establishment of plants on burned sites therefore requires that seeds be transported by wind from adjacent burned sites (Humphrey 1984). Consequently, amount of seed, rate of sagebrush establishment, and sagebrush densities on burned sites are related to the size of burn, pattern of burn, and densities of sagebrush adjacent to burned sites as it affects colonization of the burned site by sagebrush (Johnson and Payne 1968, Bunting et al. 1987).

Establishment and survival of seedling shrubs is heavily influenced by environmental conditions such as annual supplies of soil moisture (Young 1983, Bunting et al. 1987). Hence, Wyoming big sagebrush tends to establish at slower rates on burned sites compared with mountain big sagebrush because supplies of soil moisture available annually are less and therefore favor plant establishment and survival less consistently (Kauffman 1990, USSCS 1993, Miller and Rose 1998)). Field observations taken from multiple burn sites in mountain big sagebrush are consistent with observations reported in the technical literature (Refuge files). Although sagebrush was killed by fire, sagebrush seedlings were readily observed on burned sites by the second and third years post-fire (Refuge files).

Ecological Condition

Ecological condition describes the status of vegetative conditions of a site in terms of plant composition and structure (RISC 1983). It is a key parameter for management because it discloses the ratio of shrubs to understory herbaceous species, which is used to determine ecological status of a site (Blaisdell et al. 1982, RISC 1983, Bunting et al. 1987). For example, upland and wetland sites in good-excellent condition are quite diverse (Blaisdell et al. 1982, Blaisdell and Holmgren 1984, Kovalchick 1987). Biomass, cover, and density of shrubs and herbaceous species occur in relative ecological balance; competition between shrubs and understory species occurs and is maintained at low levels (Laycock 1991, Winward 1991). On upland sites in poor-fair condition the balance has shifted, favoring ecological dominance of species, typically sagebrush or cheatgrass, which competitively exclude other plants, typically native herbaceous species (Evans and Young 1973, Winward 1991). Competitive exclusion of native herbaceous species by shrubs, mainly sagebrush, was identified as a core resource management problem at Hart Mountain NAR because a large proportion of ecological sites and vegetation types are in poor-fair ecological condition (USFWS 1994).

Site ecological condition affects shrub response to fire (Bunting et al. 1987). On burned sites, shrub establishment after burning is facilitated where ecological condition is poor-fair because supplies of competitive herbaceous plants are generally depleted, an artifact of ecological condition, not burning (Bunting et al. 1987). Conversely, shrub establishment is inhibited on burned sites in good-excellent condition because of competition with herbaceous plants (Blaisdell et al. 1982, Bunting et al. 1987).

Pyle (Refuge files) examined ten year response of mountain big sagebrush-bitterbrush and low sagebrush-bitterbrush to wildland fire at Hart Mountain NAR. Rate of shrub establishment and level of shrub cover of shrubs was inversely related to cover of native perennial grasses on sites in fair-good ecological condition, but positively related to cover of cheatgrass on sites in poor-fair condition. Monitoring data collected since 1990 on prescribed burn sites at Hart Mountain NAR also demonstrate a consistent inverse relationship between rate of shrub establishment and cover of native perennial grasses (Refuge files). The exception to this pattern apparently occurs in mountain big sagebrush of high elevations (e.g., the top of Hart Mountain NAR) where burned sites show a uniform response of increase in native grasses and slow establishment of sagebrush, ecological condition of the site notwithstanding (Refuge files). Rate of shrub establishment on such sites appears governed mainly by (1) amount of residual live seed that survives burning; (2) distance of the burned site from a sagebrush seed source, which affects dispersal and; (3) densities of sagebrush in unburned sites that act as a seed source, which influences the amount of seed available for dispersal (Johnson and Payne, Young 1983, Bunting et al. 1987).

Historic decline in ecological condition of mountain big sagebrush sites excluded from fire has resulted in increased densities of sagebrush and increased amount of sagebrush seed available for dispersal into burned sites (USFWS 1994, Gruell 1995). Consequently, the rate of sagebrush establishment has perhaps increased and the duration of herbaceous dominance has diminished on burned sites because of the increased amount of sagebrush seed dispersing from unburned to burned sites.

Fire Severity

Fire severity interacts with site ecological condition to influence the outcome of secondary succession after fire (Blaisdell 1953, Harniss and Murray 1973). On big sagebrush sites there exists an apparent threshold where fire severity determines the difference between advance or decline in ecological condition based on differential influence on post-fire plant community composition (Laycock 1991). For example, fire of low severity may result in increase in ecological condition of sites in poor-fair condition (e.g., high shrub biomass, low bunchgrass biomass) (Bunting et al. 1987, J. Holechek, pers. commun). However, a high severity fire on the same site may result in reduction in ecological condition, and increased rate of shrub establishment because of reduced bunchgrass competition (Young 1983, Bunting et al. 1987, Refuge files). Such a fire severity threshold apparently occurs in mountain big sagebrush and mountain big sagebrush-bitterbrush sites on frigid soils, which are classified as poor-fair ecological condition at Hart Mountain NAR (USSCS 1993, USFWS 1994, Refuge files).

Comparison of successional responses of vegetation to separate fires on two ecological sites of similar ecological condition (i.e., poor-fair) at Hart Mountain NAR revealed that occurrence of low severity fire on one site resulted in maintenance of native vegetation, domination by native herbs during early succession, and slow establishment of shrubs (Refuge files). Occurrence of high severity on the other site resulted in rapid reestablishment and increase of shrubs, high mortality of native grasses, and increase in cheatgrass. The same interaction between fire severity and ecological condition apparently occurs on Wyoming big sagebrush sites where ecological conditions range from poor to fair at Hart Mountain NAR and cheatgrass occurs in the seed pool (Evans and Young 1973, USFWS 1994, Refuge files).

Effects on Trees.

Collectively, deciduous and conifer woodlands and forests comprise 8% of the land area on Hart Mountain NAR and 1% of the land area on Sheldon NWR (USFWS 1994, Refuge files). The woodlands and forest, comprised primarily of aspen, juniper, and ponderosa pine occur in the more productive environments of higher elevations where they afford food and cover for a diversity of wildlife species, and serve as a key source of biological and ecosystem diversity (Mewaldt 1982, USFWS 1994, Dobkin 1995, Miller et al. 1999). The following section reports on the influence of fire exclusion on the ecology of principal tree species, describes the effects of fire on individual tree species, and discusses factors associated with plant responses to fire.

Fire Exclusion

The effects of fire on trees of the Refuge cannot be fully considered without evaluation of the effects of fire exclusion. An assessment of the historical influence of fire disclosed that most woodland and forest environments of the Refuges have undergone profound change in abundance and distribution as a result of intensive livestock grazing and fire exclusion since Euro-American settlement (Vale 1975, Pyle 1991, Gruell 1995, Miller et al. 1999). For example, on Hart Mountain NAR, fire exclusion and average tree size has increased but total stand area has declined in aspen forests (Kauffman 1990, Gruell 1995). Western juniper has increased in density; new stands have established in a wide variety of shrub steppe sites, which formerly had few trees because surface and stand replacement fires kept sites mostly devoid of trees (Dealy et al. 1978, Gruell 1995). In ponderosa pine stands, stem density has drastically increased, with >90% of stems less than 100 years old (Gruell 1995, Refuge Files 2000), a direct consequence of fire exclusion.

Role of Fire in Western Juniper

Fire is the principal factor that historically regulated the abundance and distribution of western juniper (Dealy et al. 1978). It is a relatively long-lived species, exceeding ages of 1,000 years (Miller et al. 1999), with the capability to increase its range, density, and cover percent with the fire exclusion. In the Intermountain West the conversion of shrub steppe communities to juniper woodlands has been very actively ongoing since the advent of Euro-American settlement. Prior to settlement, juniper was kept primarily confined to areas less prone to experiencing disturbance from periodic fire such as rocky ridges, areas with shallow clay soils, or other surfaces with limited vegetation. However, newly formed juniper woodlands have encroached upon and occupy more productive sites with deep well-drained soils (Burkhardt and Tisdale 1969, Miller et al. 1999). Many aspen groves across the western Great Basin have been invaded by juniper, and many are in various stages of decline as the result. This invasion, as well as the replacement of shrub steppe communities with juniper woodlands, is largely attributed to fire exclusion. Heavy livestock grazing between 1880 and the 1930's removed fine fuels (herbaceous biomass) which previously was the primary fire carrier. The majority of present day juniper woodlands are less than 100 years old (Refuge Files 2000)

Relatively frequent low to moderate intensity surface fires characterized by the fire regime in big sagebrush steppe communities which exhibit fire return intervals ranging from 10 to 25 years in mountain big sage to 25 to 50 years in Wyoming big sage, and 150 to 250 years in low sage (Miller and Rose 1999), historically maintained and shaped juniper distribution and stand composition in these communities. Burkhardt and Tisdale (1976) concluded that fire frequency intervals of 30-40 years would be adequate to keep juniper from invading a sagebursh-grassland community. Old growth juniper woodlands, those in late serial stage with closed canopies and limited or no shrub/grass understory, seldom if ever experience much fire except low intensity events(Young and Evans 1981, Gruell 1995). Very infrequent, stand replacement, extreme intensity fire events likely were the disturbance agents in old growth stands (Miller and Rose 1995).

During the early phases of juniper woodland development, transition back to sagebrush steppe community is easily reversible with fire. Juniper establishment during the early seral stages of shrub steppe is limited by a low density of shrubs. By the mid- to late stages of transition, a threshold is crossed when the natural reversal back to shrub steppe community by fire is difficult or unlikely (Miller et al. 1999). As canopy closure increases and shrub understory declines, the probability of a fire event intense enough to replace the stand rapidly decreases.

Tall shrub (i.e., big sagebrush) sites without natural fire breaks typically burned at higher frequencies (e.g., 10-30 years in mountain big sagebrush) (Burkhardt and Tisdale 1976). Because juniper has a relatively thin bark, it usually is killed readily by fire on such sites where moderate fire intensities are expected (Wright et al. 1979). Fire exclusion has resulted in increase in juniper densities in savannah converting some to woodlands, and establishment of new woodlands in many big sagebrush sites unoccupied by juniper historically (Burkhardt and Tisdale 1976, Young and Evans 1981). Consequently, fire regimes that once characterized juniper have changed because tree density has increased in low and tall shrub sites (Gruell 1995).

Rate of establishment of juniper is diminished on burned sites by juniper's inability to resprout and its slow rate of seed dispersal (i.e., compared with species such as aspen with wind-dispersed seeds). Dissemination of seeds is regulated by tree density and use of juniper sites by berry-feeding birds (ODFW 1994) and mammals such as coyotes. Rate of seed dispersal apparently is affected not only by animals but also by the distance from burned to unburned stands (Gruell 1995). Historical analysis of photos revealed that establishment and development of juniper at both Refuges is associated mainly with burned site proximity to unburned old-growth stands and time since the last fire (Gruell 1985**).**

Increase in juniper density on big sagebrush sites can reduce understory shrubs, grasses, and forbs where juniper densities have exceeded a threshold density of trees, which differs among ecological sites (Dealy et al. 1978, Wright et al. 1979, Laycock 1991, Vaitkus and Eddleman 1991, Miller et al. 1999). Visual aspect of such sites, which occur on both Refuges, consists of forest more than woodland (Wright et al. 1979). Expected fire regime on these sites consists of infrequent high intensity stand-replacement fires (Wright et al. 1979). This regime substantially differs from the historic regime (e.g., moderately intense stand replacement fire involving shrub/grass fuels) that resulted in long-term exclusion of juniper, maintenance of site potential, and retention of native forb, grass, and shrub species (Burkhardt and Tisdale 1976, Gruell 1995). On altered sites encroached with juniper, fire can result in site retrogression, including soil erosion and increased abundance of exotic grasses, because supplies are depleted for seed and mature perennial herbs (Evans 1988, L. Eddleman, pers. commun.).

Role of Fire in Quaking Aspen

Description of fire ecology provided in this section is primarily based on results from study of aspen in and adjacent to the Great Basin. However, initial results from monitoring burned aspen sites at Hart Mountain NAR also are discussed.

Like juniper, aspen is readily top-killed by fire, primarily because of the absence of protective mechanisms such as thick cork (Jones and DeByle 1985). Unlike juniper, however, aspen resprouts after the mature boles are killed by fire (Brown 1985, Brown and Simmerman 1986). Killing of the bole apparently alters the hormone balance of the tree, destroys apical dominance in the bole, and releases formerly suppressed root buds for vegetative growth (Schier, 1975, Schier et al. 1985). In addition to vegetative growth after fire, aspen responds to fire by establishment of new trees from seed (Jones and DeByle 1985).

Severity of fire and vigor of an aspen clone are additional factors that determine vegetative response of aspen to fire (Schier 1975, Schier and Campbell 1978, Brown 1985). Density of suckers is greatest after fires of moderate intensity where all trees in a clone are killed (Brown 1985). Comparatively fewer suckers regenerate after fires of low or high severity (Schier and Campbell 1978, Brown 1985), which can be indexed by relative amounts of fuels consumed by time-lag class and char characteristics on the soil surface (Ryan and Noste 1985). Density of suckers apparently is inversely related to stand vigor (Brown 1985, Brown and Simmerman 1986). Decadent clones comprised of few trees produce fewer suckers after fire compared with healthy clones (Brown 1985, Brown and Simmerman 1986). Additionally, monitoring results from burned aspen sites at Hart Mountain NAR indicate that regeneration of decadent stands after fire is limited if any of the mature trees survive (Refuge files). This response is attributed to continued inhibition of suckers by maintenance of apical dominance in the live tree (Schier et al. 1985).

Aspen requires a moist mineral substrate to establish from seed, which is viable for an extremely limited time period (McDonough 1985). Periodic establishment of new stands probably is related to establishment of seedlings on suitable mineral substrates (McDonough 1985), which increase in availability during the initial years after fire (Jones and DeByle 1985). Although aspen periodically establishes from seed, most stands apparently are maintained by vegetative regeneration from root suckers (Jones and DeByle 1985, Schier et al. 1985), which is consistent with results of monitoring of burned aspen sites at Hart Mountain NAR (Refuge Files).

Technical information and site monitoring results indicate a fairly consistent initial response of vegetative reproduction by aspen after fire (Schier and Campbell 1978, Brown 1985, Brown and Simmerman 1988, Refuge files). However, the long-term outcome of succession after fire is less understood (Bartos and Mueggler 1981, Mueggler 1988), especially in the northwestern Great Basin (Kauffman 1990). Herbivory by insects and ungulates, including mule deer, elk, and domestic livestock, can regulate survival and growth of young aspen stands (Bartos and Mueggler 1981, DeByle 1985c). Technical reports and field observations by Refuge staff indicate that stand extinction may occur where burned stands are subject to intensive grazing by wildlife, domestic livestock, or livestock and wildlife in the initial years after fire (Bartos and Mueggler 1981, DeByle 1985c, USFWS 1994). Probability of extinction appears greatest where herbivory is concentrated in small, isolated burned stands of low-moderate vigor that occur on the sideslopes of mountain valleys (Bartos and Mueggler 1981, Refuge files). Influence of herbivory on regenerating aspen can be reduced by direct manipulation of herbivore numbers (e.g., recreational hunting of big game, control of livestock distribution) and indirect control of animal use (e.g., reduction in big game cover with burning large areas) (DeByle 1985c, USFWS 1994).

Quaking aspen communities are declining throughout the Great Basin due to encroachment of juniper. Wall et al. (1999) reports that 77% of aspen in the Northwestern Great Basin have either been replaced, dominated, or invaded by juniper. Fire exclusion since Euro-American settlement has greatly contributed to this decline. Bartos and Campbell (1997) state that when junipers overtake aspen communities, less water is available to the watershed, understory biomass vegetation is significantly reduced, and the diversity of wildlife and plant species declines. Juniper encroachment is evident in the Hart Mountain NAR aspen stands. If left untreated, juniper may successfully replace aspen in many of these sites. Even in sites not invaded by juniper, general decline in vigor due to fire exclusion, age of clones, and lack of top-kill disturbance may eliminate other groves over a gradual period of time (Refuge Files).

Role of Fire in Ponderosa Pine

The predominant fire regime that occurred historically in ponderosa pine stands across the western U.S. consisted of frequent low intensity surface fires (Kilgore 1981). These fires maintained the integrity and stand composition of historic stands. Ponderosa pine is viewed as being reasonably fire tolerant, with thick insulating bark and the ability to withstand moderately intense heat pulses. Although high intensity surface fires occurred in historic stands, they were less frequent because surface fire maintained low overall fuel levels and low tree densities compared with tree densities during the contemporary period (Parsons and DeBenedetti 1979, Hall 1990). Hart Mountain NAR supports low populations of relic ponderosa pine stands (60-80 acres). Historically these stands were comprised of widely spaced, mature trees surrounded by limited numbers of early/mid sucessional staged young trees. Gruell (1995) reported an average return interval of 13 years for the period 1760-1860 at Blue Sky, Hart Mountain NAR, which is highly consistent with fire return intervals reported for other sites in the Pacific Northwest (Biswell 1972, Hall 1985). Further fire history study (Refuge Files 2000) has refined fire return intervals to 10 years for the time period 1600 to 1930, with fire-free intervals ranging from 2 to 19 years. Seasonality of fires appears to have historically been in the late summer, when conditions were driest (Refuge Files 2000).

Since Euro-American settlement, fire regimes in pine changed dramatically as a result of changes in vegetation composition and fuel characteristics associated with a policy of fire exclusion (Kauffman 1992). Changes in fuel characteristics include increased density of pine, encroachment of other conifers such as western juniper into pine stands, increase in shrubs in sites adjacent to pine stands, and increase in litter under pines (Biswell 1972, Hall 1990, Kauffman 1992, Gruell 1995). Changes in vegetal composition in and adjacent to the pines of Hart Mountain NAR are consistent with changes at the regional level (Hall 1990, Kauffman 1992, Gruell 1995). Consequently, changes in vegetal composition have influenced potential fire regimes and fire effects in pine (Biswell 1972, Parsons and DeBenedetti 1979, Hall 1990, Kauffman 1992, Gruell 1995).

Pine is described as a fire-adapted species (Biswell 1972). Mature trees with thick corky bark are well-adapted for survival of most low and moderate intensity surface fires (Kilgore 1981, Hall 1990, Kauffman 1992). This fire regime also increases the rate of seed establishment on mineral substrates (Biswell 1972, Hall 1990, Kauffman 1992). Young trees are readily killed by surface fire either by direct consumption or by radiant heat (Kauffman and Martin 1989, Hall 1990). Fire served as a thinning agent in dense stands of young trees. Changes in fire regimes during the historic period have increased mortality of mature pine because surface fires are more intense, sensitive roots are easily damaged by increased heat residence in burning duff, and stand replacement events are more frequent (Hall 1990, Kauffman 1992). Whereas increased intensity of surface fires is attributed to increase in litter and duff, increase in stand replacement events is attributed to increase in density of pine and associated species (e.g., western juniper) that facilitate spread of fire from ground to tree crown, and tree crown to tree crown (Biswell 1972, Parsons and DeBenedetti 1979, Kauffman 1992). Additionally, probability of stand replacement events is increased and facilitated by conversion of fuels adjacent to pine stands (Parsons and DeBenedetti 1979, Kauffman 1992). At Hart Mountain NAR, fuels adjacent to pine have changed from grass to shrub and tree dominated over the last 130 years (Gruell 1995). Additionally, juniper has become established within the stands, serving as potential ladder fuel.

Effects on Wildlife

Historically, fire and climate were the principal ecological processes that influenced succession and progression in vegetation types and, therefore, they were the main factors that determined the quantity and quality of habitat available to wildlife (Gruell 1986, Kauffman 1990, Leonard et al. 1992, Gruell 1995). General influences of fire on wildlife habitat include alteration of vegetation structure (i.e., habitat structure), plant species composition (i.e., habitat composition), plant diversity (i.e., species, community, and landscape diversity), forage quality, and forage quantity. Since Euro-American settlement, habitat conditions changed in response to several interacting factors including fire exclusion, livestock grazing, and introduction of alien grasses and forbs (Blaisdell et al. 1982, Kovalchik 1987, Kauffman 1990, Laycock 1991). Reports indicate that these same factors determined historic and current habitat conditions of the Refuges (Deming 1961, Pyle 1991, USFWS 1994, Gruell 1995). The scope of this review is limited to discussion of several taxonomic categories including selected featured species (i.e., pronghorn, bighorn sheep, sage grouse), and wildlife community diversity.

Effects on Pronghorn

Although pronghorn habitats were historically subject to periodic fire (Gruell 1995), few reports disclose pronghorn response to fire. Those that have consist mainly of descriptive observations of pronghorn use in and adjacent to wildland fires (Deming 1961, Yoakum 1980). For example, increase in fawn ratios was attributed to effects of a wildland fire in low sagebrush in Drakes Flat, Oregon (Deming 1961). Pronghorn use seemingly increased after fire reduced shrub and tree cover, and increased grass and forb cover in Long Valley, California (Yoakum 1980) and Abert Rim, Oregon (Deming 1963). At Hart Mountain NAR, monthly surveys of antelope distribution during 1991-93 disclosed consistent use of a 4450ha (11000 acres) wildland fire site during fall and winter where fall rains had occurred and winter snowpack was light (Pyle and Yoakum 1994), however, it was not determined whether the burned site was used selectively.

No study apparently has examined the response of pronghorn to prescribed burning in the northern Great Basin, despite consensus among wildlife professionals that it may serve as a key method of management of native summer range in the northern Great Basin (Pyle and Smith 1990, USFWS 1994, Pyle and Yoakum 1994). This optimistic assumption is based on the premise that key habitats of pronghorn historically burned on a periodic basis (Gruell 1995), that forbs increased in abundance after burning in mesic vegetation types (Bunting et al. 1987), that type of response by forbs occurred consistently in key pronghorn habitats where pronghorn summer (Pyle and Smith 1990), and that antelope subsisted primarily on forbs on summer ranges (Yoakum 1990).

Despite limited information, biologists generally concur that prescribed burning has high potential as a tool for improvement of antelope foraging, fawning, and fawn-rearing habitat on summer ranges (Deming 1961, Kindschy et al. 1982, O'Gara and Yoakum 1992, USFWS 1994, Pyle and Yoakum 1994). Where, when, how much, and how often to apply fire depend on many factors including habitat type, fuel loads, type of animal use associated with a habitat, and risk of escape (Bunting et al. 1987). Objectives for burning any area should be evaluated in light of the following questions (Deming 1961, Kindschy et al. 1982, O'Gara and Yoakum 1992):

(1) History of antelope use associated with habitats?

(2) Key forbs represented in understory?
(3) Shrub canopy cover greater than 20%?
(4) Shrub height greater or less than 76cm (30 in.)?
(5) Cheatgrass a dominant understory component?
(6) Is western juniper encroaching on the site?
(7) More than 75% probability that ecological condition will be maintained or increased after treatment?

Pronghorn spend most of the year associated with upland sagebrush habitats, especially low sagebrush (Pyle and Yoakum 1994). Reduced availability of low sagebrush is not a limiting feature of winter and summer ranges at Hart Mountain NAR or Sheldon NWR as it is elsewhere (Deming 1961, Deming 1963, Pyle 1991, USFWS 1994, Refuge files). Availability of high quality supplies of forbs and browse possibly are limited, however (Pyle and Yoakum 1994, J. Holechek, pers. commun.). Nonetheless, the need for retention of patches of sagebrush cover wherever manipulations in winter habitat are planned cannot be overstated (O'Gara and Yoakum 1992).

Evaluation of prescribed fire in pronghorn habitat should be based on response of foods and habitat interspersion created (Deming 1961, Salwasser 1982, O'Gara and Yoakum 1992). Generally, large burns that maximize interspersion or juxtaposition between habitats are most consistent with requirements of antelope and other wildlife, including sage grouse (eg. linear strips. Otherwise, area of burned patches within a burn site should seldom exceed 250-405 hectares or 617-1000 acres (Salwasser 1982, Kindschy et al 1982), however, this guideline has not been empirically tested. For the overall treatment area, sagebrush-dominated cover should be retained in 5-25% of the area (Kindschy et al. 1982, Salwasser 1982).

Effects on Bighorn Sheep.
In contrast to pronghorn, more is known of bighorn sheep response to fire. However, much of this information is based on evaluation of the Rocky Mountain subspecies which differs from the California subspecies with respect to geographic distribution and habitat use. No study has evaluated the relationship between fire and California subspecies of bighorn sheep, which occurs on and adjacent to the Refuges. Management plans (USFWS 1994) presume that fire will increase herd productivity and population size based on (1) the tendency of fire to increase preferred habitat, which generally consists of open, grass-dominated habitats interspersed with cliffs and rock outcrops (Geist 1971, Risenhoover and Bailey 1985); and (2) dietary preference of sheep for grasses and forbs (Hansen 1982). Because general forage requirements correspond between regions (Peek et al. 1979, Hansen 1982), information from study of fire in Rocky Mountain bighorn habitat was used in this review of fire in California bighorn sheep habitat where similarity exists in habitat composition with the Refuges. Also included are field observations of California bighorn use of burned sites made by Refuge staff.

Reports indicate that bighorn selectively use burned sites for foraging (Peek et al. 1979, Bentz and Woodward 1985, Arnett 1990). Peek et al (1979) attributed differences in sheep use of burned and unburned Wyoming big sagebrush/bluebunch wheatgrass winter range to increased production and palatability of grasses, primarily bluebunch wheatgrass. Bentz and Woodward (1985) reported that increased bighorn use of burned sites was related to increase in quality of herbaceous plants and reduction of trees which limited visibility and security from predators. Wakelyn (1987) compared habitat characteristics among 36 populations in Colorado and concluded that decline and extinction of 17 populations were associated with long-term reduction in fire frequency and succession-induced changes in grasses (decline), shrubs (increase), and trees (increase). Arnett (1990) examined habitat and dietary selection of bighorn on burned and unburned mountain big sagebrush/bluebunch sites in Colorado. He found that bighorn selectively used burn sites in fall, winter, and spring but not in summer. Difference in habitat use was associated with difference in dietary quality, which was higher in crude protein and lower in fiber on burned sites compared with unburned sites in fall, winter, and spring.

On the Refuges, intensive sheep use has been observed on summer-fall range between July and October 1, three years after prescribed burning of low sagebrush and big sagebrush on south Hart Mountain NAR (Refuge files). Similar behavior was observed on year-round range after a 1984 wildland fire occurred on north McGee Mountain, Sheldon NWR (B. Reiswig, pers. commun.).

Burning can improve production and palatability of key grasses for bighorn (Blaisdell 1953, Willms et al. 1981, Patton et al. 1988, Wamboldt and Payne 1986, Cook et al. 1994), initiate earlier growth of grasses in spring (Klebenow 1985, Peek et al. 1979), and maintain green growth longer in summer (Nimir and Payne 1978, Cook et al. 1994) compared with unburned sites. Hobbs and Spowart (1984) and Arnett (1990) found an increase in dietary protein of sheep that fed in a burned big sagebrush/bluebunch wheatgrass. Burning shrubs on bighorn winter range may reduce competition from deer by promoting grasses and reducing shrubs that deer feed on (Peek et al. 1979,).

Bighorn are associated with grass-dominated habitats (Geist 1971). Grassland areas in the northwestern Great Basin increasingly are encroached by shrubs and western juniper due to livestock overgrazing and fire exclusion (Graf 1971, Gruell 1995). Prescribed burning can reduce tree and sagebrush cover, and increase grass and forb cover (Wright et al. 1979, Bunting et al. 1987). In bighorn ranges, burning is usually the least expensive and most efficient habitat improvement method (Peek et al. 1979). Natural fire breaks and slope can facilitate use and control of fire (Graf 1971, Wakelyn 1987, Arnett 1990).

Because grasses and forbs comprise key forage of bighorns, habitat management should stress maintenance or increased abundance and quality of these forage classes (Peek et al. 1979, Hansen 1982). Fire management and site burn plans should identify limiting habitat factors, describe objectives, and discuss expectations of wildlife response (Peek et al. 1979). Habitat composition and bighorn use are negatively affected where fire diminishes abundance of perennial grasses and reduces site ecological condition (Peek et al. 1979, Blaisdell et al. 1982).

Fire planning considerations in bighorn range include:
(1) Abundance and condition of food species present preburn (Peek et al. 1979). Minimal response can be expected of native forbs and grasses from burning of range in poor-fair ecological condition (e.g., site supports mainly cheatgrass and sagebrush).

(2) Response of food species to fire (Arnett 1990). Magnitude of sheep response will be related in part to short-term change in forage quality and long-term change in species composition (i.e., increase in perennial grass and forbs on sagebrush and juniper-dominated sites) (Blaisdell et al. 1982, Arnett 1990).

(3) Burns less than 1.6 km (1 mi) from escape terrain will receive more use. Burn sites proximate to large cliffs and rock outcrops will facilitate use by ewes (Arnett 1990).

(4) Burn areas with cover of young juniper (>25%) or tall shrubs (>60cm) (24 in.) to create increase security from predators and facilitate habitat use (Wakelyn 1987, Peek et al. 1979).
(5) Effectiveness of burns will be determined by location of burned sites in relation to key seasonal habitats (Arnett 1990). Key components include south slopes and ridges in winter; habitats proximate to lambing cliffs and lamb-rearing areas (i.e., drainages) in spring and early summer; and north slopes and high elevation escarpment ridges during summer-fall (Van Dyke et al. 1983, Seip and Bunnel 1985, Payer 1992).

(6) Limiting factors:

(a) Burned sites that disperse population likely will reduce lungworm influence; burned sites that concentrate bighorn likely will increase lungworm influence (Peek et al. 1979).
(b) Burns may attract forage competitors such as deer and elk. Interspersion of burned and unburned areas may reduce competition by offering foraging alternatives to sympatric ungulates (Peek et al. 1979, Spowart and Hobbs 1985).

(7) Pattern and size of burn:
(a) Magnitude of influence of fire is related to magnitude of increase of key native forbs and grasses, and duration that increased forage availability is maintained among the key habitats within the annual range of the sheep herd (Peek et al. 1979, Cook et al. 1994).
(b) Maintenance of an interspersion of burned and unburned habitat is not a large concern with sheep habitat. Requirements of other wildlife species need to be weighed, however, with respect to interspersion of burned and unburned habitat (USFWS 1994).
(c) No minimum or maximum limit has been established for burning on bighorn ranges. Size and pattern of individual burns is determined primarily by choice of firing technique, fuels on the site, fire weather, and topography (Brown 1982, Bunting et al. 1987).

Effects on Sage Grouse.
Although habitat requirements of sage grouse are well understood, no study has examined population response to fire. Consequently, recommendations for increased use of prescribed burning to improve habitat condition and increase populations are based on reports that describe historic habitat conditions and fire regimes (Kauffman 1990, Gruell 1995), knowledge of current habitat conditions and successional processes (Blaisdell et al. 1982, Winward 1991), understanding of the species' requirements for a mixture of habitat components (Gregg et al. 1992, Drut 1994), and inference of fire effects on habitat and bird population status (Klebenow 1972, Pyle 1993, Crawford et al. 1992).

The assumption that fire can improve habitat condition and improve population size must be critically evaluated because to date, no report has demonstrated such a relationship (Crawford et al. 1992, Drut 1994). Contrastingly, many studies have indicated that reduction of sagebrush can detrimentally impact sage grouse (Braun et al. 1977). Such information has tended to to substantiate concerns of some biologists about potential negative impacts of fire in sage grouse habitat (Autenrieth et al. 1982, Willis et al. 1993). However, this concern is based mainly on lack of information, poorly-designed, short-term research, and widespread supposition that sage grouse respond to fire as they respond to large-scale application of 2,4-D (Braun et al. 1977, Call and Maser 1985).

Apparently, periodic fire was associated with the maintenance of sagebrush ecosystems, and presumably, sage grouse habitats (Klebenow 1971, Kauffman 1990, Gruell 1995). Historically, fire-return intervals differed among sites ranging from 15-75 years in colder, wetter communities of mountain big sagebrush to >75 years in warmer, drier communities of Wyoming big sagebrush (Wright et al. 1979, Kauffmann 1990). Apparently increased densities of western juniper in Oregon and Idaho are related to fire exclusion from low sagebrush and mountain big sagebrush communities (Burkhardt and Tisdale 1976, Shinn 1980, Young and Evans 1981, Gruell 1995). To date, research has focused mainly on the effects of fire on spring and summer habitat of sage grouse.

Fire can differentially affect spring habitat of sage grouse. Establishment of new leks after wildland fire was reported where availability of open sites for use as leks was limited by the size and density of

Wyoming big sagebrush (Connelly et al. 1981, Gates 1985). A similar response was observed after prescribed burning of Wyoming big sagebrush at Hart Mountain NAR (Refuge files). This lek occurs in a 1.6km (1.0 mile) by 100m (30 ft.) burned strip and is dominated by cheatgrass. Since establishment the year after burning, peak annual attendance ranged from 40-50 males/year between 1986-94 (Refuge files). Duration of use of burned sites for leks is undetermined, however, it likely is related to rate and density of big sagebrush reestablishment.

The effect of fire on nesting habitat has not been tested. However, it is known that some sites burned 25-40 years ago currently are valued as nesting habitat (J. Connelly, pers. commun.). At Hart Mountain NAR, two sites historically subject to fire (1958, 1972) are now considered optimal for nesting use because of the balanced mix of sagebrush and perennial grass (M. Gregg, pers. commun.). Use of prescribed burning to restore nesting habitat has been repeatedly advocated (Crawford et al. 1992, Drut 1994, USFWS 1994), but not tested.

Key factors of summer habitat include availability of key forbs (i.e., selectively used taxa) and concealment cover for broods (Klebenow 1969, Martin 1990, Drut et al. 1994). Studies of fire effects are limited to evaluation of response of upland habitats, mainly mountain big sagebrush (Klebenow 1969, Martin 1990, Pyle 1993). Response of forbs and cover in uplands is determined by many factors including species composition in the pre-burn community (Bunting et al. 1987), fire severity (Blaisdell et al. 1982, Martin 1990, Pyle 1993), and land use after burning (Wright et al. 1979, Bunting et al. 1987). Type and magnitude of response differs among key foods used by hens during the pre-laying period and used by hens and broods during the brood-rearing period (Pyle 1993, Barnett and Crawford 1994). Key forbs that exhibited consistent significant short-term increases in abundance (i.e., cover, frequency, or production) after burning included yarrow (Achillea), and mountain dandelion (Agoseris) (Countryman and Cornelius 1957, Nimir and Payne 1977, Martin 1990, Pyle 1993). Although response to fire of other key taxa (i.e., Astragalus, Crepis, Lomatium, Microsteris, Taraxacum, Tragopogon) varied among studies, no significant declines were reported after the first-year post-burn (Blaisdell 1953, Martin 1990, Pyle 1993). Martin (1990) compared concealment cover among brood locations and found significantly greater cover on burned sites compared with unburned sites.

Evaluation of technical literature implies that prescribed fire can be used to create leks (Gates 1985), and restore cover of bunchgrasses and key forbs in habitats used for nesting and brood-rearing (Martin 1990, Crawford et al. 1992, Pyle 1993, Drut 1994, USFWS 1994). Primary habitats with high potential for improvement of sage grouse habitat with prescribed burning include mountain big sagebrush, low sagebrush, and meadows encroached by sagebrush. Objectives of burn plans and prescriptions need to be tailored to accommodate the range of site-specific seasonal requirements of sage grouse. Objectives for burning should be evaluated in light of the following questions (Autenrieth et al. 1982, Mangan and Autenrieth 1985, Blaisdell et al. 1982, Call and Maser 1985, Young and Evans 1978, Pyle 1993, Drut et al. 1994).

(1) History of bird use on project sites (e.g., proximity to leks, winter or summer habitat)?
(2) Is it believed that existing habitat conditions limit sage grouse use of project site?
(a) Cover of key forbs limited?
(b) Bunchgrass cover limited by sagebrush cover (i.e., >15% in Wyoming big sagebrush; >25% in mountain big sagebrush).
(c) Tree cover (i.e., juniper) increases probability of avian predation?
(3) Are the primary uses (e.g., nesting, brood-rearing) of project site described?
(4) Will site ecological condition be maintained or increased by burning (e.g., indicated by initial increase in native herbaceous species)?

(5) Will site ecological condition be degraded by burning (e.g., indicated by increase in cheatgrass).

Sage grouse spend most of the year associated with upland sagebrush habitats. In all probability, the quantity of low sagebrush and Wyoming big sagebrush are not limiting features of winter ranges of sage grouse at Hart Mountain NAR and Sheldon NWR (J. Crawford, pers. commun.). Availability is likely limited, however, for open sites in Wyoming big sagebrush for use as leks; cover of key food forbs in mountain big sagebrush, low sagebrush; and nesting cover comprised of tall grass mixed with sagebrush (Crawford et al. 1992, USFWS 1994). Evaluations of prescribed fires should be based upon evaluation of response of key habitat components including size and pattern of burned sites (Pyle 1993). Large burns with high rates of interspersion (e.g., 40-60% burned/unburned) apparently maximize cost-efficiency and are compatible with requirements of sage grouse and other wildlife species (Bunting et al. 1987, USFWS 1994).

Effects on Wildlife Community Diversity.

The purpose of managing for wildlife species richness (i.e., community diversity) is to "maintain the highest possible number of wildlife species in viable populations" (Maser and Thomas 1983). Management for species richness requires information on what native wildlife occur on the Refuges, how they are associated with habitat, the status of those habitats, and how wildlife species respond to change in habitat conditions (Maser et al. 1984a, 1984b). The recent Comprehensive Management Plan for Hart Mountain NAR prescribes the use of fire as a principal method of maintenance and restoration of wildlife diversity (USFWS 1994).

Evaluation of species richness for this plan involved development of a wildlife-habitat relationship model based on evaluation of 31 wildlife habitats and 302 wildlife species that occur at Hart Mountain NAR (see USFWS 1994:152 for description of methods and Appendix C for a list of species). Evaluation of model results indicate that wildlife species richness in upland vegetation types is highest where a mixture (i.e., mosaic) of succession stages occur. For example, in a particular area in the Wyoming big sagebrush type, we might find about 27 species of wildlife using the area for feeding if the entire area is in a late, shrub-dominated stage of succession. Contrastingly, if that same area had patches of habitat in early succession (grass-forb community), and patches of habitat in mid succession (grass-shrub community) mixed in with the late succession stand, we might find up to 36 species of wildlife consistently using the area for breeding purposes and 66 species consistently using the area for feeding purposes. This is because some species require grassland-like habitat, while others require grass-shrub or shrub-dominated habitat (Maser et al. 1984a, 1984b). Still other species such as sage grouse require more than one stage of succession in a small area to satisfy seasonal and annual life history requirements (Crawford et al. 1992, Drut 1994).

At present, about 96% of the Wyoming big sagebrush vegetation type is in a late stage of succession while only two percent is in an early stage of succession at Hart Mountain NAR. The remaining two percent is in a very late stage of succession, meaning that it is dominated by sagebrush and juniper.

Therefore, the vast majority of the Wyoming big sagebrush type supports a relatively low number of wildlife species relative to site potential. This assumption is not met, however throughout most of the Refuge uplands because of excessive shrub cover in late succession stands. This means that, for vegetation types such as Wyoming big sagebrush, the number of species shown in the "Late" column actually are higher than what currently exists.

Mosaics of succession stages have the most breeding species in 12 of 18 vegetation types and the most feeding species in 16 of 18 vegetation types. Compared to late succession stages, mosaics average 10 more breeding species and 25 more feeding species. This pattern in species richness also was found by

Thomas et al. (1979a, 1979b), who suggested that species richness was related to: (1) the kind, amount, and variety of vegetation types; and (2) the degree of interspersion that exists among vegetation types and succession stages within vegetation types. Consequently, maximum species richness usually is associated with sites where a diversity of vegetation types occurs in combination with a diversity of succession stages within vegetation types (Thomas 1979a, 1979b). Summary implications to fire management consist of the following considerations (USFWS 1994):

(1) Fire is the primary force that historically influenced the condition of upland vegetation types, proportions of succession stages within upland vegetation types, and patterns of wildlife species richness of uplands of the Refuges (Kauffman 1990, USFWS 1994, Gruell 1995).
(2) Evaluation of existing habitat conditions discloses that species richness is far below potential because late succession stages dominate uplands of the Refuge and because of the predominance of poor-fair ecological condition within late succession stages (USFWS 1994).
(3) Prescribed burning and fire exclusion are the primary options available to Refuge managers for manipulation of habitat conditions (e.g., proportion of succession stages) and wildlife species richness in upland vegetation types of the desert shrub, shrub-grassland, montane shrub, and conifer forest biomes (USFWS 1994).
(4) Amount and pattern of prescribed fire can determine the type and magnitude of response of wildlife species richness within vegetation types and across the Refuge landscape. Magnitude of richness response is related directly to the extent by which prescribed fire influences the total Refuge landscape (USFWS 1994). Initially, influence will be limited to the vicinity of a few burned sites. Ultimately, however, richness will be influenced on a landscape scale as the acreage of different succession stages increasingly is equalized (USFWS 1994). Burn pattern is important because burned sites with low interspersion may result in diminishing returns because dominance of one succession stage is replaced by dominance of another succession stage, which maintains reduced species richness (Thomas 1979b, USFWS 1994).

The pattern of species richness differs between upland and wetland habitats. In wetland, maximum richness of breeding and feeding species usually is associated with occurrence of late or very late stages of progression characterized by high availability of water supplies and site dominance of native wetland vegetation. For example, richness averages 14 breeding species in early-mid stages, 19 in late stages, and 34 in very late stages in riparian wetlands where very late progression stages occur. Increased species richness associated with later stages of progression is attributed to increased biological productivity and habitat complexity in vegetation type comprised of woody-riparian shrubs and trees (Kovalchik 1987, Busse 1989, Schulz and Leninger 1990, Leonard et al. 1992) More species are accommodated in very late stages compared to early stages of progression (Hanley and Page 1981, Schulz and Leninger 1991, Dobkin 1994).

In riparian meadows, species richness is influenced by habitat structure and occurrence of free water. For example, richness in meadows is greatest in very late progression stages, despite the fact that early-mid stages comprised of sagebrush-grass are more structurally complex. Healthy dry and wet meadow communities apparently are more biologically productive based on increased amount and stability of water supply (Thomas et al. 1979c, Kovalchick 1987, Leonard et al. 1992). Species richness in lake basins differs from riparian areas. Late stages of progression average more breeding and feeding species compared to early stages in poverty weed-primrose and rush-spikerush-arnica. However, early, mid, and late stages of cattail-bulrush and pondweed tend to maintain higher levels of richness compared to the same stages in poverty-weed primrose and rush-spikerush-arnica. Differences among vegetation types are associated with differences in water (i.e., flooding) regimes and associated dominant vegetation (Cowardin et al. 1979).

Fire can play a critical role in the long-term maintenance of riparian habitat used by wildlife (Britton et al. 1980, Jones and DeByle 1985, Starkey 1985, Young 1986, USFWS 1994). Periodic fire is considered essential for long-term maintenance of the distribution and abundance of aspen in the Intermountain West (Schier 1975, Brown 1985, Kauffman 1990). Burning can result in differential short and long-term effects on species composition of wildlife communities. For example, birds such as vireos and sapsuckers depend mainly on tree trunks and canopies for feeding and breeding purposes (Erlich et al. 1988). These taxa are reduced in the short-term where decadent aspen is burned, trees are wind-thrown, and canopy area of aspen is reduced (DeByle 1985a, Erlich et al. 1988). Although the value of a burned site is temporarily diminished for vireos and sapsuckers (Erlich et al. 1988), the value of the site is increased for species like mule deer that bed and browse in young aspen (Leckenby et al. 1982), which increases after fire (Bartos et al. 1991). In the long-term however, habitat structure used by vireos and sapsuckers would increase and populations of vireos and sapsuckers could increase because fire stimulated development of a new aspen stand that had a greater number of trees, canopy area, and distributional extent compared with pre-treatment conditions (DeByle 1985a, DeByle 1985b).

In dry meadows, periodic burning may enhance forb growth and availability to herbivorous wildlife (Britton et al. 1980, DeBenedetti and Parsons 1984, Hargis and McCarthy 1986). Periodic burning of dry meadows may benefit pronghorn and sage grouse indirectly if availability of forbs is increased (Savage 1969, Yoakum 1982, Pyle et al. 1990). However, use of meadows by these species also is influenced by other factors including site geography, water availability, and hiding cover (Oakleaf 1971, Herrig 1974, Klebenow 1985). For example, sage grouse tend to use narrow meadows more than wide meadows because of increased area of meadow feeding habitat proximate to cover in adjacent uplands (Oakleaf 1971, Evans 1986).

Removal of above-ground vegetation in emergent wetlands causes a short-term reduction in herbaceous cover available to wildlife (Cornely et al. 1983, Kantrud 1990). Probability of impact would be reduced by burning during fall and winter when plants are dormant and wildlife breeding uses are minimal (Young 1986, USFWS 1994). Immediate impacts of burning meadows is unavoidable in the case of sites occupied by some species of sedentary small mammals (Cornely et al. 1983). This study also indicated that adverse effects on sedentary species can be minimized by maintenance of unburned patches, and that population size recovered and increased on burned sites the year after treatment.

Summary and implications of species richness modelling to fire management include the following considerations:

(1) Climate and fire were the primary forces that historically influenced the condition of wetland vegetation types, proportions of succession stages within wetland vegetation types, and patterns of wildlife species richness of wetlands of the Refuges (Kauffman 1990, USFWS 1994, Gruell 1995).

(2) In contrast to uplands, species richness is not maximized by maintenance of a mosaic of structural (i.e., progression) stages within vegetation type. Instead, richness is maximized in wetlands by maintenance of very late progression stages in riparian areas and maintenance of late progression stages in lake basins (USFWS 1994).

(3) Evaluation of current habitat conditions indicates that wetland habitats and species richness are in need of restoration to site potential (USFWS 1994).

(4) Prescribed burning, rest from livestock use, and water manipulations are the primary options available to Refuge managers for manipulation of habitat conditions (e.g., proportion of progression stages) and wildlife species richness in wetland vegetation types of the deciduous forest, riparian shrub, and interior marshland biomes (USFWS 1994).

(5) Burning may influence site progression, expedite recovery of ecological condition (i.e., advance of progression), and increase species richness in degraded riparian areas of the deciduous forest, riparian shrub, and interior marshland biomes (USFWS 1994, Refuge files). Since 1985, fire managers have demonstrated consistent success with prescribed burning in restoration of (a) wetland herbaceous cover in degraded alluvial floodplain sites on Sheldon NWR and Hart Mountain NAR and (b) degraded aspen and willow riparian sites in V-shaped canyons.

(6) The effects of burning on species richness in late and very late progression stages in meadow and lake basins has not been evaluated. If it is assumed that burning at five to ten year intervals increases short-term plant productivity (Britton et al. 1980), then species richness may exhibit a corresponding increase because requirements of wildlife are satisfied more consistently (Cornely et al. 1983, Young 1986). On the other hand, reduction in cover may initially reduce richness (i.e., small mammals) (Cornely et al. 1983).

Hart Mountain NAR

APPENDIX Q: STEP-UP PLAN

Staffing Class	Burning Index	Step-Up Action
SC-1	0-15	Normal tour of duty for fire crews. Open fires allowed on Refuges in campgrounds in fire pits only. Engine crews complete weekly engine checks. Engine crews begin daily in-service contacts to servicing dispatch offices.
SC-2	16-30	Same as SC-1. Engine crews begin daily engine checks.
SC-3	31-60	All fire suppression equipment maintained in a state of fire readiness. Fire crews are not to leave Refuges or be split during normal tours of duty unless FMO approves.
		FMO may override BI to SC-4 if significant human activity is anticipated. KBDI > 180 and LFM < 120% should also coincide with this decision.
		FMO may override BI to SC-4 without anticipation of significant human activity if KBDI >200 and LFM < 100.
		No open fires allowed and Refuge Manager will post signs. Visitors are required to carry shovels in all vehicles. To be enforced by Refuge LE Officers.
SC-4	61-78	Same as SC-3 with addition of:
		FMO may access emergency preparedness funds to extend staffing period of normal work day and week to cover burning period or forecasted lightning events where fire crew would normally be off shift.
		All redcarded Refuge employees will carry PPE and handtools in work vehicles.
		Fire crew may patrol Refuge campgrounds and
		major routes of visitor transportation.
		Aerial detection flights over Refuges should be incorporated into cooperator detection flights.
		Lists of issued Back Country Permits will be provided to FMO so that visitors in back country can be monitored in the event of a wildland fire.
		Refuge work projects involving heavy equipment such as road graders and/or welding at field sites will be monitored by Refuge Managers, and workers will take precautions against accidental ignitions. Fire crews with engines may be pre-positioned to mitigate accidental ignition hazard.
SC-5	79-114	All SC-4 actions as well as:
		Temporary closures may be imposed on sensitive areas of the Refuge at the discretion of the Refuge Manager.
		Cooperator engines may be pre-positioned on the Refuges if available.
		All redcarded employees may be required to work extended shifts and/or days off to augment initial attack forces during periods of forecasted lightning activity.
		The FMO may request that Refuge LE Officers patrol front country and back country areas to enforce open burning restrictions. These patrols may be extended beyond normal tours of duty and be paid for with preparedness funding.

Request for Cultural Resource Compliance

U.S. Fish and Wildlife Service, Region 1

Appendix Determination	Date rec'd by CRT:
____________________	____________________

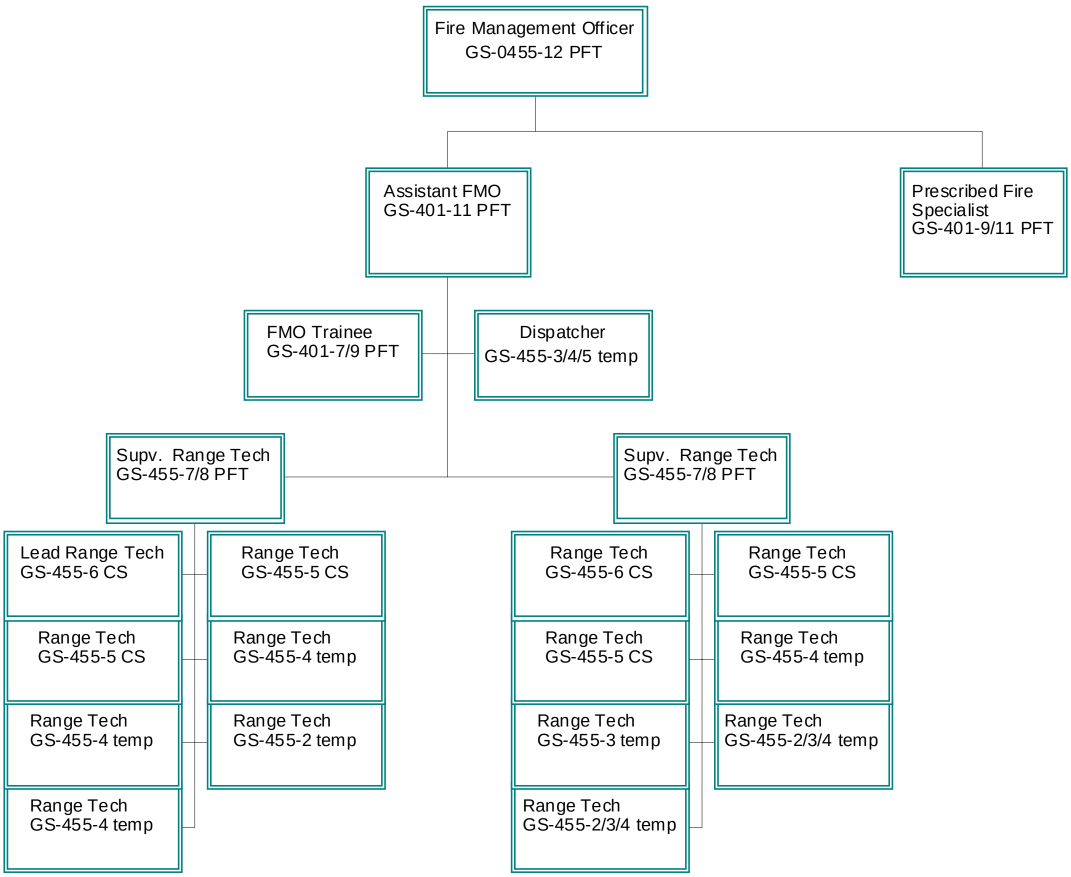
Project Name:					**Program:** (Partners, Refuges, JITW, WSECP, etc.)	
State: CA, ID, HI, NV, OR, WA		**EcoRegion:** CBE, IPE,KCE, NCE			**FWS Unit: Org Code:**	
Project Location:	**County**	**Township**	**Range**	**Section**	**FWS Contact:** Name, Tel#, Address	
USGS Quad:					**Date of Request:**	
Total project acres/linear ft/m:		**APE Acres / linear ft/m (if different)**			**Proposed Project Start Date:**	

MAPS Attached	**Check below**		
Copy of portion of USGS Quad with project area marked clearly **(required)**			Project (sketch) map showing Area of Potential Effect with locations of specific ground altering activities **(required)**
Photocopy of aerial photo showing location **(if available)**			Any other project plans, photographs, or drawings that may help CRT in making determination **(if available)**

Directions to Project: (if not obvious)	
Description of Undertaking:	Describe proposed project and means to facilitate (e.g., provide funds to revegetate 1 mile of riparian habitat, restore 250 acres of seasonal wetlands, and construct a 5-acre permanent pond). How is the project designed (e.g., install 2 miles of fence and create approximately 25' of 3' high check dam)?

Area of Potential Effects (APE):	Describe where disturbance of the ground will occur. What are the dimensions of the area to be disturbed? How deep will you excavate? How far apart are fenceposts? What method are you using to plant vegetation? Where will fill be obtained? Where will soil be dumped? What tools or equipment will be used? Are you replacing or repairing a structure? Will you be moving dirt in a relatively undisturbed area? Will the project reach below or beyond the limits of prior land disturbance? Differentiate between areas slated for earth movement vs. areas to be inundated only. Is the area to be inundated different from the area inundated today, in the recent past, or under natural conditions? Provide acres and/or linear ft/m for all elements of the project.
Environmental and Cultural Setting:	Briefly describe the environmental setting of the APE. **A)** What was the natural habitat prior to modifications, reclamation, agriculture, settlement? **B)** What is land-use history? When was it first settled, modified? How deep has it been cultivated, grazed, etc.? **C)** What is land use and habitat today? What natural agents (e.g., sedimentation, vegetation, inundation) or cultural agents (e.g., cultivation) might affect the ability to discover cultural resources? **D)** Do you (or does anybody else) know of cultural resources in or near the project area?

APPENDIX S: CURRENT ORGANIZATION CHART



MINIMUM REQUIREMENTS AND MINIMUM TOOL ANALYSIS
Fire Management Plan- Hart Mountain National Antelope Refuge

Minimum Requirements Analysis

In compliance with the Wilderness Act of 1964, the Service completed a wilderness study on Hart Mtn. NAR in 1967. Based on his review of the study, the Secretary of the Interior approved the Service proposal to recommend designation of two units, Poker Jim Ridge (17,464 acres) and Fort Warner (32,743 acres) as wilderness. The President sent the recommendation to Congress in 1969.

The Hart Mtn. proposal was introduced in legislation in 1969. Response was generally favorable but objections expressed at hearings and by letter caused it to be deleted from the bill. The Hart Mtn. proposal was introduced in Congress again in 1971, but continued opposition caused it to be deleted again.

The Service re-evaluated the proposal and withdrew the Fort Warner unit pending further study and acquisition of private in-holdings. A revised proposal was sent to Congress in 1972, reducing the size of the Poker Jim unit to 16,462 acres to delete a tract of private land. Congress has not considered either proposal since that time.

If the Service is to meet the purpose of the refuge by restoring and maintaining its habitat as a representative of the high-desert shrub-steppe ecosystem, it will be necessary to carry out fire management (prescribed fire and wildfire suppression) within the proposed wilderness. It is also the Service's policy that natural ecosystems and natural ecological processes are a wilderness value that should be restored or preserved in proposed or designated wilderness on refuges. Clearly, carrying out fire management within the proposed wilderness on Hart Mtn. NAR is the minimum requirement action because there are no less intrusive actions available that will accomplish the required ecosystem restoration within the proposed wilderness while providing the necessary safety and protection for structures and people both on and off the refuge.

Minimum Tool Analysis for Fire Management Projects in Proposed Wilderness

Alternative methods of fire management:

1. Wildland fire use for resource benefit.

Under a fire use for resource benefit program there would be no prescribed fire in the portions of the refuge that are proposed for wilderness, and all wildfires would be allowed to burn as long as they remained within the proposed wilderness boundary. This method would best protect the roadless character and solitude of the proposed wilderness on refuges.

This program would not provide for a systematic and active restoration of refuge plant and animal communities and would therefore not meet refuge purposes or management objectives. This program also has the potential to allow fire to burn the refuges plant communities in ways that create large scale or long-term damage to both plants and animals. Finally, this program has the potential to allow wild fires to get out of control with catastrophic results that could threaten structures and/or people either on the refuge or off. If catastrophic wild fires occurred, this policy would not meet the Service's legal and policy requirements to protect people and structures.

2. Restricted fire management.

Under the existing restricted fire management program the plant communities on the refuge are being gradually and systematically restored through an active prescribed fire program. Under this prescribed fire program, fire is introduced in a controlled manner that allows burning of a planned area under prescribed conditions to set back the ecological succession of the plant communities involved. Because of the heavy woody fuel that is often involved in the proposed wilderness areas, prescribed fire requires use of rubber-tired engines, a rubber-tired tractor with a brush-beater, and chain saws to effectively and safely prepare and control the fire boundaries and to maintain safe burning rates. This method would create a significant but temporary intrusion into the wilderness and would contribute to maintaining the existing primitive roads in their current condition but would not further detract from the wilderness character of the land.

Under the existing restricted fire management program, wildland fires are suppressed if they occur under weather and fuel moisture conditions that would allow them to get out of control, threaten structures or people either on the refuge or off, or burn in ways that create large scale or long-term damage to the plant communities involved. Fire suppression under these conditions normally requires use of air tankers with retardant, helicopters dumping retardant or water, rubber-tired engines operating both on and off the existing two-track roads, and crews creating fire lines with hand tools. This method would create a significant but temporary intrusion into the wilderness and would contribute to maintaining the existing primitive roads in their current condition but would not further detract from the wilderness character of the land.

Restricted fire management, as described above, is selected as the minimum tool that would effectively meet the refuge purposes and goals to restore and maintain healthy and natural plant and animal communities while meeting legal and policy requirements for safety and protection of structures and people both on and off the refuge.

Approved:

Michael L. Nunn, date

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