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COURSE 10: Ecology of Range and Wildlife Relationships

Review of Wildlife Relationships to Domestic Livestock Grazing in the Western United States with a Case Study Investigating the Impacts of Water Developments on Rangeland Habitat and Wildlife Populations

ATLANTIC INTERNATIONAL UNIVERSITY

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Introduction

Domestic livestock grazing represents the most widespread use of public lands in the western United States (Fleischner 1994; Saab and others 1995; Donahue 1999). However, unrestricted grazing of western public rangelands resulted in a number of serious resource issues that were publicly recognized well before the end of the 1800's (USDA 1895; USFS 1937; Bell 1973; Donahue 1999; Young and Sparks 2002; USFS 2004). Claims of damage to public natural resources by domestic livestock have resulted in confrontations between ranching, government, political, and conservation interests that have continued to the present day (Ferguson and Ferguson 1983; Pinchot 1998; Donahue 1999; Young and Sparks 2002; Dombeck and others 2003; USFS 2004).

Natural resource management is still considered to be a relatively young science (USFS 2004). Concerns relating to management of western public rangelands have resulted in a number of important developments, including the passing of policies such as the Taylor Grazing Act and the National Environmental Policy Act [NEPA], development of state and national rangeland standards, development of regional and local rangeland monitoring programs, development of professional range organizations, and the institution of local and regional cooperative management efforts (Baumer 1978; BLM 1996; BLM 1997a; BLM 1997b; BLM 1997c; NRCS 1997; BLM 2000; ICA 2000; BLM 2004).

Reflective of significant changes in public interest, rangeland management programs face the need to focus on much more than forage production. Issues that must now be addressed by western public land managers still include traditional grazing issues, but have expanded to include recreation, fire, historic preservation, noxious weeds, water quality and quantity, native plant communities, wildlife populations, and wildlife habitat issues (Noss and Cooperrider 1994; Saab and others 1995; BLM 1997a: Leonard and others 1997; NRCS 1997; Belsky and Gelbard 2000; ICA 2000; Pellant and others 2000; Rust and Coulter 2000; BLM 2001; Goodwin and others 2002; Dombeck and others 2003; Monson and others 2004; Arno and Fiedler 2005).

Domestic livestock grazing on rangelands of the western United States has resulted in a variety of recognized short- and long-term impacts to rangeland plant communities and to native wildlife populations (Bell 1973; Vallentine 1974; BLM 1997a: Leonard and others 1997; Belsky and Gelbard 2000; RWR 2000; Jones 2001; RWR 2003; Monson and others 2004). Similar impacts have also been attributed to free-ranging populations of feral livestock, including feral horses and burros in the desert Southwest and other western regions (BLM 1987a).

The potential for livestock grazing and management practices to impact wildlife populations and habitats forms the basis for ongoing public conservation concern around the western United States, and represents the focus of this paper. The relationship of native wildlife populations and natural habitats to domestic livestock and grazing-related activities such as range improvements (e.g. fencing, water developments) will be explored in further detail in the report sections and Case Study below.

General Analysis

The long-term introduction and maintenance of non-native ungulates (domestic livestock) on the rangelands of the western United States has not only required a number of important administrative and political changes over time, but has also resulted in increasing requests by the American public for more responsible management of native wildlife populations and their habitats. In what represents a rather dramatic change from a historical emphasis on forage production, the Utah State Office of the Bureau of Land Management (1997c) notes:

> It is time for a change, and BLM is changing to meet the challenge. BLM is now giving management priority to maintaining functioning ecosystems. This simply means that the needs of the land and its living and nonliving components (soil, air, water, flora and fauna) are to be considered first. Only when ecosystems are functioning properly can the consumptive, economic, political, and spiritual needs of man be attained in a sustainable way.

Field research by agency and university specialists has determined that livestock grazing has the potential to influence native plant communities or habitats and native wildlife populations (e.g. birds, big game) in a variety of ways. While there may be public benefits from domestic livestock grazing such as a reduction in fine fuels during fire season, most public concern relates to the potential for domestic livestock grazing to

result in adverse impacts such as accelerated erosion or competition with desirable native species like bighorn sheep, deer, and elk (Lauer and Peek 1976; Chaney and others 1991; Beck and Peek 2001). As was noted in the introduction above, populations of feral livestock such as horses and burros that graze in free-ranging herds create similar impacts to those of domestic livestock (BLM 1987a).

Public concern relating to domestic livestock grazing on native rangelands can be divided into three major categories: 1) competition (e.g. forage resources, water, cover); 2) displacement or exposure (e.g. disturbance during critical periods such as nesting or fawning, increased exposure to predation) and 3) range improvements (e.g. impacts relating to introduced structures such as fences or water developments). The following subsections will examine each of these broad categories in greater detail.

Competition

Brewer (1994, p. 754) defines competition as "a combined demand in excess of the immediate supply." Raven and Johnson (1991, p. G5) further define competition as "interaction between individuals of two or more species for the same scarce resources." Raven and Johnson (1991, p. G5) also define intraspecific competition is the "interaction for the same scarce resources between individuals of a single species." Competitive exclusion occurs when two different species compete for the same resource until more efficient use of a shared resource by one species results in the localized extirpation or competitive exclusion of the other (Raven and Johnson 1991; Brewer 1994).

Domestic livestock are herbivores, animals that consume plants or parts of plants just like many other vertebrate and invertebrate species (Raven and Johnson 1991; Brewer 1994). Cattle, sheep, and other domestic livestock (e.g. horses, burros, mules, and goats) are routinely grazed on rangelands of the western United States and must compete with native herbivores such as deer, elk, Sage Grouse, voles, Mormon crickets, Great Basin wood-nymphs, and pygmy rabbits for available herbaceous resources (Lauer and Peek 1976; Kuck 1984; Call and Maser 1985; Marks and Sands 1988; Rosentreter and Jorgensen 1986; Thomas 1987; Brewer 1994; IDFG 1997; Beck and Peek 2001; Pyle 2002; RWR 2002; Shepherd and others 2003).

Native herbivory is arbitrated through a variety of control factors, including but not limited to species-specific niche and resource partitioning (Lauer and Peek 1976; Kuck 1984; Cooperrider and others 1986; Raven and Johnson 1991; Brewer 1994). This allows for natural biodiversity of plant and animal populations within the same or different habitat types, as well as at a variety of spatial scales (Cooperrider and others 1986; Raven and Johnson 1991; Brewer 1994). When additional species, such as domestic livestock, are introduced into habitat types where they do not otherwise naturally occur, relationships between wildlife populations and plant communities can be significantly disrupted.

In addition to potentially impacting the niche and resource partitioning that existed previously between extant wildlife populations, the introduction of livestock may increase competition for scarce resources within individuals of the same species. While the competition represented by domestic livestock may affect many ecosystem components or functions, the relationship most likely to be considered by western

rangeland managers is that of forage competition with big game populations such as antelope, big-horned sheep, deer, elk, and moose (Lauer and Peek 1976; Cooperrider and others 1986; Rosentreter and Jorgensen 1986; BLM 1987; Thomas 1987; Marks and Sands 1988; Taylor and others 1988; Beck and Peek 2001).

As a result, allocations of forage and the calculations inherent to determining carrying capacity (e.g. AUM's available) are generally utilized to determine how much forage is available for domestic livestock, and at least in most instances is followed by a determination of some amount that will be left for other large ungulates such as deer and elk under proposed management plans (Lauer and Peek 1976; Cooperrider and others 1986; Rosentreter and Jorgensen 1986; BLM 1987; Thomas 1987; Marks and Sands 1988; Taylor and others 1998; Beck and Peek 2001).

Although rarely considered in forage calculations by rangeland resource managers, many game and nongame species represent major components of an ecosystem, with each potentially fulfilling one or more critical roles (e.g. nutrient cycling, pollination, seed dispersal, prey resources, natural insect or pest control) and in turn are also exerting competitive forces on limited forage and other resources such as free water and hiding cover. While most management paradigms tend to favor more visible wildlife such as big game, many other species (e.g. nematodes, voles, Monarch Butterflies, bats, birds of prey, harvest mice) are all vital components within their respective ecosystems.

Competitive exclusion of one or more game or non-game species through the grazing of domestic livestock has the potential to impoverish or otherwise seriously impact the biodiversity and functioning of many different types of native western ecosystems (Lauer and Peak 1976; Cooperrider and others 1986; Chaney and others

1991; Fleischner 1994; Leonard and others 1997; Jones 2001; Pyle 2002; Shepherd and others 2003; Monson and others 2004; WOC 2006).

Displacement and Exposure to Predation

A variety of research efforts have been undertaken to determine if the physical presence of livestock, the impacts of livestock grazing, and related vegetation management practices are negatively impacting native birds and other wildlife populations (Lauer and Peek 1976; Marks and Sands 1988; Klott and others 1993; Frisina and Mariani 1995; Saab and others 1995; DeChant and others 1999; Bombay and others 2000; Goguen and Mathews 2000; Kotliar and others 2002; Sauder 2002; Welch 2002; Wuerthner 2002; Knick and others 2003; Carlisle and others 2004; Earnst and others 2004; Trost 2004, personal communications, unreferenced; WOC 2006).

The referenced research and studies above and many other projects carried out around the western United States have produced varied results. Some studies conclude that the grazing of domestic livestock results in direct impacts to wildlife populations such as avoidance of areas occupied by livestock, or in a reductions in nesting success by riparian birds; while other studies conclude that little if any impact occurs to wildlife populations such as songbirds or waterfowl as a result of domestic livestock grazing.

Based on the review of multiple studies and their various conclusions for this report effort, it appears that direct or indirect impacts to wildlife populations as a result of domestic livestock presence and/or grazing are most likely to relate to site- or region-specific conditions (e.g. drought, conversion to agricultural or residential uses) as well as

to compounding factors (e.g. grazing within habitats already highly fragmented by roads or that have been previously logged or burned). This conclusion does not diminish the potential for livestock grazing and/or the presence of domestic livestock to impact wildlife populations. It does mean that the scientific investigation of livestock effects on wildlife populations must be carefully identified and must be correlated with an investigation of existing habitat conditions and disturbance regimes.

Existing literature does reveal a variety of situations in which the grazing of domestic livestock may displace or exclude the presence of one or more species of wildlife, or may lead to enhanced levels of predation or nest parasitism for native species. Livestock grazing may also limit or change population distribution and ecosystem biodiversity. For example, Lauer and Peek (1976) and Marks and Sands (1988) report that the presence of domestic livestock (e.g. cattle, sheep, burros) may result in avoidance of some habitats by big horned sheep, in addition to observed competitive use of forage resources by livestock and big game.

Avian species can be adversely impacted through the presence or grazing of domestic livestock. For example, Bombay and others (2000) note that early turnout of livestock correlates strongly with enhanced levels of nest parasitism by Brown-headed Cowbirds, including for threatened species like the Willow Flycatcher. Avian hosts such as Willow Flycatcher will raise Brown-headed Cowbird young in place of their own, impacting population persistence and viability over time (Bombay and others 2000). Ground-nesting and shrub-nesting birds are not only more exposed to nest parasitism through removal of forage by livestock, but may also be exposed to higher levels of nest

or individual predation through loss of reproductive cover (Saab and others 1995; Bombay and others 2000).

Other birds such as Sage Grouse can be displaced from lekking grounds or displaced from nesting and brood rearing sites by domestic livestock as well as through poor livestock management practices or improper range improvements (Call and Maser 1985; FEIS 2006). For example, fences installed close to lekking or nesting areas may result in increased predation; birds of prey tend to utilize the posts for observation perches, potentially resulting in abandonment of preferred habitats and/or in declines to local populations (Call and Maser 1985; IDFG 1997b; Connelly and others 2000; FEIS 2006).

In addition to the capacity to adversely impact vertebrate species, domestic livestock grazing and supporting management actions (e.g. prescribed fire, exotic seedings and other vegetation treatments) also have the inherent capacity to eliminate or displace invertebrate species vital to proper ecosystem functioning. Impacts can be especially evident in relation to native pollinators such as ground nesting bees, butterflies, and other Lepidoptera (Pyle 2002; Shepherd and others 2003).

Livestock-related trampling of ground-nesting bees and removal of plant biomass that contains the eggs and larva of Lepidoptera can result in a loss of native biodiversity, as well as a loss of ecosystem services such as pollination through localized extirpation of native pollinators (Pyle 2002; Shepherd and others 2003). Pyle (2002, p. 24, 25) notes:

> Most lepidopterists I know agree that the single greatest impact on butterfly habitats in the intermountain West comes from overgrazing by

> cattle and sheep…Sadly, though, as willingness has grown to conserve butterflies, so has the need…While it is extremely difficult to make a dent in most mobile insect populations with a net, the bulldozer, the cow, and the plow eradicate whole butterfly colonies in no time…

Livestock-related impacts that have the capacity to displace, expose, or otherwise physically exclude wildlife populations can also be significant for many other species of vertebrate and invertebrate wildlife and their respective habitats; ranging from ants and fish to reptiles, bats, and birds of prey (IDFG 2000, personal communications unreferenced; Welch 2002; RWR 2002; DeChant and others 2003; Hayes and Holl 2003; Kimball and Schiffman 2003; Knick and others 2003; RWR 2004, field observations, unreferenced; Sayre 2004; Peterson 2005, personal communications, unreferenced; RWR 2006, field observations, unreferenced).

Range Improvements

Range improvements most typically represent some type of human action (e.g. prescribed fire, exotic seeding) or the construction or installation of structures (e.g. fencing, water developments) within a rangeland setting for the convenience and/or enhancement of domestic livestock grazing (Bell 1973; Vallentine 1974; TWS 1980; BLM 1987c; VREW 1989; BLM 1990; Sanderson and others 1990; RWR 2004; USFWS 2005). Such projects are generally intended to increase the carrying capacity of an allotment and/or to aid in the geographical distribution of livestock (Bell 1973; Vallentine

1974; TWS 1980; BLM 1987c; VREW 1989; BLM 1990; Sanderson and others 1990; RWR 2004).

In more limited instances, range improvements such as water developments may be carried out to enhance population numbers and/or distribution of game or nongame wildlife (Bell 1973; Wilson 1977; Wildlife Society 1980; McCarty 1986; Rice 1992; Associated Press 2001; UDWR 2001; Olson 2002; Krausman and Marshall 2006). Although in some instances such wildlife projects may be proposed for management of sensitive or otherwise threatened species, range improvement projects such as water developments for wildlife are most often geared towards increasing desirable game animals (e.g. deer, antelope, big-horned sheep) and introduced game birds (e.g. Ring-necked Pheasant, Gray Partridge) to provide for increased reproductive success and in increased opportunities for hunter harvest (Associated Press 2001; UDWR 2001; NDOW 2002; RWR 2004).

Fences are one of the most ubiquitous range improvement projects, and are most often constructed to control the movements of domestic livestock, such as exclusion from sensitive resources (e.g. seeps or springs) or as a means to help control season and duration of use within pastures and allotments (Bell 1973; Vallentine 1974; NRCS 1997). Fencing may also be initiated in rangeland or other settings to prevent wildlife from entering or crossing dangerous locations such as toxic impoundments or freeways, or to exclude wildlife such as deer and elk from homes, gardens, crops, and orchards (MDNR 1999; O'Gara 2004; USFWS 2005; CDOW 2005).

Of all potential range improvement structures, fencing carries the greatest potential to impact wildlife distribution and seasonal movements, and has been observed

to result in increased levels of predation due to the use of posts as observational perches by birds of prey (Lauer and Peek 1976; MDNR 1999; Connelly and others 2000; O'Gara 2004; RWR 2005, field observations unreferenced; USFWS 2005; Taylor 2006, personal communications, unreferenced). Rangeland and other fencing is also a frequent source of direct injury or death to wildlife, including but not limited to game birds, songbirds, birds of prey, and big game (Call and Maser 1985; MDNR 1999; Connelly and others 2000: O'Gara 2004; Randall 2001, personal communications, unreferenced; RWR 2004, field observations, unreferenced; Wright 2004, personal communications, unreferenced; USFWS 2005; CDOW 2005; RWR 2006, field observations, unreferenced).

Diverse wildlife populations require diverse habitat characteristics (Brewer 1994). General rangeland improvement projects for livestock such as prescribed burning and exotic seedings (e.g. crested wheatgrass) may enhance forage production for livestock, but also have the potential to displace or eliminate wildlife from traditional habitats and/or to expose wildlife to increased predation, nest predation, and nest parasitism (Saab and others 1995; GEAS 1997; Bombay and others 2000; PIF 2000; Welch 2002; Ritter and Paige 2003). Many species, particularly birds, may be temporarily or permanently displaced or otherwise excluded from monocultures created by seeding non-native plants such as crested wheatgrass over large areas (Saab and others 1995; Call and Maser 1985; Paige and Ritter 1999; Connelly and others 2000; PIF 2000; Ritter and Paige 2000).

In some instances, limited numbers of wildlife or wildlife species may benefit from short- or long-term range improvement projects. For example, woodpecker populations tend to increase following natural or prescribed fires in woodland or forested habitats (Conner and others 1994; IDFG 1997a; PIF 2000; Imbeau and Desrochers 2002).

However, a significant loss of coniferous or deciduous tree and associated understory cover will in turn limit or exclude the successful presence of many other species of birds on a short- and/or long-term basis, including but not limited to Blue Grouse, Ruffed Grouse, Mountain Chickadee, Pinyon Jay, Northern Goshawk, Northern Pygmy Owl, and others (Saab and others 1995; GEAS 1997; PIF 2000; RWR 2002-2006, field observations, unreferenced).

The loss of big sagebrush and other shrub species through prescribed burning or herbicide applications intended to increase grassland production for domestic livestock may lead to an increase in the breeding presence of grassland birds or birds of open areas such as Horned Lark, Grasshopper Sparrow, and Long-billed Curlew (Welch 2002; RWR 2005, 2006, field observations, unreferenced). Loss of shrubs or desirable shrub densities may also result in the localized extirpation or loss of sagebrush or shrub steppe breeding species such as Brewer's Sparrow, Sage Sparrow, Sage Thrasher, Bushtit, and Gray Flycatcher (Welch 2002; RWR 2005, 2006, field observations, unreferenced).

Water developments have been used across the western United States as a means to increase stocking rates for domestic livestock beyond what surface waters are capable of supporting, as well as a method of increasing livestock distribution (Bell 1973; Vallentine 1974; Sherrets 1989; RWR 2004). As noted above, water developments have also been utilized on a more limited basis to assist in the reproduction and distribution of both game and nongame wildlife (Wilson 1977; Rice 1992; Wildlife Society 1980: McCarty 1986; Bell 1973; BLM 1998; Associated Press 2001; UDWR 2001; Olson 2002; Krausman and Marshall 2006).

Vallentine (1974) provides the following notes of caution in relation to rangeland improvements such as water developments

- Stocking rates cannot be evaluated only in terms of forage since it must be accompanied by adequate drinking water for grazing animals.

- Stockwater problems arise on the range when: 1) there are too few watering places; 2) the water yield or storage, or both, is inadequate; 3) water sources are poorly distributed; 4) water developments are wasteful because of leakage or high evaporation; and 5) there are erosion problems at present facilities.

- Ranchers and other range managers must carry out year-to-year programs of developing and maintaining water supplies…the planning of range water developments must include provisions for future maintenance.

- When water is short, ranchers may be forced to move their stock from the range before the forage is fully grazed. Even more common is a heavy concentration of animals at remaining water sources after the less dependable springs and reservoirs dry out. Care must be taken that additional water developments are not used to crowd more livestock onto a fully stocked range.

The pros and cons of water developments, particularly associated with those facilities intended specifically for use by domestic livestock, have fueled controversy among livestock and wildlife managers and members of the public at large for decades (Sherrets 1989; Taylor 2004, personal communications, unreferenced; RWR 2004; Tuttle 2005, personal communications, unreferenced). Water developments have been blamed for concentrating livestock impacts within sensitive wildlife habitats, as well as for the accidental and largely avoidable drownings of literally millions of individual wildlife across the western United States (Bell 1973; Taylor 2004, personal communications, unreferenced; RWR 2004; Tuttle 2005, personal communications, unreferenced).

The Case Study below more fully introduces the background, uses, impacts, and threats associated with water developments on western rangelands in relation to wildlife and wildlife habitats. The Case Study will also introduce and discuss potential mitigation and management actions that can lead to improved safety for wildlife in relation to water developments constructed for domestic livestock grazing purposes.

Case Study:
Impacts of Water Developments on Rangeland Habitat and Wildlife Populations

Introduction

Within our arid western ecosystems the presence or lack of free surface water may govern the ability of wildlife species to utilize a geographic location. Many game and non-game wildlife species must have access to free water during part or all of their

annual biological life cycles. While some efforts have been made within the western United States to develop and provide water sources or water systems specifically for wildlife, most water development projects on western rangelands are specifically designed for providing water to domestic livestock.

Water development proposals on federal public lands frequently include statements indicating that a major factor for authorizing the water development is to provide benefits for wildlife. While some benefits may occur to resident or migratory wildlife species through the construction of particular types of water developments, some types of livestock water developments pose a drowning hazard to resident and migratory wildlife (Wilson 1977; McCarty 1986; Sherrets 1989; RWR 2004). Water developments may also result in concentrated livestock presence or in grazing-related impacts to natural resource values such as rare plant populations (Bell 1973; RWR 2004).

As livestock grazing is the most widespread human activity occurring on our public lands today, it thus receives the lion's share of public concern and requests for accountability. There is increasing public concern that the overall ecological costs of livestock grazing, including impacts relating to range improvements such as water developments, may not justify the grazing of domestic livestock and range improvement projects within all rangeland habitat types (Bell 1973; Baumer 1978; Fleischner 1994; Vavra and others 1994; Donahue 1999; Jones 2001; RWR 2004).

Water and the Arid West

Much of the western United States is classified as "desert." A desert is characterized by low or erratic precipitation levels and by highly variable temperatures.

Western deserts extend from "southeastern Oregon and southern Idaho through Nevada and Utah, except at higher elevations, continuing south through southern California and Arizona, and eastward through central and southern New Mexico" (Jones 1986).

Deserts exhibit a variety of habitat types, from the relatively homogenous stands of sagebrush in the Great Basin Desert to the highly diverse and structurally rich vegetation observed in the Sonoran Desert. Habitat diversity, with an attendant disparity in species diversity, exists largely due to precipitation patterns and temperature regimes (Jones 1986). The structural simplicity of the Great Basin Desert is representative of a short growing season, low precipitation, and varied precipitation patterns. Approximately 60% of the precipitation in the Great Basin Desert falls as snow (Jones 1986).

The Sonoran Desert and other southern deserts often exhibit a much greater floral and faunal diversity due to the extended and often year-round growing season. These deserts experience biannual precipitation patterns- with most of the annual precipitation arriving as rain (Jones 1986). Although the Great Basin Desert region supports fewer wildlife species overall than the warmer southern deserts, certain groups of wildlife species (large native ungulates in particular) are more numerous in northern desert habitats. The colder climate's influence is also expressed through shorter growing seasons and a reduced diversity and availability of insect prey. This is further reflected through less diversity in cold desert passerines (small birds), small mammals, reptiles, and amphibians.

As noted by Jones (1986), desert habitats possess some of the most unusual wildlife in North America. Many of these species are adapted physiologically or

morphologically to survive under extreme environmental conditions- including low or infrequent levels of precipitation and highly variable temperatures. A number of small mammals and reptiles require no obvious free water and have the ability to create their own metabolic "water" from forage or prey consumed.

Some species survive through a variety of conservation strategies such as nocturnal or crepuscular behavior. Some species, such as birds and bats, may be able to travel long distances to obtain water required for drinking or bathing purposes. For example, Townsend's Big-eared Bats (*Corynorhinus townsendii*) have been observed foraging in pinyon-juniper habitats in northeastern Nevada up to 25 miles from known water sources (Bradley 1999) and up to 40 miles in other areas (Taylor 2005, personal communications, unreferenced).

Other wildlife species, including cold desert or Great Basin Desert wildlife, require access to free water. For many species, reliable free water is a critical factor for survival and for reproductive success. Many species, without the presence of free water, would be severely limited in range or distribution, would have limited reproductive success (if any), or would simply be unable to exist within a particular geographic area. For example, ungulate species such as the Pronghorn require free, permanent water sources located at less than 5-mile (8-km) intervals (Jones 1986).

Desert riparian habitats (riparian habitats are those areas where vegetation is influenced by the presence of water) and any associated aquatic desert habitats are invaluable to many species of wildlife. The microhabitats represented by small lotic (stream) and lentic (lake, pond, wetland, or seep) waters are mandatory components in the life cycles of *all* amphibians; are required by many reptiles; and may be critical for

riparian obligate or dependent birds and mammals (Chaney and others 1991; Jones 1986; Ohmart and Anderson 1986). While invertebrates are rarely considered by land managers or the public at large, habitats associated with water in the desert are also critical to many obligate or dependent species of insects- that in turn help to ensure the survival of other floral or faunal species.

Permanent running waters (lotic systems) support aquatic wildlife including insects, fish, amphibians, and some reptiles (Jones 1986). Aquatic species rely on the running water to provide for basic physiological functions such as thermoregulation, water balance, escape cover, and for food sources (Jones 1986; Ohmart and Anderson 2006). Lotic systems also provide food resources (prey) for many other wildlife species such as raptors and other predators, browse and forage for herbivores, insects for insectivorous wildlife, and provides drinking water for a wide variety of terrestrial species (Jones 1986).

Permanent standing (lentic) water systems are very important to a wide variety of desert wildlife. Certain species of lentic fish, such as pupfish, can only survive within the habitats provided by cienagas, springs, bogs, or potholes (Jones 1986). Amphibians are totally dependent upon lentic desert waters in the absence of lotic systems. Amphibians and other species may rely upon lentic habitats for one or more of the following needs: reproduction, food, escape cover, and for physiologic processes- such as thermoregulation, water regulation, and developmental stages of young (including the eggs and tadpoles of frogs and toads) (Jones 1986). As with lotic systems, lentic systems also supply food resources (prey) for other wildlife species such as raptors and other

predators, browse and forage for herbivores, insects for insectivorous wildlife, and similarly provides drinking water for a wide variety of terrestrial species (Jones 1986).

Temporary lentic waters are also very important for wildlife species, and are common throughout U.S. deserts following summer precipitation events (Jones 1986). Water may pool above clay soils that are relatively impervious, may be found in rock depressions, or may be found as temporary ponds among the boulders of canyons and washes (Jones 1986). Although these waters may exist only briefly they are important to insects, amphibians (such as toads and salamanders), reptiles, waterfowl and other birds, and even to larger wildlife such as big-horned sheep (Jones 1986). These temporary water sources can become especially important during hot summer months.

The importance of riparian systems (those areas with vegetation influenced by the presence of water) is further illustrated by the following information condensed from Jones (1986):

- Riparian ecosystems provide three main components for large ungulates (big game such as deer, elk)- food, water, and cover.

- Many medium-sized mammal species are either obligate or facultative users of riparian systems at all elevations.

- Riparian sites tend to have greater species richness and total biomass of small mammals than upland sites.

- Reptiles or amphibians may provide up to 99% of the total predator biomass in some streams.

Additional points to consider regarding the importance of riparian zones include:

- Riparian habitat provides for the needs of more species of birds than all other western rangeland vegetation types combined (Chaney and others 1991).

- Riparian habitat provides both game and nongame wildlife with water, food, hiding cover, shelter, and protected pathways to adjacent habitat (Ohmart and Anderson 1986).

- Riparian zones are important as migratory routes for many species of waterfowl and other migratory species (Chaney and others 1991; Ohmart and Anderson 1986).

Water Developments for Livestock

Water developments have been constructed throughout the western United States since the early 1800's in order to provide for the watering needs of domestic livestock. Unlike many species of wildlife adapted to arid climates, domestic livestock require relatively large amounts of free water on a daily basis (Valentine 1974). Water developments have been utilized to provide free (surface) water to domestic livestock as

well as to assist in controlling or managing livestock use of rangelands (Bell 1973; Vallentine 1974; Wilson 1977; McCarty 1986; Sherrets 1989; RWR 2003).

Recommendations by the Forest Service have been to allow from 12-15 gallons per day for horses and cattle, and approximately 1 to 1.5 gallons per day for ewe-lamb pairs (Vallentine 1974). These daily water requirements will decrease when succulent green forage is available. Increases in daily water intake by domestic livestock occur with high temperatures, low humidity, when forage is dry, and when forage contains high levels of either salt or protein (Vallentine 1974).

Water serves as a nutrient, as well as providing a medium for metabolic functions (Vallentine 1974). Water is an important tissue constituent for livestock just as for other living organisms, and plays a role in waste disposal (Vallentine 1974). Research has determined that if water intake is limited, livestock weight gains will be impaired (Bell 1973; Valentine 1974; NRCS 1997). Under continued or severe water limitations impaired weight gain can remain permanent, even if livestock are later moved to rangelands or pastures with more favorable conditions (Vallentine 1974). Infrequent watering of cattle as well as sheep can also result in plant poisonings and other health risks.

The need to provide daily or frequent water sources of sufficient amount to meet the needs of concentrated numbers of livestock (as well as attempts to utilize widely scattered forage values) has led to the practice of constructing water developments within arid landscapes. Water developments for domestic livestock employ a wide range of designs, from simple earthen reservoirs and dugouts to the elaborate pumping of water through miles of pipelines to distant troughs. Existing natural surface waters can be

captured, diverted, or dammed, while subsurface waters may be made available through excavation or the drilling of wells.

Vallentine (1974) suggests that at least one water development facility is needed for every 50-60 animal units throughout a full growing season of use. Vallentine also notes that cattle should not be expected to travel more than one-quarter to one-half mile from forage to water in steep rough country, or more than one mile on level or gently rolling range. Forced restrictions of daily water intake by livestock on the range can result in sharply reduced milk production of lactating mothers, reduced weight gains in both weaned and unweaned young, and may contribute to or even cause death of both cattle and sheep (Vallentine 1974).

Water Developments for Wildlife

Although native wildlife such as antelope, deer, and some species of birds require frequent access to free water, wildlife in general are more efficient than domestic livestock at utilizing minimal water resources such as seeps and springs, intermittent creek flows, and temporary pools or constructed catchments (e.g. guzzlers) (BLM 1987a; Rice 1992; RWR 2003; Krausman and Marshall 2996). In addition, native ungulates and other wildlife species are adapted to western rangeland types, and instinctively carry out migration and foraging strategies in relation to the seasonal availability and palatability of native plant species as well as water resources (Lauer and Peek 1976; Ackerman and others 1984; Thomas 2000).

Natural selection over time has resulted in the survival of those western wildlife species and population densities that are best adapted to arid or semi-arid conditions,

including highly variable precipitation and temperature regimes (Jones 1986). However, efforts to provide water to wildlife may become necessary if natural waters have been captured or removed through human development or activity (e.g. mining, road construction, urban development, logging, agricultural diversion, livestock water developments).

The distribution of desirable wildlife, including introduced game species, can also tended into habitats that were formerly marginal or unsuitable for species requiring frequent access to water through the development of artificial water sources. Such efforts are usually initiated to enhance or expand the distribution of native or introduced game species (such as antelope, quail, or Chukar), to provide for increased hunter harvest, and for ensuring greater success during species re-introductions, such as for bighorn sheep (BLM 1987a; Rice 1992; Olson 2001; UDWR 2003). Water developments constructed specifically for wildlife may range from small portable containers to wells, ponds, and temporary or permanent catchment systems such as guzzlers (TWS 1980; BLM 1987a; VREW 1989; Rice 1992; Olson 2001; RWR 2003; UDWR 2003).

As of July 1999, it was estimated that at least 5,859 water developments had been constructed specifically for wildlife in 11 western states (Rosenstock, Ballard, and deVos 1999). Although the presence of guzzlers, drinking boxes, or protected ponds and reservoirs may result in some benefits to incidental non-game species (ranging from amphibians and reptiles to rabbits and passerines) the overriding purpose for wildlife water developments has been to increase native or exotic/introduced game species for increased hunter harvest. As a result, wildlife water development proposals have come under increased public scrutiny in recent years (SUWA 2003).

Impacts to Wildlife Habitat

Installation of water developments and concentrated use of these sites by domestic livestock can result in highly localized habitat impacts, including but not limited to impacts to natural hydrologic functions, soils, and to native plant communities (Bell 1973; Vallentine 1974; RWR 2004). Water developments can also lead to generalized impacts within immediate wildlife habitat, such as reductions in cover, reductions in palatable forage, and the introduction and maintenance of weedy species tolerant of high disturbance (Fleischner 1994; Belsky and Gelbard 2000; Jones 2001; RWR 2003; RWR 2004). Depending on the annual levels of disturbance, grazing of native vegetation may exert a profound influence on the presence and reproductive viability of many wildlife species (Cooperrider and others 1986; Fleischner 1994; Jones 2001; RWR 2003).

Water developments typically involve some sort of physical diversion, capture, or storage of natural surface or ground waters, and may disrupt or alter over-surface flows and natural watershed drainage or discharge functions (Vallentine 1974; TWS 1980; Rice 1992; RWR 2003). Water developments are also typically involve disturbance of vegetation and soils, ecosystem components that are closely associated with functions of the hydrologic cycle. Grazing management standards and guidelines have been developed in recognition of the potential for water developments to impact hydrologic functions.

A sampling of BLM Standards and Guidelines from a number of western states provides the following management direction:

- The development of springs, seeps, or other projects affecting water and associated resources shall be designed to protect the ecological functions, wildlife habitat, and significant cultural historical, archeological, and paleontological values associated with the water source. (Idaho BLM 1997a, Guidelines for Livestock Grazing Management, Guideline #6)

- The development of springs and seeps or other projects affecting water and associated resources shall be designed to protect the ecological functions, processes, and native species of those sites. (Montana BLM 1997b, Butte and Lewistown District Guideline #6, Miles City District Guideline #7, Dakotas Guideline #6)

- Locate permanent facilities (e.g. corrals, water developments) away from riparian-wetland areas. (Montana BLM 1997b, Butte and Lewistown District Guideline #7, Miles City District Guideline #8, Dakotas Guideline #7)

- Any spring or seep developments will be designed and constructed to protect ecological process and functions and improve livestock, wild horse and wildlife distribution. (Utah BLM 1997c, Guidelines for Grazing Management #2)

Vallentine (1974) notes that livestock water developments should be located on well-drained, non-erosive sites in order to avoid unnecessary habitat impacts. Bell (1973)

makes the following recommendations to help avoid soil erosion and related habitat impacts:

> Misplaced or too widely spaced water locations cause undesirable grazing patterns. If animals have too far to travel between water and suitable grazing areas, the pattern of use is that of grazing out and trailing back. As this continues, trails become longer and deeper, making bigger and better water channels to carry rainfall off the range and inducing erosion.

Examples within BLM Standards and Guidelines from Idaho, Utah, and Montana include the following management directives or guidelines regarding soils or soil health:

- Watersheds provide for the proper infiltration, retention, and release of water appropriate to soil type, vegetation, climate, and landform. Indicators may include: 1) The amount and distribution of ground cover, including litter, for identified ecological site(s) or soil-plant associations are appropriate for site stability; 2) Evidence of accelerated erosion…physical soil crusts/surface sealing, and compaction layers below the soil surface is minimal for soil type (Idaho BLM 1997, Standards for Rangeland Health, Standard #1).

- Apply grazing management practices to maintain, promote, or progress toward appropriate stream channel and streambank morphology and functions. Adverse impacts due to livestock grazing will be addressed

(Idaho BLM 1997a, Guidelines for Livestock Grazing Management, Guideline #7).

- Apply grazing management practices that maintain or promote the interaction of the hydrologic cycle, nutrient cycle, and energy flow that will support the appropriate types and amounts of soil organisms, plants, and animals appropriate to soil type, climate, and landform (Idaho BLM 1997a, Guidelines for Livestock Grazing Management, Guideline #8).

- The development of springs and seeps or other projects affecting water and associated resources shall be designed to protect the ecological functions, processes, and native species of those sites (Montana BLM 1997b, Butte and Lewistown District Guideline #6, Miles City District Guideline #7, Dakotas Guideline #6).

- Grazing management practices will be implemented that: b) Promote attainment or maintenance of proper functioning condition riparian/wetland areas, appropriate stream channel morphology, desired soil permeability and infiltration, and appropriate soil conditions and kinds and amounts of plants and animals to support the hydrologic cycle, nutrient cycle, and energy flow (Utah BLM 1997c, Guidelines for Grazing Management #1).

A major public concern in relation to any activities associated with the grazing of domestic livestock is the potential for serious impact to native plant communities, including rare plant populations (Fleischner 1994; Belsky and Gelbard 2000; Jones 2001; RWR 2003; RWR 2004). The very nature of livestock grazing will result in consumption (removal) of native plant materials from native ecosystems, trampling impacts (trailing, bedding), impacts to or destruction of soil crusts, introduction of large amounts of solid animal wastes, and alteration of soils or hydrologic functions vital to plants.

Livestock grazing in general, as well as grazing associated directly with water developments, results in disturbances of varying levels. The most observable impacts relating to native plant community values are trampling and partial to complete removal of vegetative cover (Fleischner 1994; Leonard and others 1997; Belsky and Gelbard 2000; Jones 2001; RWR 2003). This can include impacts to common as well as to uncommon or rare plants (RWR 2003, 2004). Vegetative removal can include extensive areas that may encompass up to several square miles (Bell 1973; Vallentine 1974; RWR 2003). .

Loss of vegetation and accompanying soil impacts may include compaction, pulverization of soil structure, loss of water infiltration properties, and active soil erosion (Chaney and others 1991; Fleischner 1994; Brady and Weil 1999; Jones 2001; RWR 2003). Loss of vegetation results in disruptions of the hydrologic cycle- from loss of the hydraulic properties of root systems or shading of the soils from the sun, to the loss of transpiration and precipitation relationships (Brady and Weil 1999).

Loss or disturbance of riparian-wetland vegetation can lead to accelerated erosion, sedimentation, lowering of water tables, and other undesirable impacts to natural

ecosystems (Chaney and others 1991; Leonard and others 1997; Brady and Weil 1999; Jones 2001; RWR 2003). Alteration of plant community values may in turn exert profound influences upon native wildlife species dependent upon vegetation for food resources, prey base resources, hiding cover, nesting cover, escape cover, thermal cover or other needs (Chaney and others 1991; Fleischner 1994; Belsky and Gelbard 2000; Jones 2001; RWR 2003).

Water developments pose particular management concern for rare plant communities for two major reasons: 1) the developments may concentrate livestock numbers or livestock use in upland areas that might not have otherwise been grazed in any substantial amount; and 2) inappropriate placement of developments within riparian-wetland habitats poses significant risks to a number of resource values, including plant community values.

Examples found within BLM Standards and Guidelines from Idaho, Utah, and Montana include the following directives or guidelines relating to plant community health on public rangelands:

- Riparian-wetland areas are [should be] in properly functioning condition appropriate to soil type, climate, geology, and landform to provide for proper nutrient cycling, hydrologic cycling, and energy flow (Idaho BLM 1997a, Standards for Rangeland Health #2).

- Healthy, productive, and diverse native animal habitat and populations of native plants are maintained or promoted as appropriate to soil type, climate,

and landform to provide for proper nutrient cycling, hydrologic cycling, and energy flow. Indicators may include, but are not limited to, the following: 1) native plant communities (flora and microbiotic crusts) are maintained or improved; 2) diversity of native species is maintained; 3) plant vigor (total plant production, seed and seedstalk production, cover, etc.) is adequate to enable reproduction and recruitment of plants when favorable climatic events occur; 4) noxious weeds are not increasing; and 5) adequate litter and standing dead plant material are present for site protection and for decomposition to replenish soil nutrients relative to site potential (Idaho BLM 1997a, Standards for Rangeland Health #4).

- Apply grazing management practices to maintain adequate plant vigor for seed production, seed dispersal, and seedling survival of desired species relative to soil type, climate, and landform (Idaho BLM 1997a, Guidelines for Livestock Grazing Management #9).

- Apply grazing management practices and/or facilities that maintain or promote the physical and biological conditions necessary to sustain native plant populations and wildlife habitats in native plant communities (Idaho BLM 1997a, Guidelines for Livestock Grazing Management #12).

- Riparian and wetland areas are in properly functioning condition as indicated by vegetation reflecting: Desired Plant Community, maintenance of riparian and wetland soil moisture characteristics, diverse age structure and

composition, high vigor, large woody debris when site potential allows (Utah BLM 1997c, Standards for Rangeland Health, Standard #2).

- Grazing management practices will be implemented that: a) maintain sufficient residual vegetation and litter on both upland and riparian sites to protect the soil from wind and water erosion and support ecological functions; c) Meet the physiological requirements of desired plants and facilitate reproduction and maintenance of desired plants to the extend natural conditions allow; d) Maintain viable and diverse populations of plants and animals appropriate for the site (Utah BLM 1997c, Guidelines for Grazing Management #1).

- Manage grazing to maintain or improve watershed vegetation, biodiversity… Maintain or improve riparian vegetative cover and structure (Montana BLM 1997b, Butte District Guideline #1, Lewistown District Guideline #2, Miles City District Guideline #2, Dakotas Guideline #2).

- Grazing will be managed to promote desired plants and plant communities of various age classes (Montana BLM 1997b, Lewistown District Guideline #5).

- Noxious weed control is essential (Montana BLM 1997b, Butte District Guideline #8, Lewistown District Guideline #9).

Noxious weed introductions are another impact that can be linked directly to water developments, as weed invasions correspond with frequent soil disturbance regimes and repeat visits by weed vectors (e.g. livestock, vehicles). The soil disturbance inherent to pipeline construction can also serve as weed corridors- enhancing the spread of both noxious species and exotics (such as cheat grass). Belsky and Gelbard (2000) note:

> The contribution of livestock grazing to weed invasions has generally been downplayed. While the effects of drought, historic overgrazing, fire, and seed introductions associated with outdoor recreation, roads, and wildlife have been emphasized…At the landscape and regional scales, livestock grazing is one of several factors causing and enhancing the invasion of alien weeds into grassland, shrubland, and woodland communities; but at the community scale, livestock may be the major factor causing these invasions…the more than 20 million cattle and sheep grazing western grasslands, shrublands, and woodlands of the American West … may be the most pervasive factor moving seeds into and throughout plant communities. Unlike large wildlife species, which are sparse …and outdoor recreationists, who for the most part are restricted to trails, roads, and campgrounds, cattle and sheep are far-ranging; they reach all but the steepest slopes and areas farthest from water…

Weeds are often associated with range improvement projects such as pipeline and water development construction (RWR 2003). Weeds represent plant community changes

that may affect native wildlife population densities as well as native wildlife distribution (Fleischner 1994; Belsky and Gelbard 2000; Jones 2001; RWR 2003). As a further concern, many native invertebrates such as pollinators are host-plant specific and may unable to utilize exotic plant species (Glassberg 2001; Pyle 2002; Brock and Kaufman 2003; Miller and Hammond 2003; Shepherd and others 2003; RWR 2003). Weeds and exotic plant communities may actually favor the range expansion of exotic or introduced insects and other non-native wildlife (Williamson 1997; Belsky and Gelbard 2000; Pimentel 2002; Pyle 2002; RWR 2003).

In relation to water developments created specifically for wildlife, Rosenstock, Ballard, and deVos (1999) state:

> Based upon a comprehensive review of scientific literature, we conclude that wildlife water developments have likely benefited many game and non-game species, but not all water development projects have yielded expected increases in animal distribution and abundance. Hypothesized negative impacts of water developments on wildlife are not supported by data and remain largely speculative. However, our understanding of both positive and negative effects of wildlife water developments is incomplete, because of design limitations of previous research. Long-term experimental studies are needed to address unanswered questions concerning the efficacy and ecological effects of water developments. We also recommend that resource managers apply more rigorous planning

criteria to new developments, and expand monitoring efforts associated with water development programs.

Although there are few if any scientific studies that specifically address the impacts of livestock water developments on wildlife, some very important observations regarding water developments and impacts to wildlife (or wildlife habitats) appear in published literature:

- The most extensive and severe impacts to wildlife are those that occur from loss of habitat and habitat quality. Of all habitats, deserts are probably the most severely affected by domestic livestock grazing. Low, erratic precipitation and extreme environmental temperatures reduce the ability of most desert plants to handle persistent livestock grazing, especially around water developments where livestock tend to concentrate (Jones 1986).

- Livestock advocates suggest that water developments, such as troughs and stock ponds, benefit wildlife. While some wild animals undoubtedly use them, these facilities tend to lack adequate surrounding vegetation for hiding cover, nesting habitat, foraging, and other wildlife needs. Thus these structures are almost useless to wildlife species, and they exist at the expense of natural seeps, springs, and streams that would support far more native creatures if left intact (Wuerthner and Matteson ed. 2002).

- Other supposed solutions, such as pumping water from seeps or springs to water tanks or troughs, create other problems. For example, rings of nearly bare ground usually appear around water developments as entire herds of livestock descend on them. These sacrifice zones become compacted, with many native plants driven out, to be replaced by exotics and tough, unpalatable plants…it requires only the simplest logic to realize that with less water in a spring or stream, there is less habitat for water-dependent species (Wuerthner and Matteson ed. 2002).

- For example, dewatering of perennial streams and springs for domestic and livestock water has drastic effects on wildlife, especially aquatic organisms (Jones 1987).

- Moreover, associated [livestock grazing] activities- such as rangeland "improvements" to springs, seeps, bogs, riparian areas, or other unique and uncommon microhabitats- have major deleterious effects to aquatic and terrestrial invertebrates such as snails (Frest 2002).

- Water developments can become a point of concentration, with destructive grazing of everything edible. As this continues, a series of concentric rings of progressive degrees of overuse will result (Bell 1973).

- Destruction of springs by livestock grazing…and human exploitation (such as troughing, capping, or diverting for stock use…) has already caused extinction of different species throughout western North America. The Great Basin region has many such examples. In some Bureau of Land Management (BLM) districts, 90 percent of all named springs have had their native mollusks completely extirpated due to these causes (Frest 2002).

- In Idaho and Montana alone, the BLM and livestock permittees have developed over 3,500 springs on public lands. Some BLM Districts have developed all known springs. Yet in desert ecosystems, natural springs are critical areas for maintaining biological diversity (Frest 2002).

Obviously, livestock grazing and associated activities such as water developments have the potential to impact wildlife as well as wildlife habitats. State and federal agencies generally incorporate a number of wildlife-related directives within their various planning, and operating documents. Sample excerpts from agency planning or operating manuals and similar public documents include the following language regarding livestock and wildlife interactions and management protocol:

- Project clearances for threatened and endangered species would be conducted on all project proposals. All BLM management actions will comply with Federal and State laws concerning fish and wildlife. Wildlife escape devices will be installed on al troughs and tanks. Range

improvements will be designed to achieve watershed, wildlife, and range objectives. Wildlife provisions will be incorporated into all future fence proposals (BLM 1987b, Jarbidge RMP).

- Forage/cover requirements will be incorporated into allotment management plans and will be specific to areas of primary wildlife use. Water will be provided in allotments (including rested pastures) during seasonal periods of need for wildlife (BLM 1987b, Jarbidge RMP).

- BLM will manage fish and wildlife habitat on the public lands. A variety of methods may be employed, including management actions designed to maintain or improve wildlife habitat, inclusion of stipulations or conditions in BLM leases, licenses and permits, and development of detailed plans for fish and wildlife habitat management. Priority will be given to threatened or endangered species habitat. All BLM management actions will comply with federal and State laws concerning fish and wildlife (BLM 1985; Cassia RMP).

- Within each grazing allotment or group of allotments the available forage is allocated among domestic livestock, wildlife, and wild horses and burros. Sufficient vegetation is reserved for purposes of maintaining plant vigor, stabilizing soil, providing cover for wildlife and other nonconsumptive uses (BLM 1985, Cassia RMP).

- Habitats are suitable to maintain viable populations of threatened and endangered, sensitive, and other special status species (BLM 1997b, Standards for Rangeland Health #8).

- Maintain or promote grazing management practices that provide sufficient residual vegetation to improve, restore, or maintain healthy riparian-wetland functions and structure for energy dissipation, sediment capture, groundwater recharge, streambank stability, and wildlife habitat appropriate to site potential (Idaho BLM 1997a, Guidelines for Livestock Grazing Management #5).

- The development of springs, seeps, or other projects affecting water and associated resources shall be designed to protect the ecological functions, wildlife habitat, and significant cultural and historical, archaeological, and paleontological values associated with the water source (Idaho BLM 1997a, Guidelines for Livestock Grazing Management Guideline #6).

- Apply grazing management practices to maintain adequate plant vigor for seed production, seed dispersal, and seedling survival of desired species relative to soil type, climate, and landform (BLM 1997a, Idaho Guidelines for Livestock grazing Management #9).

- Apply grazing management practices and/or facilities that maintain or promote the physical and biological conditions necessary to sustain native plant populations and wildlife habitats in native plant communities (Idaho BLM 1997a, Guidelines for Livestock grazing Management #12).

- Grazing management practices will be implemented that: a) maintain sufficient residual vegetation and litter on both upland and riparian sites to protect the soil from wind and water erosion and support ecological functions; c) meet the physiological requirements of desired plants and facilitate reproduction and maintenance of desired plants to the extend natural conditions allow; d) maintain viable and diverse populations of plants and animals appropriate for the site (Utah BLM 1997c, Guidelines for Grazing Management #1).

- Manage grazing to maintain or improve watershed vegetation, biodiversity, maintain or improve riparian vegetative cover and structure (Montana BLM 1997b, Butte District Guideline #1, Lewistown District Guideline #2, Miles City District Guideline #2, Dakotas Guideline #2).

- Parties deriving the primary benefit(s) from a structural improvement shall be responsible for maintaining that improvement. Primary benefits constitute more than 50 percent of the benefits realized (BLM 1987b).

- Requirements for water catchments, springs, pipelines, and troughs include periodic inspection, repair or replacement of worn or damaged parts, repair of leaks, removing trash or silt, repainting tanks (if they were originally painted), repair of associated fences if appropriate…winterizing the facility, maintaining water flows during agreed-upon times, and maintaining wildlife escape ramps (BLM 1987b).

As indicated in several of the management directives above, another important factor relating to wildlife and livestock water developments is appropriate safety measures, including provision of a means for wildlife to safely access and/or escape from livestock troughs and water storage tanks. Hazards encountered by wildlife at water developments and wildlife access and escape issues which will be discussed in greater detail in the following three sections below.

Water Development Hazards

Many wildlife species rely on or require daily access to free (surface) water (TWS 1980; Jones 1986; RWR 2003). However, the proliferation of water developments for domestic livestock across arid and semi-arid rangelands has resulted in the capture and containment of many natural water sources though spring developments, installation of pipeline and trough systems, the use of storage tanks and bladders, construction of reservoirs and dugouts, and other artificial water delivery or storage facilities (RWR 2003).

Water resources may be contained in storage facilities or within facilities that do not allow for easy wildlife access, such as steep-sided troughs and tanks. Water developments and the concentrated livestock use they encourage may also result in a loss of cover or in the provision of artificial perches or observation points for predators. Wildlife species entering open areas or areas supporting minimal cover values are vulnerable to predation. Wildlife may be reluctant to utilize water or even taller vegetative structures such as shrubs or trees when such resources are not associated with ample groundcover or understory vegetation. A prime example is the avoidance of western locations with an overgrazed understory by Yellow-billed Cuckoos, even when large cottonwoods are still present (Austin 2001).

Raptors perching on or near water developments substantially increase the risk of predation for smaller wildlife attempting to access the water source. As many water developments have wooden posts and structures placed around, on, or over them- raptors may be observed perching directly on the water developments themselves. This phenomenon is evidenced by feathers dropped into troughs during preening activities, and through the observation of portions of prey (such as portions of a rabbit carcass) dropped into troughs or left alongside (RWR 2003).

The existence of a water source without cover or other substantial resource values such as a large denuded area around water developments (under severe use this can represent up to several square miles) may limit wildlife species presence as well as overall population densities (reproductive success) within a respective habitat (RWR 2003). Observations and comparisons of troughs with moderate to heavy cover values to troughs with very little or no cover values immediately reveals differences in wildlife

behavior regarding the water resources. Observations and comparisons between sites with and without substantial cover values during similar daily timeframes tends to reveal the greater wildlife diversity for troughs with substantial cover, as opposed to the presence of few if any species of wildlife at troughs with little or no cover nearby (RWR 2003).

Water quality can also become a serious issue for those water developments consisting of small impoundments or overflow sites (RWR 2003). As water levels decline, the water resource may become loaded with animal waste products and/or experience eutrophication. Some wildlife species, such as those belonging to the weasel family, are especially susceptible to water borne pathogens (Fulcher 2000, personal communications, unreferenced). Troughs and tanks can also eutrophy to the point where algae and other aquatic organisms create toxic conditions (RWR 2000-2006, field observations, unreferenced). Water quantity may also become an issue if livestock exceed the capacity of an existing water development, potentially leaving wildlife without required water resources (RWR 2003).

In addition to water quality and quantity, the seasonal availability of water for wildlife at livestock developments may pose a serious threat to resident or migratory wildlife (Valentine 1974; Sherrets 1989; RWR 2003). If water developments are only turned on or otherwise used to provide water when domestic livestock are present, wildlife that have grown accustomed to the presence and availability of water at certain times of the year may be faced with an unexpected loss of water (Sherrets 1989; RWR 2003). Wildlife mortality can result if water developments are turned off or drained during critical time periods including but not limited to migration periods, breeding or

nesting seasons, while wildlife are nursing young, or during extremely hot or dry conditions.

Sherrets (1989) makes the following statement and recommendation for providing wildlife with water when cattle are not in a grazing unit:

> …the primary beneficiaries of the livestock water should agree to provide wildlife waters during times livestock is not present (except for winter months).

Although agency planning and regulatory documents may occasionally contain language regarding the availability of water for wildlife when livestock are not physically present in a grazing unit, Sherrets' guideline does not appear to be routinely followed in the field (RWR 2003). This creates unusual hardships for many species of wildlife, particularly when part or all of natural surface waters within a geographic region have been captured and placed within water development systems (RWR 2003).

Some kinds of water developments are more accessible to wildlife than others. In the case of developments such as dugouts, reservoirs, or similar ground-level impoundments wildlife would typically be able to access the waters in approximately the same manner as a natural lotic or lentic system. Problems may still arise due to removal of vegetation and the corresponding loss of cover or forage values and the potential for increased predation. Ground nests or the young of some avian species, as well as small mammals, amphibians, or reptiles may be physically trampled if water impoundments are frequently accessed by domestic livestock or are placed in inappropriate locations such as

meadows or within stream channels. Fences or other objects (e.g. braces or barriers to livestock access) placed in or across water impoundments can also impede wildlife access or movements.

Water developments for livestock and even those created specifically for wildlife use may not necessarily provide for safe ingress or egress by all species of wildlife, and may either exclude use by some types of wildlife or may pose significant drowning hazards. Water troughs and tanks, including large open storage tanks, may be difficult for wildlife to access and utilize as water resources. Many wildlife species may not be able to physically reach the water within some types of livestock developments. Sides of many developments may be too high off the ground for some or even all terrestrial wildlife to reach over; or may simply be made of materials too smooth (slick) for wildlife to climb up to, or hang onto the sides or other structures (e.g. stand pipes), and/or climb out of should wildlife accidentally fall in.

Mitigation for Wildlife Access

Vallentine (1974) notes, "Ramps are often needed to allow livestock, game animals, and birds safe access to water." The BLM Technical Report by Sherrets (1989) provides range managers with a number of excellent diagrams and other illustrations that show various ways in which troughs can be constructed or modified so as to allow for the safe access (ingress or use) as well as safe escape (egress or escape) of livestock, big game and smaller wildlife species such as birds and small mammals.

Field observations reveal that terrestrial as well as aerial access to a great many troughs and tanks are often blocked by foreign structures or objects, ranging from posts and metal bars to barbed wire (RWR 2003; Taylor 2004, personal communications, unreferenced). While it is recognized that some of these objects are placed or constructed around, over, or within troughs to keep livestock from jumping, falling, or climbing into the water developments; such structures present substantial impediments to use of the water facilities by wildlife (RWR 2003).

Species that drink while flying such as bats and some species of birds typically require an open area or "swoop zone" free of objects that would hinder approaches to, and movements away from, an open water source such as a trough, tank, or other facility (RWR 2003; Taylor 2004, personal communications, unreferenced). Other barricades and junk, and even weeds may simply prevent safe or easy ground or aerial access to a water facility, even for larger terrestrial species (RWR 2003). In some cases objects may extend out over the water- or appear "trap-like" and may deter or eliminate approach and use by some species (RWR 2003; Taylor 2004, personal communications, unreferenced).

In many cases, drowned wildlife observed in the field may well have ended up in troughs or tanks after colliding with structures placed over or around the water facilities (RWR 2003; Taylor 2004, personal communications, unreferenced). Wire can be difficult for many species (including bats) to detect in flight or during pursuit of prey, and may inadvertently be leading to increased fatalities at certain developments (RWR 2003). While bats have the ability to echolocate, they do not always use it during flight (RWR 2003; Taylor 2004, personal communications, unreferenced). Under poor light conditions, such as after dark, during storms, or in the early dawn or late evening hours-

wires and other very thin obstructions over water development may not be identified by wildlife in time to avoid a collision.

Sherrets (1989) makes the following statements and recommendations for providing wildlife access to watering troughs and tanks:

- If all available water is captured and the only water outlet source is a trough, wildlife water should be provided through an alternative water outlet. If sufficient water is available, an overflow outlet a little distance from the livestock trough will normally meet wildlife needs. It is also best to fence overflow areas so livestock do not trample the outlets.

- Immature wild ungulates (fawn deer, bighorn sheep lambs, calf elk, antelope kids, etc.) cannot utilize watering facilities that exceed 20 inches above ground level Whenever ground-level wildlife drinking facilities are not provided in association with other water developments, the height of livestock troughs or other containers must not exceed 20 inches. Larger troughs may be set below ground level to reach the desired height.

Sherrets (1989) further notes:

- If the quantity of water is insufficient to provide separate livestock and wildlife developments, the livestock facility must serve a dual role. This can be accomplished by constructing wildlife ladders that lead into water facilities. These

ladders can be constructed of expanded metal or rebar and hardware cloth and should be protected by posts or protective fencing.

- An alternative method of providing access by small animals to raised troughs is to construct concrete or rock ramps topped with concrete. Advantages of such ramps include minimal maintenance and decreased chance of injury to livestock. Protective fencing would be optional if concrete/rock ramps are used.

Mitigation for Wildlife Escape

When open containers of water are placed within wildlife habitats, a wide variety of species may be attracted even if natural sources still exist within the region. If natural water sources are artificially captured, dry up, are severely contaminated, or otherwise become unavailable to wildlife; species of all kinds may make desperate attempts to access artificial troughs and tanks (Sherrets 1989; RWR 2003). When waters are only present in troughs and tanks, the danger of accidental drowning of wildlife can reach epidemic proportions during stressful periods such as drought (RWR 2003).

As biological need for free water increases, many species of wildlife may overcome their natural cautions, leading a variety of species taking drowning risks that they would not take under ordinary circumstances (Sherrets 1989; RWR 2003). For biological reasons not fully understood, birds in particular are drawn to the waters of troughs and tanks, even when natural surface waters are available (RWR 2003). In some cases, this appears to occur because existing surface waters have become contaminated

with livestock wastes (2003). Individual wildlife may inadvertently, through collision with objects or other miscalculations, simply end up falling into a tank or trough while trying to water in a development such as a trough or tank (RWR 2003). .

Almost without exception, wildlife species of all types (e.g. birds, reptiles, bats and other mammals) are excellent swimmers (Sherrets 1989; RWR 2003). However, if an animal is unable to escape from a particular situation, such as from water within a smooth-sided container, they are doomed to eventual exhaustion and drowning (McCarty 1986; Sherrets 1989; RWR 2003). Hypothermia may also play a significant role-depending on water temperatures (RWR 2003).

Some waterfowl may be able to gain the air directly from limited aquatic surfaces. However, most passerines (perching birds) and others including diurnal and nocturnal raptors (e.g. hawks, eagles, owls) must have dry feathers in order to fly. If these birds cannot climb onto a safe substrate in order to fluff and dry saturated feathers, even after natural bathing, they are unable to escape hazards or fly to safety (RWR 2003).

In most cases, bats cannot "rise up" from the water and fly away either (RWR 2003; Taylor 2006, personal communications, unreferenced). . While bats typically drink on the wing, if their wingtips catch the water or if they strike a foreign object they may inadvertently tumble into the water. Bats are excellent swimmers just like other wildlife-but they are also generally doomed without some way to climb out of the water and escape a steep-sided container such as a livestock trough or storage tank (Sherrets 1989; RWR 2003; Taylor 2006, personal communications, unreferenced).

Large animals (e.g. deer, antelope) as well as livestock are also at risk of drowning under certain conditions (McCarty 1986; Sherrets 1989; RWR 2003). Sherrets (1989) notes:

- Often cattle, domestic sheep, wild horses, and other large ungulates will push, crowd, or fight adjacent to a water facility. With the lip of the trough 20 inches or more above ground level there is the possibility of some ungulates (e.g., domestic sheep, calves, fawn deer, antelope, etc.) falling into the trough. If the water level exceeds 20 inches, the animal may not be able to reach the bottom and stand. Consider installing safety barricades in all livestock watering developments to prevent accidental entry and possible drowning.

- In addition, escape from a trough by a large ungulate may be more difficult than an accidental entry. Consider installation of concrete blocks and/or rocks to form escape ramps in all livestock water facilities where water depth exceeds 20 inches.

Although not recognized or otherwise discussed by Sherrets, caution must be exercised in attempting to exclude larger animals, as such barriers may then impede other kinds of wildlife or result in the collision-related drownings of birds and bats (RWR 2003; Taylor 2006, personal communications, unreferenced. Decisions on how best to allow for wildlife entry and escape or other safety issues, including for livestock, need to be made by utilizing site-specific information; including but not limited to season of livestock use, wildlife species present, and the potential for alternative water sources for

wildlife (RWR 2003). Rangeland managers need to evaluate potential species use as well as potential risks when considering, constructing, and maintaining any type of artificial water source, including those designed primarily for wildlife use (RWR 2003).

Another escape issue not specifically discussed by Sherrets (1989) is the fact that submerged surfaces quickly become extremely slippery due to the presence of algae, water slime molds, and other aquatic organisms (RWR 2003). Larger animals may not be able to stand up on the bottom of a trough or tank, even in shallow water or climb rocks or ramps if slippery (RWR 2003). In addition, many smaller wildlife species may not be able to climb the surface materials used in water development construction or even of deliberately installed escape devices if developments or escape materials are not properly cleaned and maintained.

In attempts to prevent the drowning of wildlife, a wide variety of escape devices have been created and used in rangeland troughs. Some styles work fairly well, some designs are excellent, some are largely ineffective, and some ill-conceived designs are actually dangerous to wildlife (McCarty 1986; Sherrets 1989; RWR 2003; Taylor 2006, personal communications, unreferenced). Agency and other researchers have carried out efforts to determine behaviors to be expected from a drowning animal, the most effective designs for providing escape, and methods of retrofitting troughs originally constructed without escapes (McCarty 1986; Sherrets 1989; RWR 2003; Taylor 2006, personal communications, unreferenced).

Sherrets (1989) notes in the BLM Technical Bulletin entitled “Wildlife Watering and Escape Ramps on Livestock Water Developments” that the most important trough

modifications for small wildlife are the installation of escape ladders and ramps. Sherrets also provides the following observations and recommendations:

- Birds, lizards, rodents, rabbits, and other small animals generally swim the circumference of a tank trying to find a way out. Therefore, wildlife escape ladders must be constructed and installed to intercept the line of travel around the edge of the tank.

- All wildlife escape ladders should be attached to the watering facility by a hinge or bracket to facilitate trough and ladder cleaning and to reduce the possibility of the ladder being removed. Brackets have proven to be more effective than hinges. If not installed properly, hinges tend to bind and break with prolonged use.

- Wildlife escape ladders should have a minimum slope of 30 degrees and a maximum of 45 degrees. The more gradual the slope of an escape ladder the more effective it will be.

- A minimum of one escape ladder per 30 linear feet of trough perimeter should be installed. Information suggests that many small animals become exhausted and drown if forced to swim more than 30 feet. Where troughs are connected in a series (such as three 10ft troughs), each trough section must have its own set of escape ladders.

- It is possible to make wildlife escape ramps serve purposes other than wildlife protection. In water facilities where float valves are installed, the escape ramp may provide a protective cover for the valve, as well as a landing from which animals can drink and a method by which trapped animals can escape.

- In many grazing areas large open water storage tanks are used. The majority are out of reach of livestock, big game animals, and most small wildlife species (except birds and bats). Livestock trough modifications may be impractical and are usually unnecessary in storage tanks. Some provision to allow trapped birds to escape the deep water is needed. A floating wildlife platform should be installed in all large open water storage tanks. Such a platform will allow birds to escape or to drink.

However, Sherrets (1989) has failed to recognize a couple of issues that more recent research efforts have identified in the field (RWR 2003; Taylor 2006, personal communications, unreferenced). Floating platforms do not necessarily intercept the paths of drowning birds in tanks any more than in troughs, as evidenced by the discovery of many dead birds and bats floating in large tanks provided with rafts (RWR 2003, RWR 2004, field observations, unreferenced; Taylor 2006, personal communications, unreferenced).

Big game animals such as antelope also occasionally access large tanks and face entrapment and/or drowning (RWR 2003). Therefore, some additional recommendations are made as follows:

- Provide multiple rafts in very large storage tanks, as well as one or more escape devices (depending on tank circumference) that are situated so as to intercept the path of drowning birds or bats seeking the tank's edge. Rafts and other escape devices must be cleaned and maintained on a regular basis (RWR 2003).

- When large, open storage tanks exist, particularly if sides are between 4 and 5 feet in height- immediately adjacent and alternative water resources must be provided for big game species. Otherwise, big game species ranging from antelope to moose may attempt to access the tank; not only with the possibility of the wildlife drowning, but possibly resulting in serious damage to the water facility as well (RWR 2003).

Sherret's designs (1989) are based upon previous reports by McCarty (1986) and The Wildlife Society (1980), and show escapes extending to the bottoms of troughs for accessibility by wildlife at different water levels. The importance of this factor should be emphasized, as it may not be self-evident to rangeland managers. Dozens of troughs exist on western rangelands where escape devices are either left high above the water's surface (or are fully submerged) as water levels change during the grazing season (RWR 2003).

The following recommendations will assist in avoiding unnecessary mortality of wildlife in water developments:

- Devices must extend fully from the rim to the floor of each livestock trough or tank in order to provide for the escape of birds and other wildlife species regardless of the water level (Sherrets 1989; RWR 2003).

- Having escapes that extend to the bottom of watering facilities also remedies the plight of hapless small mammals or reptiles and amphibians that fall into a dry tank. While they may not necessarily drown, they still cannot escape the "trap" if it is constructed of materials that do not provide any climbing traction or other means of escape (Sherrets 1989; RWR 2003).

In an apparent effort to cut costs, some agencies have been observed to only partially duplicate the designs recommended by Sherrets (1989), without realizing that such actions may result in additional wildlife drownings (RWR 2003). Some wildlife escape devices may serve limited purposes- such as wire wrapped pieces of boards floating in troughs or tanks. However, these may not necessarily be intercepted by drowning wildlife, and do not provide an adequate substrate for use by larger birds such as eagles or owls (RWR 2003).

There are many reports of drowned birds, bats, and small mammals in troughs where floating boards have been provided (RWR 2003; RWR 2004, field observations, unreferenced; Taylor 2006, personal communications, unreferenced). Tire troughs in particular, such as those made from large tractor tires are one of the more difficult to provide with functional escapes due to the curved surfaces and the lip at the top rim (RWR 2003). However, Sherrets (1989) provides numerous examples of how to retrofit a variety of trough designs, including tractor tires, to make them safer for wildlife.

While this case study has been directed at water developments on public rangelands, the same access, escape, and wildlife drowning issues apply to troughs or tanks on private lands, and to other bodies of water such as children's wading pools. For example, many owls are trapped in troughs as well as swimming pools and children's wading pools (RWR 2003).

Tubs or barrels in corrals, and even buckets, represent drowning hazards for birds and other small wildlife. As was mentioned previously, even when natural or surface waters are present- birds may still be drawn instinctively to deeper containers of water (RWR 2003).

The conscientious provision of functional escapes in all water developments represents an important wildlife conservation measure. Occasionally accidents will still happen, even with properly installed and maintained escapes. Just like humans that may have an auto accident, fall off a ladder, or slip on an icy sidewalk, wildlife are also prone to accidents. Some organisms may simply have less natural caution than others, while some may simply end up in the wrong place at the wrong time. However, the provision of properly constructed, properly installed, and properly maintained escapes will prevent most if not all wildlife drownings in water developments.

Case Study Conclusion

The presence or lack of free surface waters often governs the ability of wildlife species to utilize particular geographic locations, as many game and non-game wildlife species must have access to free water during part or all of their life cycles. Most water development projects on western rangelands are designed to provide water to domestic livestock, although some developments are created specifically for wildlife. In some cases, a natural water source may have served the needs of area wildlife over time, but may not be sufficient to meet the needs of large domestic animals or of concentrated groups of domestic animals.

The answer to this situation has been to construct water developments throughout the arid and semi-arid western United States. There is increasing public concern that livestock water developments on public lands in Idaho and adjacent western states may be providing limited value to resident or transient wildlife species, and may also pose significant hazards or mortality risks. However, water development proposals presented to the public for approval continue to indicate that a major factor for project authorization is that of providing benefits for wildlife.

As domestic livestock grazing is the most widespread human activity occurring on western public rangelands, it receives the lion's share of public concern and requests for accountability. While agency personnel and livestock permittees are often annoyed by public scrutiny of water developments and other projects, the public has a vested interest in the responsible management of wildlife on public lands. Largely in response to public pressure initiated by Red Willow Research Inc. and graduate student Miriam Austin, the USDI Bureau of Land Management is now issuing requirements that wildlife escapes be placed in all troughs on lands administered by the Bureau of Land Management.

However, dozens of Idaho and other western locations, particularly on private lands and on lands administered by the USDA Forest Service, continue to use troughs without properly installed escape devices for wildlife. Many species of wildlife continue to drown annually in these unprotected western water developments. Collaborative efforts are currently underway by the USDA Natural Resource Conservation Service, the USDI Bureau of Land Management, and Bat Conservation International to address water developments and the hazards they pose to wildlife through development of a new range handbook (BCI 2006). The manual should be available to the public by February 2007.

General Discussion

The long-term introduction and maintenance of non-native ungulates (domestic livestock) on the rangelands of the western United States has also resulted in increasing requests by the American public for more responsible management of native wildlife populations and their habitats, and for greater public accountability (Vavra and others 1994; RWR 2003; IDFG 2005a; IDFG 2005b; BCI 2006). Public issues relating to rangeland management in the western United States include habitat conservation, wildlife conservation, sustainable management, and the reintroduction and recovery of threatened species (Vavra and others 1994; BLM 2004; IDFG 2005a, 2005b).

Habitat Conservation

Habitat conservation has become a critical management issue as human populations and their influence continue to expand. Few if any habitats in the western United States are reflective of pre-settlement conditions (Vavra and others 1994; Saab and others 1995; Saab and Rich 1997; IDFG 2005a, 2005b). Rangelands and other natural habitats have been altered through domestic livestock grazing, logging, mining, water impoundments, road construction, agriculture, and rural and urban development.

Native plant communities throughout the west have also been profoundly altered, not only directly through human activities such as livestock grazing, but also through altered fire regimes, the introduction and spread of alien plant species, and through climatic changes generally believed to be influenced by anthropogenic causes (Fleischner

1994; Belsky and Gelbard 2000; Epps and others 2004; Monson and others 2004; Tarleton.edu 2006).

Rangeland management agencies such as the USDI Bureau of Land Management [BLM] have recognized the need for responsible management of multiple resources represented by public lands, including for wildlife habitat. The following management direction appears in state and national handbooks or other public resources prepared by the BLM:

- The Standards for Rangeland Health, as applied in the State of Idaho, are to be used by the Bureau of Land Management for the betterment of the environment, protection of cultural resources, and sustained productivity of the range (Idaho Standards and Guides, BLM 1997a).

- Healthy, productive, and diverse native animal habitat and populations of native plants are maintained or promoted as appropriate to soil type, climate, and landform to provide for proper nutrient cycling, hydrologic cycling, and energy flow (Idaho Standard 4, Native Plant Communities, BLM 1997a).

- Habitats are suitable to maintain viable populations of threatened and endangered, sensitive, and other special status species (Idaho Standard 8, Threatened and Endangered Plants and Animals, BLM1997a).

- Protect riparian-wetland habitats and associated uplands through proper land management and avoid or mitigate negative impacts. Acquire and expand key areas to provide for their maximum public benefit, protection, enhancement, and efficient management. (National Riparian Wetland-Initiative, BLM 1991).

- The BLM has the statutory responsibility to manage and protect, for present and future generations, the 170 million acres of desert, grassland, sagebrush steppe, and woodlands that comprise BLM rangelands. The task is daunting; while providing for multiple use of those lands and resources, the agency must also address immediate and long-term conservation needs for rangeland restoration and recovery, wetlands improvement and wildlife habitat enhancement (Sustaining Working Landscapes on Federal Lands, BLM 2004).

Working to meet habitat conservation goals such as those presented above will help mitigate the potential for habitat and related natural resource competition (e.g. forage resources) between domestic livestock and wildlife on public rangelands.

Wildlife Conservation

The management and conservation of wildlife populations on the rangelands of western North America is closely tied to habitat conservation, and requires collaboration

between state and federal agencies as well as between potentially competitive public uses such as livestock grazing, recreation, and hunting (BLM 1997a, 1997b, 1997c; BLM 2004; IDFG 2005a, 2005b). Idaho Department of Fish and Game [IDFG] notes the following in relation to state wildlife management responsibilities:

- We believe our management responsibility is to foster solutions to fish and wildlife issues that are ecologically viable, economically feasible, and socially acceptable. We believe productive habitats and healthy ecosystems are essential in sustaining diverse fish and wildlife and Idaho's communities and economies (IDFG 2005b).

In relation to national management responsibilities, the USDI Bureau of Land Management, provides the following directive:

- The BLM is responsible for the balanced management of the public lands and resources and their various values to that they are considered in a combination that will best serve the needs of the American people. Management is based upon the principle of multiple use and sustained yield; a combination of uses that take into account the long-term needs of future generations for renewable and nonrenewable resources. These resources include recreation, range, timber, minerals, watershed, fish and wildlife, wilderness, and natural, scenic, scientific, and cultural values (National OHV Management Strategy, BLM 2000).

Continued public collaboration will be critical to conserving wildlife populations, including for the western United States. In relation to Idaho wildlife populations, IDFG makes the following comment in its Draft Idaho Comprehensive Wildlife Conservation Strategy (IDFG 2005a, p. 1):

> As the State's fish and wildlife management agency, the Idaho Department of Fish and Game (IDFG) has the legal responsibility to develop a statewide Comprehensive Wildlife Conservation Strategy. IDFG is the appropriate agency to develop and carry out a wildlife strategy. The statutory authority for managing all wildlife is entrusted to IDFG, acting under the policy guidance of the Fish and Game Commission. Although IDFG is the State's lead wildlife manager, it is not a major land management agency and does not administer significant regulatory programs other than regulating the take of wildlife. By necessity, IDFG's ability to conserve wildlife will depend on its effectiveness in working cooperatively with others.

Without consistent and conscientious management collaboration, the needs of wildlife for quality habitat and a reasonable share of available forage and water resources may not be adequately ensured, as the majority of natural and managed environments are now dominated by domestic livestock grazing and other human activities (BLM 1997a; BLM 2000; BLM 2004; IDFG 2005a, 2005b).

Sustainable Management

Public and private sectors have become increasingly concerned with the need for sustainable management of our remaining natural resources. Western public rangelands are no exception, and without the development of sustainable management practices domestic livestock and other human uses have the potential to exclude many wildlife populations and the habitat qualities they require from public and private ranges (Fleischner 1994; Costanza and others 1997; Hardin 1998; Jones 2001; Capra 2002; RWR 2003; BLM 1994; Monson and others 2004).

Hardin (1998, p. 683) notes:

> Individualism is cherished because it produces freedom, but the gift is conditional: the more the population exceeds the carrying capacity of the environment, the more freedoms must be given up.

In other words, sustainability can only be achieved when individuals concede to reasonable constraints. In relation to the sustainability of domestic livestock grazing and wildlife conservation, Fleischner (1994, p. 629) provides the following comments:

> Livestock grazing is the most widespread land management practice in western North America. Seventy percent of the western United States is grazed, including wilderness areas, wildlife refuges, national forests, and even some national parks. The ecological costs of this nearly ubiquitous

> form of land use can be dramatic. Examples of such costs include loss of biodiversity, lowering of population densities for a wide variety of taxa, disruption of ecosystem functions, including nutrient cycling and succession, change in community organization; and change in the physical characteristics of both terrestrial and aquatic habitats.

Fleischner (1994, p. 629) further notes that "range science has traditionally been laden with economic assumptions favoring resource use."

In recognition of the need to pursue sustainability on public rangelands, the USDI Bureau of Land Management [BLM] has conceived a new program titled "Sustaining Working Landscapes on Federal Lands" (BLM 2004). Within this draft direction, the BLM proposes four concepts of collaborative management, the "Concepts for Four C's Grazing Administration" (BLM 2004). The BLM's Four C's collaborative rangeland management plan (BLM 2004) includes five major concepts: 1) conservation partnerships; 2) development of reserve common allotments [grass banking]; 3) voluntary allotment restructuring; 4) conservation easements; and 5) endangered species act mitigation.

Tenets of the Four C's collaborative rangeland management plan (BLM 2004, p. 1) include the following:

- The magnitude of the conservation challenge calls for a new conservation strategy- one founded upon federal obligations but built bottom-up by an engaged and voluntary citizen stewardship. The

framework for the new citizen stewardship is the Secretary's Four C's: conservation through consultation, communication, and cooperation.

- Grazing permittees, if given the conservation latitude and the right incentives, can help the BLM meet its statutory responsibility. Key policies and programs will foster new partnerships, spark new activity, and kindle new conservation opportunities to simultaneously provide for conservation and grazing. This will, in turn, strengthen and sustain the product of citizen stewardship on federal lands: economically sound and ecologically healthy landscapes- that is, working landscapes.

Working towards sustainable rangeland management will hopefully help to ensure that state, federal, and public conservation goals for healthy native wildlife populations and quality habitats can be achieved.

Restoration and Reintroduction

Concerns relating to management of western public rangelands have resulted in a number of important developments, including the passing of policies such as the Taylor Grazing Act and the National Environmental Policy Act [NEPA], development of state and national rangeland standards, development of regional and local rangeland monitoring programs, development of professional range organizations, and the

institution of local and regional cooperative management efforts (Baumer 1978; BLM 1996; BLM 1997a; BLM 1997b; BLM 1997c; NRCS 1997; BLM 2000; ICA 2000; BLM 2004). However, many western rangelands are categorized as being in poor condition or in need of restorative management (BLM 1991; BLM 2004; Monson and others 2004).

Whether or not poor rangeland conditions are the product of historic or ongoing overgrazing and/or other improper land management practices, habitat restoration and species reintroductions are playing a major role in modern range and wildlife management (BLM 1987a; BLM 1991; WDFW 1995; BLM 1997a; Monson 2004; IDFG 2005a, IDFG 2005b; WOC 2006). Improvement of existing vegetation and edaphic (soil-related) conditions on western rangelands can generally be improved through management, including restorative projects (Monson and others 2004).

Monson and others (2004, p. 25) report that "proper management is the key to the improvement or maintenance of acceptable plant cover and soil stability." Monson and others (2004, p. 20) also make the following specific comments in reference to rangeland and other types of habitat (plant community) restoration:

> The general goal of most revegetation projects is to change a plant community having undesirable characteristics to one with desirable characteristics. Land managers must determine whether the proposed changes are necessary or desirable and ecologically sustainable. Revegetation normally involves changes in community composition, plant cover and density, and reduction in competition from undesirable species. If the results are to be sustainable, sites targeted for revegetation must

> have the ecological potential to support the proposed changes and to initiate natural successional processes following treatment.

Rangeland restoration can be used for improvement of forage for livestock and wildlife, wildlife cover, and for improvement of other values such as riparian or aquatic habitat (BLM 1991; BLM 1997a; Monson and others 2004). Restoration activities can also be used to mitigate for specific actions or events such as road construction, overgrazing, wildfire, and weed invasions (BLM 1991; BLM 1997a; Goodwin and others 2002; Monson and others 2004).

Reintroductions of wildlife to restored habitats and/or back into historic habitats from which they have been extirpated or seriously depleted is one of the many tools available to wildlife managers (BLM 1987a; WDFW 1995; RWR 2002; RWR 2003). Although costly and subject to many factors that may influence success or failure, wildlife reintroductions have been carried out for many species of game and nongame species. Singer and others (2000) note:

> Translocating animals into former habitats is an effective tool for the conservation of many species. However, translocations of large ungulates or carnivores can be expensive, time consuming, and logistically and politically challenging.

Formal reintroduction or translocation efforts in the west have included but are not limited to desert tortoises, cutthroat trout, big horned sheep, Canada lynx, pygmy

rabbits, timber wolves, grizzly bears, black-footed ferrets, beaver, Burrowing Owls, California Condors, Whooping Cranes, Peregrine Falcons, Mountain Quail, and Sharp-tailed Grouse (BLM 1987a; Parker 1989; Olson and Hubert 1994; USFWS 1998; Singer and others 2000; IDFG 2001; WDOW 2002; Cheater 2003; Todd 2003; FEIS 2006). However habitat restoration is often necessary prior to reintroduction in order to ensure success for transplanted wildlife. This has not always been carried out; with the result that many attempted wildlife reintroductions have not resulted in viable new populations (BLM 1987a; Singer and others 2000).

In addition, species requiring large territories or requiring the making of significant migratory movements (e.g. timber wolves, grizzly bears, Whooping Cranes) may not be able to adapt to changes at the landscape level created by expanding human populations and human activities. The ideal situation for recovering declining wildlife populations on western rangelands may well be to increase existing population viability through restorative management, rather than attempting to rely significantly on wildlife reintroductions (BLM 1991; Chaney and others 1991; BLM 1997a; Pyle 2002; RWR 2003; Earnst and others 2004; Monson and others 2004; IDFG 2005a; IDFG 2006).

Recommendations

Livestock and wildlife may compete for resources, including but not limited to forage on western rangelands. Livestock grazing and associated activities may displace some kinds of wildlife, or result in increased predation (e.g. nest predation) through

removal of cover. Range improvements, such as fencing and water developments can have negative impacts on wildlife populations, including mortality. The following management recommendations appear in literature that is available to rangeland managers as well as the public at large, and provide a sampling of management direction relating to livestock and wildlife interactions on western rangelands. Species that may be specifically benefited by the recommendation are noted, along with literature source(s).

Competition

- Designate pastures with riparian areas as separate units with individual management objectives and strategies. Exclude livestock from sensitive sites. Benefits: fish, Neotropical songbirds, big game, beaver, reptiles, amphibians, native pollinators and many other species (Olsen and Hubert 1994; Saab and Rich 1997; PIF 1998; Paige and Ritter 1999).

- Maintain proper stocking and livestock distribution to protect riparian and adjacent upland habitats. Limit grazing intensity to a level that will maintain or improve desired plant species composition and vigor (Marks and Sands 1988; BLM 1997a; Saab and Rich 1997; PIF 1998; Taylor and others 1998; Paige and Ritter 1999).

- Add more rest to grazing cycles to regenerate, and to encourage desirable plant communities. Benefits: Neotropical songbirds, big game, Sage Grouse, small mammals, amphibians, invertebrates, many other species (IDFG 1997a; PIF 1998).

- Crucial areas such as lambing or calving grounds, migration routes, mineral licks, and areas within 1 mile of permanent water sources should receive maximum habitat protection Benefits: bighorned sheep, other species of big game (BLM 1987a; Taylor and others 1998).

- Livestock grazing should be managed to mitigate impacts to native ungulates and other herbivores. Benefits: bighorned sheep, mule deer, elk, pronghorn [antelope], small mammals, invertebrates. (BLM 1987a; BLM 1997a; PIF 1998; Taylor and others 1998; RWR 2002).

- Forage and carrying capacity calculations need to be carefully carried out in order to ensure that adequate forage resources are available for native herbivores. Benefits: bighorned sheep, elk, mule deer, pronghorn [antelope], and many other species including Sage Grouse, small mammals, and native pollinators (BLM 1987a; Thomas 1987; Beck and Peek 2001).

- Modify annual grazing practices to improve critical forage resources and minimize competition between livestock and big game. Benefits: bighorned sheep, deer, elk, pronghorn. (Lauer and Peek 1976; Rosentreter and Jorgensen 1986; Thomas 1987; Marks and Sands 1988; BLM 1997a).

Displacement or Exposure to Predation

- If exotic ungulates (e.g. feral burros or horses) are present and capable of competing with bighorned sheep, the exotic population will be controlled at the lowest possible numbers, with no additional releases of exotic ungulates. Benefits: bighorned sheep (BLM 1987a; Marks and Sands 1988)

- Develop water and shade in upland areas to reduce livestock pressure on riparian zones. Benefits: Neotropical songbirds, Sage Grouse, big game, small mammals, fish, beaver, many other species (PIF 1998

- Forage and carrying capacity calculations need to be carefully carried out in order to ensure that adequate cover resources are available for native herbivores. Benefits: bighorned sheep, elk, mule deer, pronghorn [antelope], and many other species including

birds, small mammals, and native pollinators (Rosentreter and Jorgensen 1986; BLM 1987a; Marks and Sands 1988; Shepherd and others 2003).

- Delay spring turnout of cattle and other livestock in areas where cowbird parasitism is an issue. Benefits: Neotropical songbirds, other birds (Bombay and others 2000).

- Manage grazing to provide sufficient residual ground cover and sufficient shrub for nesting and fawning protection. Benefits: Sage Grouse and other ground/shrub nesting birds, mule deer, pronghorn (Call and Maser 1985; Rosentreter and Jorgensen 1986; Connelly and others 1994; PIF 1998; Paige and Ritter 1999).

- Prevent shared use of rangelands between domestic sheep and bighorned sheep in order to avoid transmission of disease pathogens or parasites (Marks and Sands 1988).

- Where native communities exist, minimize disturbance and conversion to exotic communities. Utilize native species for rangeland restoration, rehabilitation. Benefits: native wildlife species, including big game, small mammals, birds IBLM 1997a).

- Provide for adequate rest following fire and other major disturbances to minimize establishment of exotic and other weed species. Benefits: big game, small mammals, birds, other wildlife (BLM 1997a).

Range Improvements

- Carefully consider effects of any new management facilities, including water developments or fencing on habitats prior to implementation (BLM 1997a).

- Utilize three strand fences with a smooth bottom wire (wires spaced at 20m, 35, and 39 inches from the ground). Benefits: bighorned sheep (BLM 1987a).

- Utilize fencing with a smooth bottom wire and an upper height limit of 40-45 inches with a preferred distance of 12 inches between the top two strands of wire. Benefits: deer, elk (CDOW 2005; USFWS 2005).

- Locate fences that parallel a stream well away from the riparian zone to avoid concentrating livestock impacts in riparian habitat. Benefits: fish, birds, big game, many other species (PIF 1998).

- Provide all livestock water developments with safety features that allow for wildlife access and escape. Benefits: big game, bats and other small mammals, birds (TWS 1980; McCarty 1986; Sherrets 1989; RWR 2003).

- Locate livestock handling facilities away from riparian resources. Benefits: big game, Neotropical songbirds and other birds, many other wildlife species (BLM 1997a; PIF 1998).

- Provide fresh, clean water in developments through routine inspection, cleaning, and maintenance year round except in winter for locations where freezing damage may occur to water systems (Bell 1973; Sherrets 1989).

- Provide safe and clean water resources for wildlife when natural sources have been diverted, or otherwise lost through drought or through water development for livestock. Benefits many species of wildlife, including bats, birds, and big game (Bell 1973; Sherrets 1989; RWR 2003).

- Utilize letdown fencing and/or lay-down sections in areas with heavy snow accumulation to facilitate wildlife movements. Benefits: big game, other large wildlife species (CDOW 2005).

- Install adjustable fences (can be lowered when livestock are not in the area) and wildlife passages in fences as recommended by state wildlife departments. Benefits: big game, other large wildlife species (CDOW 2005).

- Design management fences to minimize adverse impacts, such as habitat fragmentation, to maintain habitat integrity and connectivity for wildlife. Benefits: big game, other wildlife. (BLM 1997a).

- Remove fence sections or open gates located in strategic locations during migration periods in order to allow wildlife access to winter ranges, as well as providing access to local food and shelter. Benefits: big game and other large wildlife species (CDOW 2005).

- The development of seeps, springs, or other projects affecting water and associated resources should be designed to protect ecological functions, wildlife habitat, and other important values. Benefits: big game, birds, reptiles and amphibians, invertebrates, and many other species (BLM 1997a).

Conclusion

Domestic livestock grazing on rangelands of the western United States has resulted in short- and long-term impacts to rangeland plant communities and to native wildlife populations (Bell 1973; Vallentine 1974; BLM 1997a: Leonard and others 1997; Belsky and Gelbard 2000; RWR 2000; Jones 2001; RWR 2003; Monson and others 2004). As domestic livestock grazing is the most widespread human activity occurring on western public rangelands, it receives the lion's share of public concern and requests for accountability.

While agency personnel and livestock permittees are often annoyed by public scrutiny of water developments and other projects, the public has a vested interest in the responsible management of wildlife on public lands. Reflective of significant changes in public interest, rangeland management programs face the need to focus on much more than forage production. A statement issued by the Utah State Office of the Bureau of Land Management (1997c) illustrates very well the current and future relationship of rangeland management to other public land management responsibilities:

> It is time for a change, and BLM is changing to meet the challenge. BLM is now giving management priority to maintaining functioning ecosystems. This simply means that the needs of the land and its living and nonliving components (soil, air, water, flora and fauna) are to be considered first. Only when ecosystems are functioning properly can the

> consumptive, economic, political, and spiritual needs of man be attained in a sustainable way.

Fleischner (1994, p. 629) notes that "range science has traditionally been laden with economic assumptions favoring resource use." In recognition of the need to pursue sustainability on public rangelands, the USDI Bureau of Land Management [BLM] has conceived a new program titled "Sustaining Working Landscapes on Federal Lands" (BLM 2004). Within this direction, the BLM proposes four concepts of collaborative management, known as "Concepts for Four C's Grazing Administration" (BLM 2004).

The framework for this new citizen stewardship program is based upon conservation through consultation, communication, and cooperation. The BLM's collaborative rangeland management plan (BLM 2004) includes five major categories 1) conservation partnerships; 2) development of reserve common allotments [grass banking]; 3) voluntary allotment restructuring; 4) conservation easements; and 5) endangered species act mitigation.

It will only be through integrated programs of agency and public involvement such as the BLM's Four C's program that management challenges presented by shared use of our remaining natural resources by domestic livestock and wildlife will be able to be realistically addressed. Challenges will include addressing public concerns represented by domestic livestock grazing within wildlife habitats, such as the potential for resource competition, potential displacement of wildlife or increased risks of predation, and the potential for range improvement projects to negatively impact wildlife habitats and wildlife populations.

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