Chapter 5

Fire History, Effects, and Management in Southern Nevada

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Executive Summary

Fire can be both an ecosystem stressor and a critical ecosystem process, depending on when, where, and under what conditions it occurs on the southern Nevada landscape. Fire can also pose hazards to human life and property, particularly in the wildland/urban interface (WUI). The challenge faced by land managers is to prevent fires from occurring where they are likely to threaten ecosystem integrity or human developments, while allowing fires to occur where they will provide ecosystem benefits. This chapter provides information that will help land managers develop strategies to achieve Sub-goal 1.1 in the SNAP Science Research Strategy, which is to "Manage wildland fire to sustain southern Nevada's ecosystems" (see table 1.1).

Fire History and Patterns of Burning

Since the last glacial period at the beginning of the Holocene approximately 10,000 years ago, the Mojave Desert and southern Great Basin Desert landscapes of southern Nevada have experienced continuous arid to semi-arid conditions. A general trend towards increased aridity has resulted in an upslope shift in vegetation associations and their associated fire regimes during prehistoric times (i.e., pre-settlement). With increased aridity and decreased productivity, the spatial extent of fire across southern Nevada undoubtedly declined and became increasingly isolated within disjunct mixed conifer, piñon and juniper, sagebrush, and riparian ecosystem types.

The first accounting of extensive historic fire in southern Nevada was in the late 1930s and early 1940s when it was estimated that fires burned 20 percent (approximately 80,000 acres, 32,375 ha) of the total extent of blackbrush that occurred in the region at that time. During the mid-century drought from 1942 to 1975 there were relatively few fires, but significant burning occurred after precipitation began to increase in 1976. Between 1972 and 2007, approximately one million acres (404,686 ha) burned in 116 large fires (≥1,000 acres) in Lincoln and Clark counties, primarily within the blackbrush/shadscale and Mojave Desert scrub ecosystems (fig. 5.1). Most of that burned acreage (90%) occurred in areas that had not previously burned during the 36-year study period, 8 percent occurred in areas that had burned once before, and 2 percent occurred in areas that had burned two or three times before (fig. 5.2). The largest areas burned in the 2005 and 2006 fire seasons and appear to have been unprecedented during the past century. There was a general increase in number of large fires and area burned between 1972 and 2007, largely due to the 2005 and 2006 fires (fig. 5.3). Trend analyses that only span a few decades can be suspect, so the conclusion that fire activity has recently increased beyond historical conditions is somewhat tenuous.

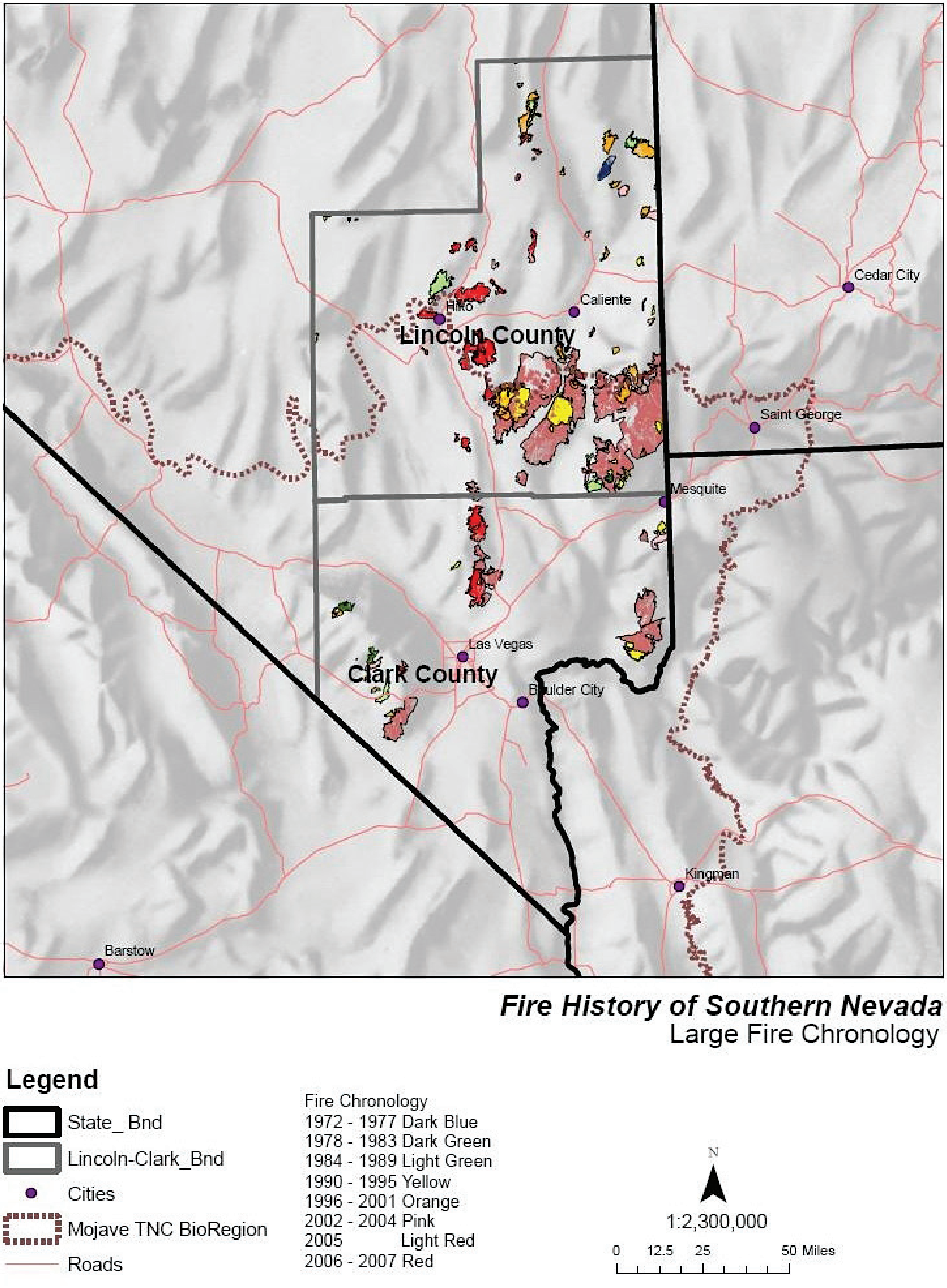

Figure 5.1—Large fire chronology 1972 through 2007 inclusive (≥1,000 acres). Shades from cool to warm colors represent the chronology of fire occurrence beginning with the oldest fires (blue) and ending with the recent fires (red) (reprinted with permission from McKinley and others, in press).

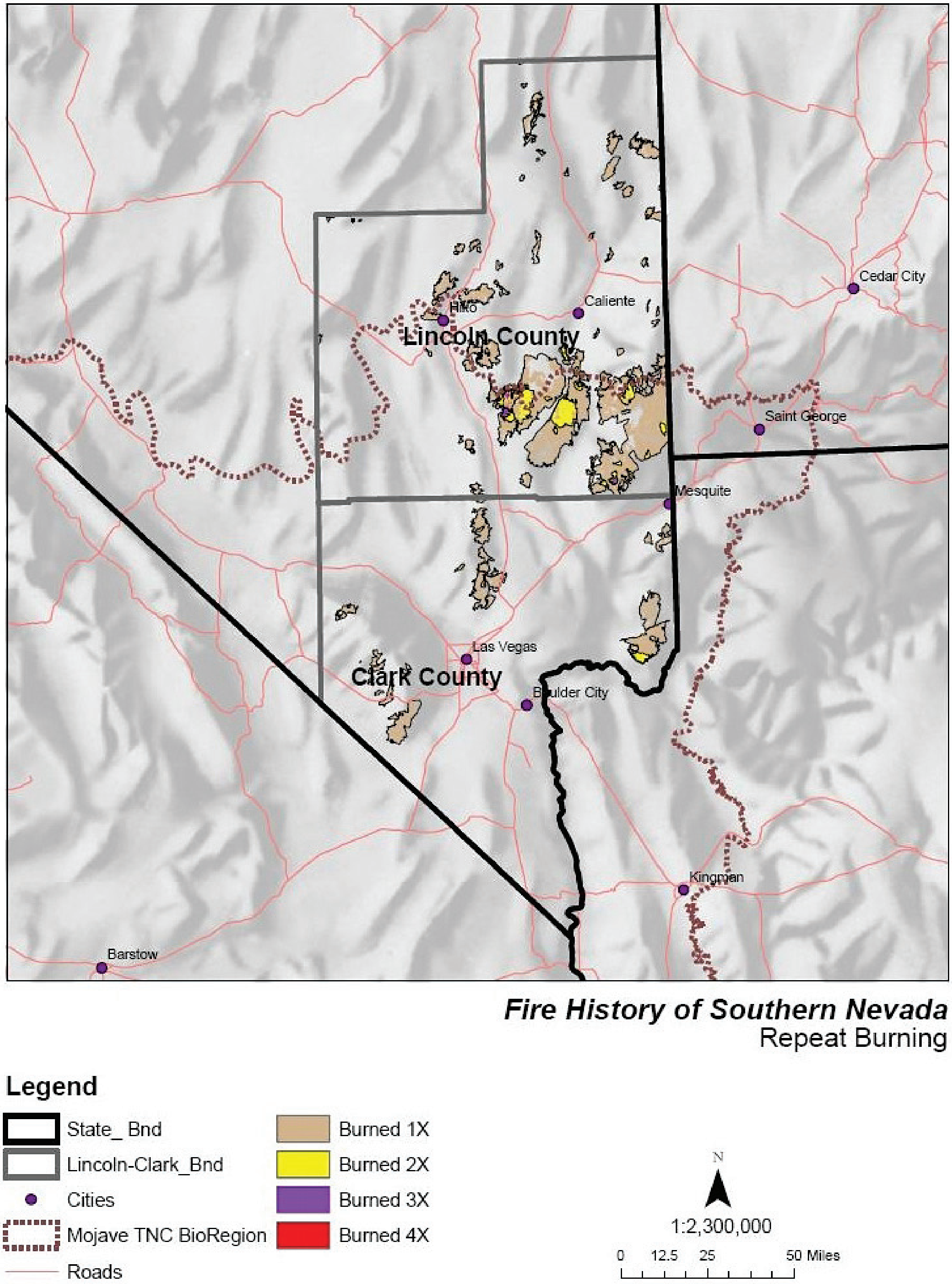

Figure 5.2—Fire frequency of large fires 1972 through 2007 inclusive (≥1,000 acres) (reprinted with permission from McKinley and others, in press).

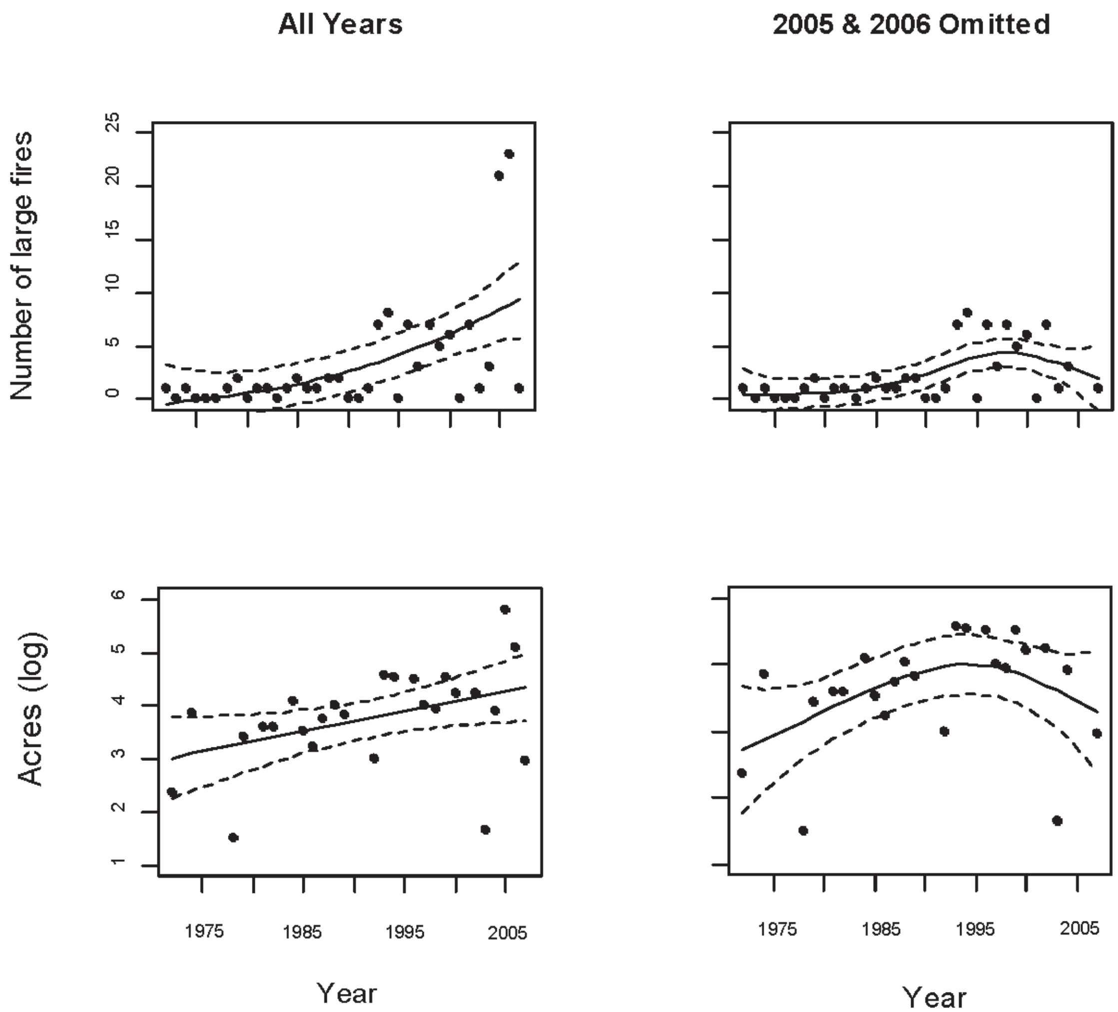

Figure 5.3—Patterns over time (1972-2007) for the number of large fires (≥1,000 acres), total area burned (log_{10} acres), mean fire size (log_{10} acres), and the proportion of burned area classified as high severity in Clark and Lincoln counties, Nevada. The shape of the relationship was derived from generalized additive models. Dotted lines are 95% confidence bands (modified with permission from McKinley and others, in press).

During the past century, fire activity in southern Nevada has been primarily associated with the warm (positive) phase of the multi-decadal Pacific Decadal Oscillation (PDO) cycle during which perennial fuels increase, and secondarily with the El Niño phase of the interannual El Niño-Southern Oscillation (ENSO) cycle during which fine ephemeral fuels increase due to increased precipitation. The El Niño effect alone may not be sufficient to promote large fires, and may only kick in during the latter part of or soon after a multi-decadal period of high rainfall associated with the PDO (e.g., after 1993, and especially during 2005 and 2006). Although intentional burning by humans has at times added significantly to acres burned, these fires likely remain small when climatic conditions result in sparse fuels.

Plant species in the genus *Bromus* are directly associated with changes in temporal and spatial patterns of burning in upland areas of the Mojave and Great Basin deserts. Although these species can undoubtedly alter fire regimes, their influence is ultimately tied to the PDO and ENSO cycles. Warm PDO phases are associated with exponential population growth of non-native annual grasses, such as that documented for *Bromus rubens* from the late 1970s through 1990. Increasing populations lead to high propagule production and dispersal into new areas, potentially increasing the regional scope of the grass/fire cycle. The El Niño ENSO phase is associated with years of extremely high rainfall that lead to episodic spikes in fuel loads created by invasive annual grasses and result in heightened fire hazards, especially in lower and middle elevation shrublands. The hallmark of the grass/fire cycle is a landscape dominated by invasive annual plants, with low abundance of native woody species, and continuous fuelbeds of ephemeral fine fuels that promote short fire return intervals (fig. 5.4). These conditions are most prevalent in Lincoln County.

Fire Effects and Management Actions

Although land management actions focus on individual fires, the ultimate influence of fire across landscapes and over time is attributed to fire regimes. The type (ground, surface, or crown fire), frequency (i.e., return interval), intensity (heat released), severity (ecological response), size, spatial complexity, and seasonality of fire define the fire regime. When fire regimes are altered (e.g., by plant invasions or land management practices) the recovery of the resident species following fire can be compromised and landscapes can be converted to new vegetation types.

All fires are not the same, although most published studies on fire effects report the effects of "fire" as if it is a univariate factor. The ultimate effects of fire are influenced by fire behavior, seasonality, and spatial pattern, in addition to the predominant life forms of plants and animals, the time elapsed since the previous fire, and the historical and current land uses and weather patterns.

Fire effects and appropriate management actions vary among the various ecosystem types in southern Nevada (table 5.1). Fire management is not a one-size-fits-all proposition, and the typical fire management concerns and guidelines for appropriate management actions must be examined in the context of each major ecosystem type.

Figure 5.4—A section of the 2005 Southern Nevada Fire Complex in the Tule Desert region of Lincoln County, NV. This is an area that had burned within the past few decades and was dominated by standing dead *Bromus* spp. biomass at the time of the fire (photo credit, Bureau of Land Management, Ely Field Office files).

Table 5.1—Typical fire management concerns associated with site and fire characteristics and guidelines for appropriate fuels management, fires suppression, and Emergency Stabilization and Rehabilitation (ES&R) actions in the major ecosystem types of southern Nevada.

Ecosystem type burned	Typical fire management concerns	Guidelines for appropriate management actions
Alpine and Bristlecone pine	*Fire* – Fires that burn more than a few acres and/or completely consume multiple trees. *Site* – Tree mortality and increased down woody fuels. Low tree recruitment post-burn and increased dominance of *Bromus* spp. could alter fire regime.	*Fuels* – Rarely warranted *Suppression* – Rarely warranted except to protect small and/or isolated stands if excessive fire spread is likely. *ES&R* – Rarely warranted unless perhaps to control invasive plants or following excessively large and severe fires.
Mixed conifer	*Fire* – High severity crown fire. Long fire return interval that allow excessive fuel accumulation. *Site* – Heavy surface and ladder fuel loads could lead to high severity crown fire. Wildland/urban interface (WUI) limits fire management options.	*Fuels* – Periodically warranted in the WUI, egress routes, and where surface and ladder fuels have accumulated increasing the risk of large fires. Mechanical treatments may be initially needed, but subsequent treatments should utilize low severity, surface prescribed fire. Follow-up control of invasive plants may be needed during the first few post-treatment years. *Suppression* – Rarely warranted except in the WUI, egress routes, and where surface and ladder fuels have accumulated increasing the risk of large fires. Low severity surface fire with minimal crowning should be allowed as a natural fire regime component for vegetation management benefits. Follow-up control of invasive plants may be needed during the first few post-fire years. *ES&R* – May be warranted to stabilize slopes near the WUI or following excessively large and severe fires.
Piñon and Juniper	*Fire* – High severity crown fire. Short fire return interval that does not allow re-establishment of shrub understory or trees. *Site* – Dominant invasive annuals. Short fire return intervals (≤60 years).	*Fuels* – Rarely warranted except in the WUI and egress routes and in shrub-dominated areas exhibiting tree expansion. Prescribed fire may be the more cost-effective over large areas. Follow-up control of invasive plants may be needed during the first few post-fire years. *Suppression* – Warranted in the WUI, and to prevent large, high severity crown fires, but low severity surface fire in areas of undesirable tree expansion may be allowed as a natural fire regime component for vegetation management benefits. Follow-up control of invasive plants may be needed during the first few post-fire years. *ES&R* –Warranted to reestablish native plant community characteristics and to control invasive plants if inadequate perennial herbaceous species and shrubs exist for recovery. Herbicides may allow short-term control, but long-term control requires a wider array of management actions, aerial seedings have low to moderate establishment rates.
Sagebrush	*Fire* – Large, homogenous fires *Site* – Dominant invasive annuals. Short fire return intervals (≤40 years).	*Fuels* – Rarely warranted, except in the WUI and egress routes and perhaps to increase the competitive ability of perennial herbaceous species and prevent invasive annual grass dominance. Prescribed fire rarely warranted except perhaps to create a stand-age mosaic in very old late-successional contiguous stands. Follow-up control of invasive plants may be needed during the first few post-treatment years. *Suppression* – Warranted in the WUI, and in areas with low abundance of perennial herbaceous species and high risk of conversion to annual invasive grasses. *ES&R* – May be warranted to reestablish the native community and to control invasive plants if inadequate perennial herbaceous species and shrubs exist for recovery. Herbicides may allow short-term control but long-term control requires a wider array of management actions, aerial seedings have low to moderate establishment rates.

(continued)

Table 5.1—(Continued)

Ecosystem type burned	Typical fire management concerns	Guidelines for appropriate management actions
Blackbrush/shadscale	*Fire* – Large, homogenous fires. *Site* – Dominant invasive annuals. Short to moderate fire return intervals (≤100 years).	*Fuels* – May be warranted to reduce non-native annual grass fuels, perhaps centered on roads, to facilitate fire suppression. Follow-up treatments may be needed on an annual basis. *Suppression* – Warranted under most circumstances. Prescribed fire is never warranted except perhaps for experimental purposes. *ES&R* – May be warranted to reestablish the native community and to control invasive plants if inadequate perennial herbaceous species and shrubs exist for recovery. Herbicides may allow short-term control of non-native annual grasses, but long-term control requires a wider array of management actions including reestablishment of native perennial species. Aerial seedings have low establishment rates. Livestock closures are necessary post-fire to facilitate recovery of native perennial plants.
Mojave desert scrub	*Fire* – High severity, large, homogenous fires *Site* – dominant invasive annuals, short to moderate fire return intervals (≤100 years)	*Fuels* – May be warranted to reduce non-native annual grass fuels, perhaps centered on roads, to facilitate fire suppression. Follow-up treatments may be needed on an annual basis. *Suppression* – Warranted under most circumstances. Prescribed fire is never warranted except perhaps for experimental purposes. *ES&R* – May be warranted to reestablish the native community and to control invasive plants if inadequate perennial herbaceous species and shrubs exist for recovery. Herbicides may allow short-term control but long-term control requires a wider array of management actions including reestablishment of native perennial species. Aerial seedings have low establishment rates. Livestock closures are necessary post-fire to facilitate recovery of native perennial plants.
Riparian and Spring	*Fire* – High severity crown, large homogeneous fire. *Site* – Dominant invasive perennials. Heavy surface and ladder fuel loads could lead to high severity crown fire. Flood disturbance may have larger effects than fire especially in unregulated riverine systems (e.g. Virgin River)	*Fuels* – May be warranted to reduce non-native tamarisk and Russian olive fuels to reduce high severity fire. Prescribed fire may be the most cost-effective way to reduce invasive plan biomass over large areas, but follow-up control of surviving invasive plants will always be needed during the first few post-fire years, potentially followed by native plant revegetation. *Suppression* – May be warranted in the WUI or where tamarisk and native vegetation are intermixed, otherwise low to moderate severity fire may be allowed where native fuels predominate as a natural fire regime component for vegetation management benefits, or moderate severity fire may be allowed where tamarisk dominates to remove above-ground biomass as a prelude to other tamarisk control actions such as herbicide treatments followed by native plant revegetation. *ES&R* – May be warranted to control tamarisk, herbicides may allow short-term control but long-term control requires a wider array of management actions including native plant revegetation which may be accomplished by seedings or outplantings.

Alpine and bristlecone pine ecosystem fires that burn more than a few acres and/or completely consume multiple trees are the primary management concern. Due to a warming climate, tree mortality and down woody fuels may increase, tree recruitment post-burn may decrease, and *Bromus* spp. may increase to the point that the fire regime is altered. Fuels management and fire suppression are currently not warranted, but may be in the future. Postfire Emergency Stabilization and Rehabilitation (ES&R) actions are rarely warranted, except to reduce the threat of future type conversion mediated by invasive plants or excessively large fires.

High severity crown fire is the primary management concern in the mixed conifer ecosystem. This type of fire can result from long fire return intervals that allow excessive accumulation of surface and ladder fuels. Fuels management in the form of wildland fire use in resilient tree communities with low risk of high severity fire may be warranted to maintain low levels of ladder fuels. Moderate intensity surface fires at appropriate intervals can help maintain managed fuel zones and provide ecosystem benefits in many mixed conifer communities. However, in communities with low resilience to fire and resistance to invasive species or that are at risk of high severity fires, mechanical thinning may be required. Fire suppression is warranted to prevent high severity fires and protect the loss of human life and property at the (WUI). Postfire ES&R actions are warranted to stabilize slopes in the WUI following large and/or high severity fires, and in areas that lack the necessary understory species for ecosystem recovery. Concerns about land management activities within the WUI often limit management options, especially the use of managed fire. However, these tools are necessary to ultimately reduce threats to human life, infrastructure, and ecosystem integrity.

High severity crown fire is also the primary management concern in the piñon-juniper ecosystem. Piñon and juniper species are actively expanding into sagebrush and other shrub dominated ecosystems in southern Nevada. Progressive increases in fuel loads due to tree infilling are increasing the risk of large, high severity fires. In addition, invasion of annual grasses (*Bromus* spp.) at low to mid elevations can shorten fire return intervals below levels where either sagebrush species or piñon and juniper trees can reestablish (≤60 years). Wildland fire use is warranted in communities that are resilient to fire and have sufficient understory species (fire-tolerant shrubs and perennial grasses and forbs) for natural recovery. Mechanical thinning is the preferred tool in areas that have low resilience to fire and/or insufficient understory species for recovery. Fire suppression is warranted to prevent high severity fire and protect the loss of human life and property at the WUI. Postfire ES&R actions are warranted to reestablish native communities and to control invasive plants if inadequate perennial herbaceous species and shrubs exist for recovery. Herbicides may allow short-term control but long-term control requires a wider array of management actions, and aerial seedings have low to moderate establishment rates.

Large fires that encompass a majority of stands and the initiation of a grass/fire cycle, shorter fire return-intervals, and vegetation type-conversion are the primary management concerns in the sagebrush ecosystem. Fuels management is rarely warranted, except in the WUI and perhaps to increase the competitive ability of perennial herbaceous species and prevent invasive annual grass dominance. Fire suppression is warranted in the WUI and in areas with low abundance of perennial herbaceous species and high risk of conversion to annual invasive grasses. Postfire ES&R actions may be warranted to reestablish the native community and to control invasive plants if inadequate perennial herbaceous species and shrubs exist for recovery. Herbicides may allow short-term control but long-term control, requires a wider array of management actions, and aerial seedings have low to moderate establishment rates.

Blackbrush/shadscale and Mojave Desert scrub fires of most any type, but especially large, homogenous fires, are a primary management concern. Increased dominance of invasive annual grasses that lead to short to moderate fire return intervals (≤100 years) is also a management concern. Fuels management may be warranted to reduce invasive annual grass fuels, perhaps focused on roadsides, to facilitate fire suppression. Fire suppression is warranted under most circumstances. Postfire ES&R may be warranted to reestablish the native community and to control invasive plants if inadequate perennial herbaceous species and shrubs exist for recovery. Herbicides may allow short-term control, but long-term control requires a wider array of management actions. Aerial seedings have very low establishment rates and are not a solution. Postfire closures of livestock, wild horses, and burros may be necessary to facilitate recovery of native perennial plants.

Riparian and spring ecosystem fires that are large, homogenous, high severity crown fire are the primary management concern. Increased dominance of invasive tamarisk and accumulation of heavy surface and ladder fuels can lead to high severity crown fire. The non-native Russian olive may produce similar results in the future if it becomes more dominant. Fuels management may be warranted to reduce invasive tamarisk and Russian olive fuel loads. Fire suppression may be warranted in the WUI or where invasive and native vegetation are heavily intermixed. Low to moderate severity fire similar to the natural fire regime may be warranted where native fuels predominate for vegetation management benefits. Moderate severity fire also may be warranted where tamarisk dominates to remove above-ground biomass as a prelude to other control and restoration actions. Postfire ES&R actions may be warranted to control tamarisk and other invasive plants. Herbicides may provide short-term control but long-term control requires a wider array of management actions. Native plant revegetation may be accomplished by seedings or outplantings.

Knowledge Gaps and Management Implications

Important take home messages for land managers are that: (1) the effect of an individual fire event should be evaluated within the context of the ecosystem type in which it occurs, the characteristics of the fire, and characteristics of the site; (2) fire suppression is the most cost effective way to manage fires across most of southern Nevada, except in those ecosystem types where fire is part of the natural disturbance regime and wildland fire use can be used to achieve management objectives; and (3) the current range of post-fire mitigation tools are either ineffective or their effectiveness is poorly documented. Like all aspects of land management, fire management must ultimately be placed in the broader context of all the other factors associated with managing landscapes in southern Nevada. In some cases, decisions may need to be made regarding where to allocate limited resources; in other cases, conflicting objectives may need to be resolved between fire management and those focused on other management topics (especially natural and cultural resources). For a complete discussion of topics in this executive summary, see *Chapter 5, Fire History, Effects and Management in Southern Nevada*, in "The Southern Nevada Agency Partnership Science and Research Synthesis—Science to Support Land Management in Southern Nevada" (RMRS-GTR-303).

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