



Developing a Monitoring Program for the Nevada Wildlife Action Plan

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The Nevada Wildlife Action Plan is one of 56 State Wildlife Action Plans that together represent a significant milestone for biodiversity conservation in the United States. For the first time, the wildlife agencies in each state and territory have identified species of greatest conservation need, priority ecosystems and habitats, significant threats to biodiversity, key conservation actions, and potential monitoring and evaluation activities.

The states and territories will soon find themselves under pressure from Congress and others to demonstrate that the actions described in these plans can actually achieve meaningful improvements in wildlife populations. At the same time, resources for implementing the plans (including the monitoring and evaluation components) remain quite limited; funding for the federal State Wildlife Grants program has remained level in FY-06 and FY-07 at \$67.5 million, or only slightly more than \$1.2 million on average for each state and territory.

With such limited resources, the state wildlife agencies need to identify creative strategies for monitoring and evaluation. Ideally, in Nevada these strategies should be relatively inexpensive and take advantage of existing monitoring programs, yet still provide meaningful feedback on plan implementation.

Nevada's well-developed, comprehensive Wildlife Action Plan, its rich wildlife and fishes diversity, its history of resources stewardship, and experience in assessment and monitoring combine to provide a near perfect template for developing an model performance measures approach. In partnership with The Heinz Center and the University of Nevada, Reno, the Nevada Department of Wildlife (NDOW) has sponsored a series of three workshops to select indicators for monitoring the status of target ecosystems and species and for monitoring the effectiveness of conservation activities. This series of workshops has brought together technical experts and natural resource decision-makers to identify broad conservation targets, develop conceptual models showing the relationship of stressors and conservation activities for each target, select monitoring indicators for each target, and initiate development of a sampling design for each indicator.

First Workshop: Target Selection and Conceptual Modeling

The first workshop was held on March 6-7, 2008, in Reno, Nevada. The workshop was hosted jointly by Nevada Department of Wildlife and The Heinz Center. Participants included representatives from federal and state natural resource management agencies (U. S. Fish and Wildlife Service, U. S. Bureau of Land Management, U. S. Geological Survey, U. S. Environmental Protection Agency, USDA Forest Service, Nevada Department of Wildlife, Nevada State Land Agency), non-profit organizations (The Nature Conservancy, Nevada Audubon Society, Great Basin Bird Observatory), as well as academic institutions (University of Nevada-Reno, Colorado State University).

This first workshop addressed three major topics: the selection of targets for management and monitoring; the identification of threats, opportunities, and desired condition for targets; and the development of a conceptual model for each target.

1) Select Targets for Management and Monitoring

The Nevada Wildlife Action Plan includes detailed descriptions of numerous priority ecosystems and species within the state of Nevada. Given that there are limited resources for

implementation, and even more limited resources for monitoring and evaluation, it makes sense to identify a modest suite of targets for management and monitoring. In evaluation practice, “targets” are specific environmental conditions or variables that managers are attempting to influence through project activities (Margoluis and Salafsky 1998).

The group as a whole developed a consensus set of conservation targets for priority monitoring work in the state.

Target Selection Exercise

- 1) Each partner organization lists its own highest-priority conservation targets that are included in the Nevada Wildlife Action Plan, which are written on large sheets of paper and displayed at the front of the room.

- 2) The group reviews the list and amalgamates similar or related targets. For instance, “springs” and “springbrooks” might be amalgamated into a single category. “High-altitude ecosystems in the White Mountains” and “Alpine ecosystems” could be amalgamated into a single category. The definition of “similar or related” is determined by the group. Amalgamation continues until the group feels comfortable with the list of targets.

- 3) Participants use sticky dots to “vote” on the highest priority targets: those which are most important for the conservation of wildlife and biodiversity in the state of Nevada.

Nevada workshop participants identified three “ecosystem-level” Wildlife Action Plan targets – the Mojave Desert ecosystem, the land cover across the southern one fourth of the state; springs and springbrooks, critical water sources for wildlife and biodiversity hotspots across most of the state, and sagebrush ecosystems, the most extensive and widespread vegetation cover type in the state.

2) For selected targets, identify threats and other factors that could influence the target, possible conservation actions, as well as desired future condition

We wanted to be clear on the management goals and objectives for each of the targets identified in the first exercise. Different goals or objectives can very easily translate into different management activities and different performance measures.

The group divided into a series of working groups, each of which focused on one of three targets identified as highest priority by the larger group: the Mojave Desert, springs and springbrooks, and sage and sagebrush ecosystems.

Each working group brainstormed a list of possible threats to the target, as well as conservation actions that could be taken to counteract the threats. Using the list of threats as well as the participants' knowledge of the target ecosystems, a very simple desired future condition statement was developed for each of the targets.

Threats

The Nevada Wildlife Action Plan identifies numerous potential threats to wildlife and habitat areas. For each target, we listed the specific threats that are thought to influence the target.

Conservation Actions

For each threat or stressor, we listed the potential conservation actions that could be taken to counteract its negative effects on the target. These should be actions that could be realistically taken by NDOW or its partners, with appropriate resources.

Desired Future Condition

For each target, we developed a simple statement of desired future condition (described below for the sagebrush ecosystem). The statement included a description of the desired condition for each of the threats or stressors (e.g. "invasive plants removed," "point source pollution eliminated") as well as statements about the structure and extent of the ecosystem (e.g. "heterogeneous mix of forbs, grasses, and mature sage," "composed of large, unfragmented blocks over 10,000 acres in extent"). Although we did not use

individual species as targets in this exercise, a desired future condition statement for a species would include statements about key demographic parameters such as population size, population growth rate, and/or geographic distribution.

3) Develop Conceptual Model for one or more targets

Conceptual models are an important part of the process of developing performance measurement systems. Such models range from simple box-and-arrow diagrams to sophisticated computer models that allow quantitative predictions.

Our workshop break-out groups developed a diagrammatic conceptual model for each of our targets. These models use boxes and arrows to show the cause-and-effect relationships between a target, the major threats and stressors that affect the target, and the conservation actions that could ameliorate these threats and stressors.

Although the basic components of these models are quite simple (a conservation target, multiple stressors, multiple conservation actions, and arrows illustrating causal links), the actual models that we developed were complex, with multiple arrows showing causal linkages between the individual stressors as well as between stressors and the target.

These models provide important information about how a conservation action would actually help to benefit the target, by identifying threats and stressors that the conservation action would affect. The models also help suggest potential measures of the effectiveness of conservation actions: if an activity is designed to reduce a particular stressor on a target, then measures of the action's effect on the stressor could be a useful measure effectiveness of the conservation activity. Since most targets are affected by multiple stressors, however, measurements of the target's status and comparison with the desired future condition are needed as well.

The following conceptual models were developed at our first workshop.. Each model includes a target (selected by the group of natural resource managers attending the workshop) in RED at the center, as well as a suite of threats or stressors that could potentially affect the target. The threats

and stressors are further divided into direct threats (those that affect the target directly) in WHITE and indirect threats (those that operate through intermediaries) in YELLOW. The arrows indicate cause-and-effect relationships: the factor at the blunt end of the arrow affects the target or factor at the pointed end of the arrow. The models also include potential actions or categories of activities in GREEN that can be undertaken to ameliorate each of the potential threats.

The first model (Figure 34) describes the broad relationships between the Mojave Desert ecosystem in southern Nevada and its major stressors, both direct (such as fire, urban growth, and off-highway vehicles, or OHVs) and indirect (such as climate change and a lack of human appreciation). Potential conservation actions have been described for some, but not all, of these stressors. Note that information needs are also included in this model: there are clear needs for identification of successful mitigation techniques, as well as better information on reptile species distribution and abundance.

Mojave Desert Ecosystem:

Relationships between targets, direct factors, indirect factors, and actions/opportunities

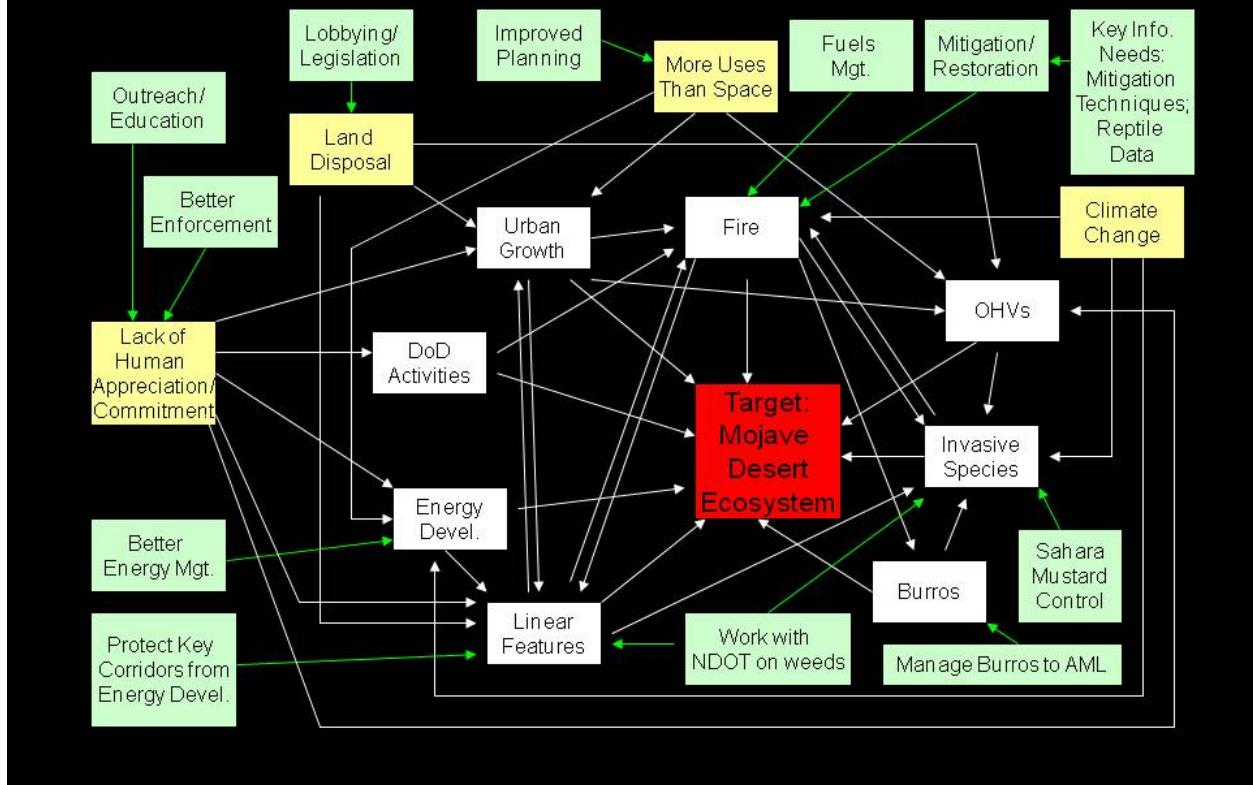


Figure 34: A conceptual model of the Mojave Desert ecosystem in Nevada, showing the conservation target (red), factors which directly affect the target (white), factors which only indirectly affect the target (yellow), and potential conservation actions (green).

The second conceptual model (Figure 35) depicts the direct and indirect threats and potential conservation actions for spring and springbrook communities in Nevada. This model highlights some key research needs: the development of viable methods for habitat restoration, and the development of methods of control for invasive species.

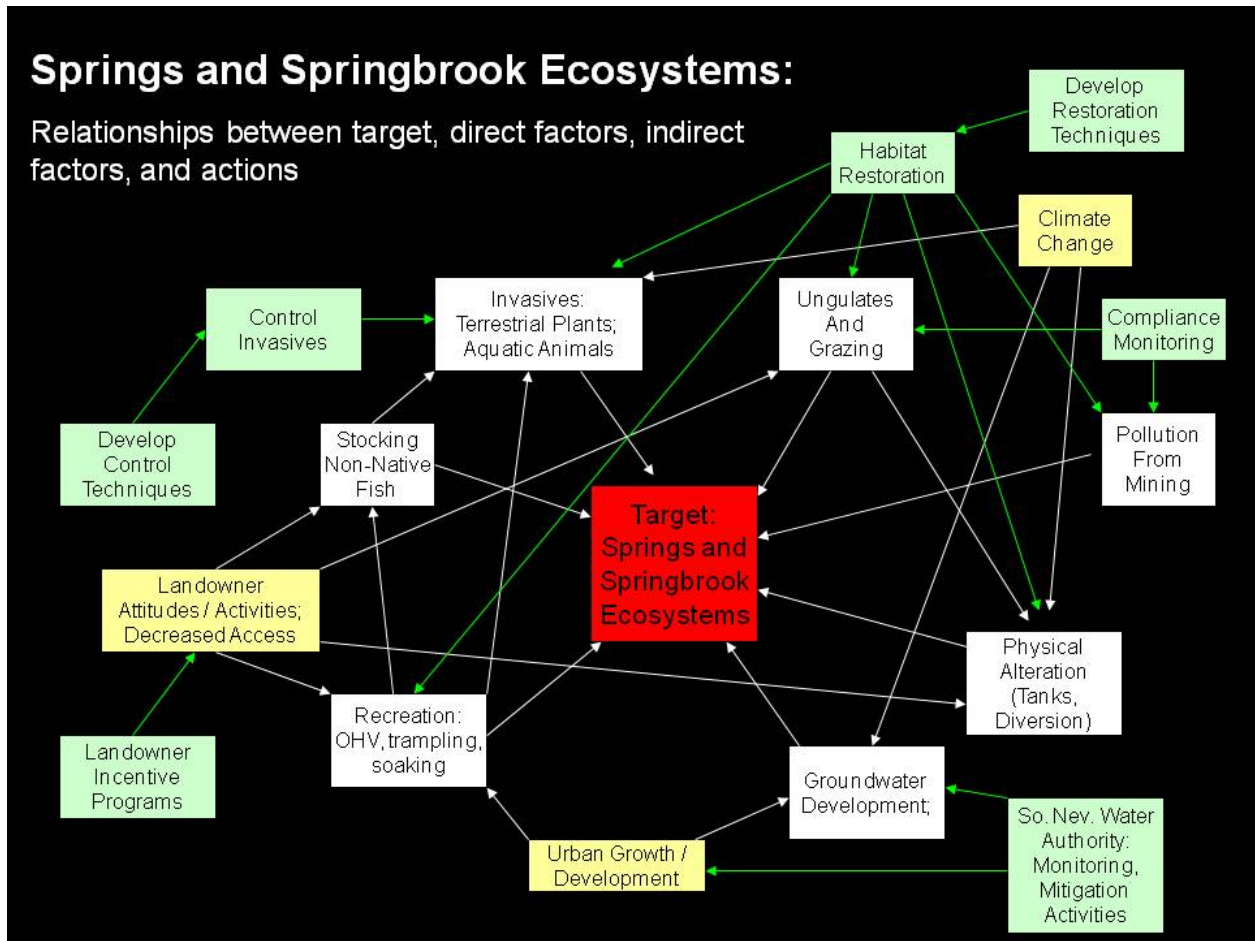


Figure 35: A conceptual model for spring and springbrook ecosystems in Nevada, with conservation target (red), factors directly affecting the target (white), factors indirectly affecting the target (yellow), and conservation and management activities (green).

Our final conceptual model (Figure 36) illustrates the relationships between sagebrush ecosystems, major threats and stressors, and potential conservation activities. Major concerns in this ecosystem center around the interrelated effects of fire and invasive/noxious weeds.

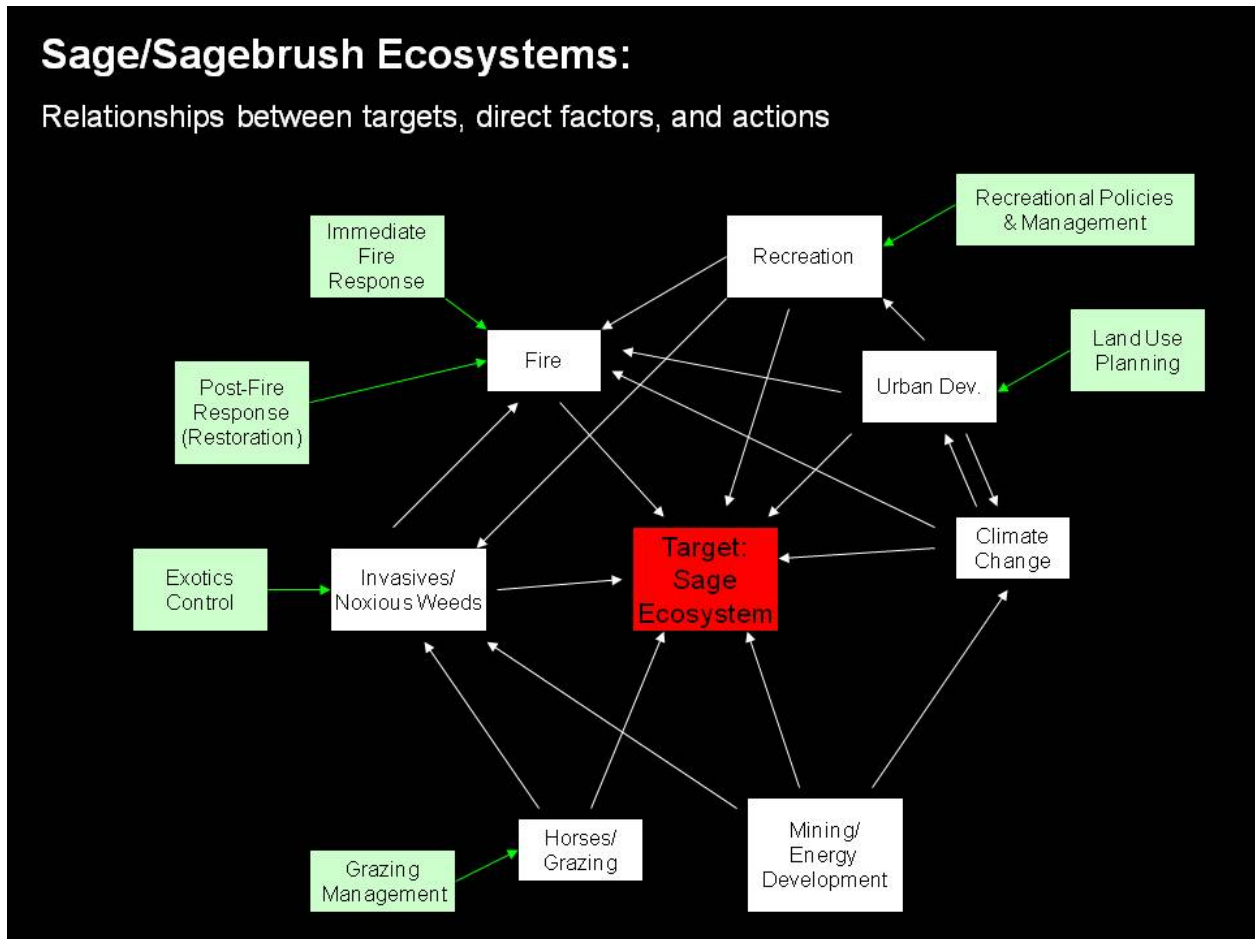


Figure 36: Conceptual model for sage and sagebrush ecosystems in Nevada, showing target (red), factors (white), and potential conservation and management actions (green).

The Sagebrush Technical Advisory Team

The conceptual models described above were built with the expectation that they would provide the basis for expert ecologists and wildlife managers to identify indicators the actual vegetative or wildlife population-based parameters that would most likely give Action Plan monitors insights into the status and trend of the target ecosystems' wildlife habitat performance. It was recognized that the next stage of the process would require a set of subject matter experts different from the first committee, and NDOW extended invitations to a set of such experts in sagebrush ecology to form the Sagebrush Technical Advisory Team (STAT). This committee met for the first time on August 15 and 16, 2008, and again on December 4, 2008.

The STAT operated under the programmatic goal from Nevada’s Wildlife Action Plan for wildlife in the state’s extensive sagebrush lands. It calls for *“Thriving self-sustaining wildlife populations in healthy sagebrush communities on stable soils; vigorous structurally diverse shrub component in various age classes; vigorous, diverse self-sustaining understory of native grasses and forbs.”*

The advisory team ultimately adapted that goal statement to a statement of desired future condition for the sage ecosystem with a *draft* preamble that will require policy review by Wildlife Action Plan partners -- *The Nevada Wildlife Action Plan supports management activities that will sustain and recover viable populations of the state’s desired wildlife and the ecosystems that they depend upon. The Department of Wildlife and its land management partners intend to manage and restore Nevada’s sage-dominated lands for desired wildlife species to provide habitats that are sufficiently extensive, interconnected, and widely distributed across full the historical ranges of those species, in an effort to assure the persistence of the state’s wildlife heritage.*

The STAT began by reviewing a set of “desired conditions” identified for the sagebrush ecosystem by the partners working group. These objectives were extracted from Nevada’s Wildlife Action Plan; they include:

- Stopping losses and conversion of sagebrush ecosystems and habitat
- Encouraging healthy sagebrush communities on stable soils
- Sustaining sagebrush communities that are consistent with ecological site descriptions
- Managing for sagebrush stands that include diverse age classes
- Restoring vigorous sage community under-stories of native grasses and forbs
- Maintaining these conditions in large, contiguous blocks of sagebrush vegetation across landscape

The committee learned that these objectives were relatively well-corroborated by independent analysis occurring in such publications as Paige and Ritter’s “Birds In A Sagebrush Sea” (1999)

and Miller and Eddleson’s “Spatial and temporal changes of sage-grouse habitat in the sagebrush biome” (2001), and provided the basis for the following draft description of desired future conditions for Nevada’s wildlife and their sagebrush habitats –

For wildlife that require resources that are provided in sage-dominated vegetation communities, the WAP recognizes that a mosaic of sage community types and subcommunities, represented as diverse successional stages across the landscape, will benefit the widest diversity of targeted species. Both dominant shrub species and a rich under-story of native grasses and forbs is required to assure ecosystem function and wildlife persistence. Healthy sage communities that support targeted wildlife are interdigitated with other shrub and woodland communities, dry and wet meadows, riparian strands, seeps, and springs that support native woody vegetation, grasses, and forbs. Sage-dominated communities are most resilient to natural and human-generated disturbances where they are diverse in composition and structure. Such communities experience wildfire patterns that are patchy because of limited and discontinuous fuels, and are resistant to conversion to less desired community types following landscape-level disturbance events. To sustain viable populations of Nevada’s wildlife species under the WAP, managers will need to closely monitor the status and trends of wildlife in sage communities across the state, and anticipate future changes in distribution and abundances, especially those associated with climate change.

During discussion of WAP sagebrush habitat goals several key issues were vetted, including recognition that vegetation community variability within the “sagebrush ecosystem” is great and that selection of performance indicators would need to account for that variability with respect to wildlife-habitat relationships. It was also recognized that there is a wide range of perceptions among experts regarding the definition of “healthy” sagebrush communities. “Stop the loss” needed to be addressed within a temporal context, with the recognition that sagebrush cannot be conserved without recruitment from a diversity of age classes and successional stages. Also key to development of performance indicators is an understanding of how different elements of the sagebrush community function to support key wildlife life history requirements.

The STAT elected to address the sage ecosystem as three distinct community types -- Wyoming big sage, mountain big sage, and short sage (that is, low or black sage) – each of which support a distinct suite of wildlife species and require different management prescriptions. The team also recognized the importance of evaluating the contribution to wildlife life history requirements of each community type as breeding habitat (summer range) and survival habitat (winter range). It was noted that the mountain big sage type provides the majority of shrub species diversity that is important to mule deer. The STAT also postulated that under-story grasses and forbs are critical in the performance of sagebrush as wildlife habitat.

With that background, the STAT listed the Species of Conservation Priority from the Wildlife Action Plan, which was intended to constitute a first-cut list of candidate indicators. The list included --

- Greater Sage-grouse
- Sage Sparrow
- Brewer’s Sparrow
- Pygmy Rabbit
- Sage Thrasher
- Black-throated Sparrow
- Mule Deer
- Gray Flycatcher
- Sagebrush Vole
- Merriam’s Shrew
- Preble’s Shrew
- Ferruginous Hawk
- Bald Eagle
- Burrowing Owl
- Prairie Falcon
- Green-tailed Towhee
- Desert Horned Lizard
- Bald Eagle
- Burrowing Owl
- Prairie Falcon
- Green-tailed Towhee
- Desert Horned Lizard
- Bald Eagle
- Burrowing Owl
- Prairie Falcon
- Green-tailed Towhee
- Desert Horned Lizard
- Greater Short-horned Lizard
- Pygmy Short-horned Lizard
- Wyoming Ground Squirrel
- Mountain Bluebird
- Columbian Sharp-tailed Grouse
- Vesper Sparrow

- Greater Short-horned Lizard
- Pygmy Short-horned Lizard
- Wyoming Ground Squirrel
- Mountain Bluebird
- Columbian Sharp-tailed Grouse
- Vesper Sparrow

The group added the sagebrush lizard to the list of candidates, because of its general recognition as a “sagebrush obligate” species, and white-tailed jackrabbit, because of recent elevated concern over its conservation since the completion of the Wildlife Action Plan in 2005.

The STAT then explored what is known about habitat elements that are believed to trigger population responses in each species. Species were addressed in the following “habitat type” and functional group categories --

- Mature Shrub
 - Greater Sage-grouse
 - Sage Sparrow
 - Brewer’s Sparrow
 - Sage Thrasher
 - Black-throated Sparrow
- Early and Midseral Shrub
 - Mule Deer
- Tall Big Sage/deep soils
 - Pygmy Rabbit
 - Gray Flycatcher
- Woodland and Rock Ecotone
 - Ferruginous Hawk
 - Mountain Bluebird
- Grasses/Forbs

- Greater Sage-grouse
- Columbian Sharp-tailed Grouse
- Vesper Sparrow
- Sagebrush Vole
- Merriam's Shrew
- Preble's Shrew
- Sandy Soils
 - Burrowing Owl
 - Dark Kangaroo Mouse
 - Pale Kangaroo Mouse
- Mesic Sites
 - Green-tailed Towhee
- Prey Populations
 - Ferruginous Hawk
 - Bald Eagle
 - Prairie Falcon
 - Horned Lizards
- Generalists
 - Wyoming Ground Squirrel

The STAT developed a list of vegetation and physical characteristics that are associated with the sagebrush ecosystem and are believed to determine habitat suitability for wildlife species. It evaluated how readily the characteristics can be measured. The characteristics included --

- Shrub height and density
- Shrub species diversity and relative abundance
- Understory forb and grass species diversity and abundance
- Diversity of seral stages
- Contiguity of large blocks over the landscape (patch size)
- Habitat configuration (mosaic qualities)

- Availability of surface water
- Soil characteristics (depth, friability, trace elements)
- Rock features (cliffs, monoliths, etc.)

Next, the STAT parsed the vegetation characteristics across the three sagebrush community types:

- Mountain Big Sage – all nine attributes listed above
- Wyoming Big Sage – all attributes listed above except “shrub species diversity
- Low/Black Sage
 - Shrub Height and Density (less variable and less pertinent for some species)
 - Understory
 - Seral State
 - Soil Characteristics
 - Rock Features

As its next task, the STAT identified key stressors that operate to compromise the integrity of sagebrush ecosystems, and discussed the impacts of each stressor on the vegetation community characteristics that appear to serve as important wildlife habitat attributes. Team members were in agreement that wildfire, non-native animal species and weeds, and grazing exert significant impacts on and cause important changes in all the key habitat attributes except “rock features.” “Stand decadence” was identified as a vegetation condition that suppressed overall ecosystem vigor, with concomitant negative wildlife responses, and its existence was attributed to fire suppression and lack of natural disturbances. Recreation and off-highway vehicle use were identified as important vectors of invasive species, disturbance, and habitat fragmentation. Several stressors were grouped into one set with similar impacts – “urban and exurban development, mining and energy development, and water transport interrupt of landscape (ecological) connectivity, and impact wildlife dispersal, including migration, cause habitat fragmentation and loss, reduce availability of surface water, create disturbance, cause direct mortality, and facilitate predation. “Agriculture” was identified as a source of habitat loss and conversion, weed invasion, habitat fragmentation, contaminant pollution, disease, and concentrated grazing in uplands adjacent to agricultural areas. It is important to note that this

evaluation of “agriculture” was within the context of sagebrush habitat maintenance and did not constitute an evaluation of the intrinsic wildlife habitat values of agricultural lands themselves, which can be considerable.

Effects of climate change included facilitation of plant invasion; wholesale distributional shifts in vegetation distribution, composition, and structure, and altered availability of surface water; altered soil characteristics; altered fire intervals; increases in disease vectors; altered habitat connectivity; changes in plant phenologies and concomitant perturbations of pollinator relationships; and changes in precipitation regimes. Predator-prey relationships are impacted by artificial anthropogenic subsidies (for example, garbage and roadkill) A population-specific stressor, disease, was prioritized, as was animal harvest, particularly commercial reptile collecting, which is chiefly perceived as a population stressor, but an additional concern is habitat alteration, which frequently accompanies the harvest of certain reptile species.

The STAT next linked the prioritized wildlife species to the vegetation and physical sagebrush. While determining the positive, negative, or neutral responses of the list of priority species to the different attributes, the team also considered the relative dependence of the wildlife species on sagebrush communities, both in terms of presence and “relative density” (defined as the expected densities of a species in sagebrush types when compared to other vegetation types with which they may occur). The conservation status of each species was also considered - whether it was listed or a candidate under the federal Endangered Species Act, its status in the state’s “bird plan” priorities, or its priority in the Nevada Wildlife Action Plan (Table 1).

The STAT chose to assess “indicator value” of each species on the list using the following criteria:

- Availability of data
- Specificity of habitat association
- Widespread distribution
- Ease of detection
- Species abundance

These important practical criteria recognize the real logistical and technical limitations placed on potential monitoring efforts. In general small mammals and most reptiles were rejected because of sampling constraints and challenges, as well as, acknowledgement that populations (particularly those of small mammals) have been demonstrated to fluctuate dramatically from year to year in response to environmental triggers that in many cases are poorly understood. The group recognized value in prioritizing high-profile species such as Greater Sage-grouse, mule deer, and pygmy rabbit because of standing public focus on these species, and at least for mule deer and sage grouse, the existence of well- developed monitoring programs. In addition, the STAT recognized the value of monitoring sagebrush-associated passerine birds, not only for their differential coverage of several key habitat attributes, but because, again, a statistically rigorous monitoring program already exists for these species -- the Nevada Bird Count administered by Great Basin Bird Observatory -- with five years of survey already in hand. The STAT explored the feasibility of attaching simple vegetation surveys to the Nevada Bird Count to take advantage of its extensive sample grid and manpower base.

Certain species were recognized as likely candidates for monitoring, but for reasons other than as indicators of vegetation type or condition. For example Ferruginous Hawk is currently under review for potential listing under the federal Endangered Species Act, and is suspected of being susceptible to impacts from energy development across its range. This heightened awareness might very well result in increased monitoring attention to the species, but its value as an indicator of sagebrush ecosystem health is likely not as acute as other species with a more direct association to sagebrush habitat. The white-tailed jackrabbit has also come under heightened conservation status scrutiny in the last year, but the STAT recognized its rarity and distribution limitations as problematic in selecting it as a statewide sagebrush indicator.

Indicator species selected for each of the three sagebrush types include --

Mountain Big Sage

- Greater Sage-grouse – suitable all-around

- Loggerhead Shrike – possibly well-connected to lower trophic organisms as a predator, which might reflect community conditions
- Brewer’s Sparrow – sagebrush cover
- Sage Sparrow – sagebrush cover
- Gray Flycatcher – sagebrush height and shrub species diversity
- Sage Thrasher – sagebrush cover, height
- Green-tailed Towhee – strong association with mountain big sage, shrub species diversity
- Vesper Sparrow – strong association with early seral stages, perennial bunchgrasses, and steppe
- Black-throated Sparrow – possibly indicative of declining habitats
- Pygmy rabbit – simple, inexpensive to monitor
- Mule deer – shrub species diversity and understory

Wyoming Big Sage

- Greater Sage-grouse – suitable all-around
- Loggerhead Shrike
- Brewer’s Sparrow – shrub density/height
- Sage Sparrow
- Gray Flycatcher – tall sage, tall riparian sage, and deep soils
- Sage Thrasher – shrub density/height/age
- Black-throated Sparrow – possibly indicative of declining habitats and strong association with Wyoming big sage
- Pygmy rabbit – simple, inexpensive to monitor
- Mule deer – understory, shrub vigor, and thermal cover value

Low/Black Sage

- Greater Sage-grouse – breeding habitat and early-season forb use
- Mule deer – abundant winter forage and shrub vigor

Vegetation Sampling

Three site-sampled parameters were selected as habitat performance indicators – shrub height and density, shrub species diversity, and understory. Prospective methods for data collection were explored, with emphasis on measurement tractability and efficiency

- Shrub height and density – line transect, cover board, photo plot. A volunteer might possibly be trained to conduct, but paid biotechnician might be necessary for acceptable data quality.
- Shrub species diversity – line transect.
- Understory – grass and forb abundance measurements could be conducted by a volunteer, but species composition would require trained technicians. Digitized plots for presence/absence – presence would indicate availability. Intensive plot sampling might be necessary to establish more reliable understanding of wildlife and understory connections.

Vegetation sampling parameters measurable through remote sensing included --

- Seral stage
- Available habitat (sagebrush type identification)
- Patch size
- Configuration
- Distance to surface water
- Soils

The STAT next evaluated the ability to monitor the impacts of the major stressors on the key habitat elements within the sagebrush types, with the following results:

- Stand Decadence
 - Fire suppression – yes
 - Lack of disturbance – yes
 - Altered disturbance regime – yes

- Recreation- OHV
 - Vectors for invasive species – yes
 - Vectors for disturbance – no
 - Vectors for roads/trails – yes (GIS)
 - Direct mortality – no

- Urban/exurban Development
 - Direct loss – yes

- Mining/energy development/water transport
 - Ecological connectivity – yes (GIS)
 - Habitat fragmentation and loss – yes (GIS)
 - Availability of surface water – yes (GIS)
 - Disturbance (noise) – no
 - Direct mortality – no
 - Facilitation of predation – no; specialized monitoring necessary

- Agriculture
 - Habitat loss or conversion – yes
 - Invasive species – yes
 - Habitat fragmentation – yes
 - Concentrated grazing in adjacent uplands – yes
 - Pesticide applications – no; additional monitoring as appropriate
 - Disease – no; additional monitoring as appropriate

- Climate Change (direct and indirect)
 - Facilitated invasions of plants – yes
 - Wholesale distributional shifts in vegetation – yes
 - Availability of surface water – yes
 - Soil characteristics – yes
 - Fire interval – yes
 - Disease vectors (susceptibility to pathogens) – no; additional monitoring
 - Connectivity (seasonal movement and migration) – yes
 - Phenology changes – no; additional studies needed
 - Precipitation change – yes

- Predator/Prey Relationships (indirect)
 - Anthropogenic subsidies – no; additional monitoring
 - Roadkills and ravens – no; additional monitoring

- Disease – no

- Harvest/collection management – no; monitoring as needed

From indicators to sampling design

An expanded Sagebrush Technical Advisory Team convened on 4 December 2008 with the intention to reconfirm selected species-level indicators from an updated list. The group reminded itself of the intention of the performance indicators and measures task for the WAP -- that the intended purpose of identifying indicators and measures is to provide the environmental attributes to be assessed in a monitoring scheme that will inform management actions under the Wildlife Action Plan. The objectives of this third meeting were to:

- further narrow (or otherwise focus) the candidate indicator species list
- agree on a process to follow for identifying indicator species

- initiate the identification of monitoring protocols and/or pilot studies necessary to guide the development of a sampling design.

Presentations were made by technical experts who have designed sampling schemes for birds, small mammals, and the herpetofauna that inhabit sagebrush. All aspects of species biology were considered in vetting the list of candidate indicators, as were the life history characteristics that make each candidate either effective or ineffective as a surrogate measure for environmental condition, and an appropriate surrogate measure for the status of co-occurring species. Importantly, the tractability of each species in the potential role a monitoring target was discussed – that is, could the species be surveyed effectively and efficiently in a monitoring framework that will be constrained by available funding. And, does time-series survey data exist that can provide historical status and trends context, and help to inform the design of the monitoring framework?

Accordingly *Priority Key Species* were identified from the candidate list --

- | | |
|-----------------------|------------------|
| • Greater Sage-grouse | Mule deer |
| • Vesper Sparrow | Pygmy rabbit |
| • Sage Sparrow | Sagebrush vole |
| • Brewer’s Sparrow | Least chipmunk |
| • Lark’s Sparrow | Horned lizard |
| • Sage Thrasher | Sagebrush lizard |

These species will serve as initial indicators for the Wildlife Action Plan. It was generally agreed that, even for this comparatively trim species list, a full-scale, geographically dispersed monitoring framework could not be immediately brought on line given the limited information available for most of the priority species. A pilot study was proposed. The pilot study would adopt all proposed survey tools and environmental measurements at a well-distributed subset of proposed study sites across the state. Three or more years of biannual sampling in the pilot study will allow assessment of the efficacy of the initial indicators as targets for the monitoring effort. It is expected that one or more of the initial indicators may prove ineffective in providing

information about environmental status and trend, and may be dropped in the monitoring effort or replaced with another species. During the pilot studies it is expected that ecosystem (vegetation community) conditions and indicator species values be identified, which will be used to set initial thresholds for management intervention or restoration action.

Towards a sampling design

The STAT discussed the scale of the approach, with primary recognition that scaling was irrevocably tied to available funding. The state has previously been divided into “land resource areas,” ten of these areas support at least some sagebrush communities. To capture regional (statewide) status and trends of wildlife and the ecosystems that support them, these large “subregions” ought to be subjects of WAP sagebrush ecosystem monitoring. The group set a target of 100 sample sites to be established across sagebrush communities with a minimum of 10 sample sites (monitoring units) in each of the land resource areas. (The pilot study phase will operate at ten of those one hundred sites.) Locations will be selected to represent not only the geographic breadth of the sage ecosystem, but vegetation condition, species diversity, and successional status. Sites should be visited two times a year for data collection (for a total of 200 sampling events per year state wide).

The geographic distribution of sample sites is on a relatively concordant scale with ongoing annual Nevada Bird Count data collection in sagebrush communities; tiering off that current effort in order to take advantage of historical data and continuing survey efforts, using currently employed standard ten-point bird point-count techniques. Sampling strategies for the other taxonomic groups and species were proposed. Greater sage grouse is the one priority bird species that is not expected to be encountered during point-count surveys. Well-developed and long-established sage grouse monitoring is ongoing state wide; WAP sample sites, wherever possible, will be located adjacent to active or historic lek sites so to be able to use those data.

The key logistical challenge is to set up and distribute small mammal traps at each survey site Sherman traps are to be set at 50 stations at each site. Each animal caught will be subjected to ear punch and blood withdraw for genetic and disease baseline monitoring (with expansion of

sampling contingent on funding). Evenings on site will include spotlighting for rabbits and mule deer. During daytime surveys for deer and rabbit pellets and other sign are carried out. Dirt roads will be surveyed for lizards as part of the mammal trap deployment and trap visitation activities. It is expected that lizards (as well as snakes) will be counted along transects by surveyors on the way into the survey site to set mammal traps. Each site will require an overnight survey, but trap set ups will be established early in the day to sample diurnal animals.

Vegetation sampling will address shrubs at two-year or greater intervals using belt transects, with measures of plant species composition and frequencies, and vegetation cover, height, and density. Frequency of herbaceous cover, using step-point sampling will be carried out annually (annual sampling) at 300 points at each site along belt transects; measuring basal and canopy cover, standing dead and residual material, species composition (related directly to dominant vegetation type), cover, and height.

Concomitant data will be gathered on environmental stressors including livestock grazing and horses/burros intensity, precipitation (from data loggers, fire on site and in adjacent areas (as well as history where ascertainable), OHV use, trash, and any indications of disease in sampled species.

Next steps – informing a fourth workshop

At the end of the third workshop the STAT took on a set of inter-meeting tasks with committee assignments in order to have a set of draft products to move forward with in February, 2009. The team committed to drafting a sample scheme pilot study that would demonstrate the actual deployment of site selection, bird survey points, Sherman live trap grid, and search protocols for night-lighting, pellet counts, rabbit sign identification, and reptiles surveys. The pilot study would be featured in a draft proposal with a provisional budget to be written between meetings. Several members of the team agreed to stage a “mock data run” with a dataset fabricated to appear as if it had been generated by the sample scheme. Other members would run a “strategic framework test” for Wyoming big sage by moving through the four steps of “current status,” “desired future conditions,” “setting management action thresholds,” and “evaluation of

management opportunities and options.” Another committee would initiate discussions to build the greater sage-grouse monitoring element into the sampling scheme. And GIS layers pertinent to the sagebrush ecosystem performance analysis were to be gathered; those layers including Nevada Bird Count survey sites, greater sage-grouse lek locations, Land Resource Area delineations, Southwest ReGAP, and other pertinent coverages. The February meeting is intended to organize these draft products, finalize them, and meld them into a “performance measures project implementation strategy” to move toward actual field implementation with the desired target date of summer 2009.

Table 1. Information about priority species in Nevada's Wildlife Action Plan

Species	Status	Sagebrush Dependence	Relative Density	Shrub		Shrub				Surface	
				Height Density	Understory	Species Diversity	Patch Size	Seral Stage	Configuration	Water	Soils
kit fox	Priority	mod	low	0	0	0	0	0	yes	0	yes
<i>desert horned lizard</i>	Priority	low	mod	0	0	0	0	0	yes	0	yes
sagebrush lizard		mod	mod	0	0	0	0	0	0	0	0
Gray Flycatcher	Stewardship	mod	low	+	0	+	0	+	yes	0	yes
<i>sagebrush vole</i>	Priority	high	high	0	+	0	0	-	0	0	yes
Wyoming ground squirrel	Priority	high	high	0	+	0	0	0	yes	0	yes
white-tailed jackrabbit		mod	mod	0	+	0	0	-	0	0	0
mule deer	Priority	mod	mod	0	+	+	0	-	yes	+	0
pygmy rabbit	Priority	high	high	+	+	0	0	+	0	0	yes
<i>Preble's shrew</i>	Priority	mod	?	?	+	0	0	-	?	0	0
<i>Merriam's shrew</i>	Priority	mod	mod	?	+	+	0	-	?	0	0
Ferruginous Hawk	ESA petition	low	low	-	+	0	0	-	yes	0	yes
Western Burrowing Owl	Priority	low	low	-	-/0	0	0	-	0	0	yes
Black-throated Sparrow	Stewardship	mod	low	0	-	0	0	0	yes	0	0
<i>greater short-horned lizard</i>	Priority	low	mod	0	-	0	0	0	0	0	0
<i>pygmy short-horned lizard</i>	Priority	mod	mod	0	-	0	0	0	0	0	0
Loggerhead Shrike	Priority	low	mod	+	0	+	+	+	0	0	0
Greater Sage-grouse	ESA petition	high	high	+	+	0	+	?	yes	?	?
Brewer's Sparrow	C-PIF MA	high	high	+	-	0	+	+	0	0	0
Sage Thrasher	Stewardship	high	high	+	-	-	+	+	yes	0	yes

Columbian Sharp-tailed Grouse	Priority	mod	mod	+	+	+	?	-	?	0	?
Green-tailed Towhee	Stewardship	mod	high	+	+	+	-	-	yes	0	0
Vesper Sparrow	Stewardship	mod	mod	-	+	0	-	-	yes	0	0
Mountain Bluebird	Stewardship	low	low	-	+	+	-	-	yes	0	0
Sage Sparrow	Priority	high	high	+	-	0	-	+	yes	0	0
<i>Inyo shrew</i>	Priority	mod	mod						yes	0	