APPROACH & METHODS

Organizational Structure

Nevada Department of Wildlife identified its Wildlife Action Plan Development Team in August, 2004 through the application for a conservation planning grant from the State of Nevada's Question One Conservation Bond and Resource Protection Grant Program. The partnership to develop the Nevada WAP included The Nature Conservancy's Nevada Chapter, the Lahontan Audubon Society, and the Nevada Natural Heritage Program. The Q1 grant was awarded by Nevada Division of State Lands in October, 2004, and the team commenced work on the deliverables for Phase I of the WAP. The primary objective of Phase I was assembling Nevada's WAP.

Phase II began immediately after Plan approval and focused on implementation of the WAP. Some key achievements of the Nevada Wildlife Action Plan Team that "stepped down" from the WAP included the completion of the Nevada Wetland Priority Conservation Plan led by The Nevada Natural Heritage Program, the completion of the Steptoe Valley Conservation Action Plan, a project led by The Nature Conservancy to demonstrate techniques for stepping down Wildlife Action Planning to local scales, and the revision of Nevada's Partners In Flight Conservation Plan (now the Nevada Comprehensive Bird Conservation Plan) led by Great Basin Bird Observatory. Other stepdown planning efforts included the Springs Conservation Plan, a collaborative effort between Nevada Natural Heritage Program and The Nature Conservancy, and a county-planning/WAP integration project led by Nevada Audubon. All these stepdown planning projects were funded by Question One grants.

The Climate Change Challenge

In anticipation of major climate change policy and funding emanating from Congress, in early 2008, the Association of Fish & Wildlife Agencies (AFWA) encouraged states to update their Wildlife Action Plans to address the predicted effects of climate change in their state. Options were suggested to either add a chapter discussing the effects of climate change or to conduct a full revision of their 2005 Plan. The Nevada Team anticipated the effects of climate change to be somewhat dramatic in Nevada to the point that the Species of Conservation Priority list might significantly change as well as the focus on key habitats based on their predicted responses, so Nevada opted for a full revision with climate change analysis pulled through every aspect of analysis and strategy. The "climate change revision" effort was initiated in May 2008 and plans were made to secure another Q1 grant to fund the revision partnership. NDOW also received State Wildlife Grant funds to support agency staff in the revision of this plan. In addition, the Nevada Team reached out to key representatives of the major federal resource management agencies – Bureau of Land Management, Forest Service, U.S. Fish and Wildlife Service, and Bureau of Reclamation for membership on the team. All four agencies responded with designees. Major elements of the revision process that the Team developed and funded through the Q1 grant are described by header below:

Habitat Analysis

The Nature Conservancy took on the task of predictive modeling of climate change effects on Nevada's vegetative communities. The methodology used by TNC is Landscape Conservation Forecasting™ (formerly Enhanced-Conservation Action Planning; Low et al. 2010), which consist of a) maps of potential and current vegetation obtained from remotely-sensed imagery; b) state-and-transition computer modeling of alternative management scenarios (for example, without and with climate change effects) applied to each ecological system in the mapped landscape with the goal of improving ecological condition, and c) return-on-investment analysis (ecological improvement relative to the cumulative cost of management actions) comparing the different management scenarios and all managed ecological systems. The Conservancy measured ecological condition using two landscape-scale metrics for each ecological system: ecological departure from the reference condition and the percentage of high-risk vegetation classes. Additionally, TNC provided results of each vegetation class, which was essential to relate changes in vegetation structure and food availability to the needs of wildlife species. The results of Landscape Conservation Forecasting™ applied to each of Nevada's 13 regions were provided to NDOW in the report, "Climate Change Revisions to Nevada's Wildlife Action Plan: Vegetation Mapping and Modeling"; hereinafter, referred to as the "*TNC Climate Change Report*" (Provencher and Anderson, 2011).

Species Vulnerability Analysis

Concurrent with habitat modeling, the Nevada Natural Heritage Program conducted a wildlife species vulnerability analysis using the NatureServe Climate Change Vulnerability Index evaluation program (Young et al. 2011) to determine which wildlife species exhibited characteristics that might uniquely hinder their adaptation to climate change, including but not limited to general mobility, physiological challenges, dependence on certain vegetation types or plant species, etc. Because of cost concerns, the WAP Revision Team made the decision to limit CCVI analysis to the 2005 Species of Conservation Priority list. Methods and results of the Nevada CCVI are presented in Appendix D.

After the first draft of the Nevada CCVI was completed, members of the WAP Revision Team conducted intuitive analysis of all terrestrial wildlife species *not* on the Species of Conservation Priority list to look for patterns and similarities between non-priority species and priority species that scored above "presumed stable" in the CCVI. Non-priority species that exhibited traits or habitat limitations similar to CCVI species with elevated scores were then run through CCVI analysis and scores were assigned to them for standardization purposes.

Avian Climate Change Response Modeling

The Great Basin Bird Observatory was contracted through the Q1 grant to provide specific data-supported climate change predictions for Nevada's breeding birds using point-count data from the Nevada Bird Count (NBC), a statistically-rigorous 10-year database with georeferencing and coarse-scale habitat association capability. Avian Species of Conservation Priority occurrences in the NBC were geospatially attached to the LANDFIRE map used by TNC to generate the habitats analysis. Results from the TNC analysis were then evaluated regarding potential consequences to Nevada's breeding birds and avian species responses were predicted. The results of the GBBO report are presented in the report "Bird Population Responses to Projected Effects of Climate Change in Nevada: An Analysis for Revision of the Nevada Wildlife Action Plan" (Appendix E).
Another partner group associated with University of California, Davis, the Connectivity Assessment Group, graciously donated another avian climate change analysis to the WAP revision process that evaluated possible patterns of movement on the landscape of priority birds based on the availability and connectivity of suitable habitats as currently understood versus climate change projections in habitat shifts. This analysis was interpreted and presented geospatially and demonstrated more detailed "stepdown" analysis that could be implemented as part of the WAP Adaptive Management framework once the Revision goes into effect. Results from this effort will be presented in the upcoming report "Current and projected future connectivity of habitat for breeding birds in the central Great Basin" (Fleischman et al., *publication pending*).

Pulling It All Together

Once the analytical products were completed, the Revision Team had to fit the results together to ultimately project the future of wildlife on Nevada landscapes over the next 50 years under a changing climate. Seven major tasks were undertaken:

1. Revision of the Species of Conservation Priority List
2. Revision of the ecological framework to fit the new vegetative analysis
3. Analysis of how ecological system changes/shifts were likely to impact living conditions and survival potential for priority species within relevant regional contexts
4. The construction of conservation strategy to maximize the preservation of wildlife diversity within state boundaries
5. Revision of the Focal Area analysis
6. Revision of the Implementation and Adaptive Management Framework
7. Revision of the Wildlife Action Plan itself with meaningful partner/stakeholder participation and review

Each of these tasks and how they were engaged are discussed in the following chapters.

APPROACH & METHODS:
REVISING THE SPECIES OF CONSERVATION PRIORITY LIST

The Revision Team started with the Species of Conservation Priority list generated during the 2005 planning process through a species risk evaluation tools – one for terrestrial vertebrates, one for fishes and amphibians, and one for mollusks and crustaceans. The Team expressed basic satisfaction in the utility and appropriateness of the 2005 list, and while recognizing that climate change vulnerability had not been strongly evaluated through the 2005 process, opted for an iterative process that fit climate change vulnerability to the existing priority results, rather than go back to the beginning and redesign a completely new tool with climate change vulnerability incorporated in it. For a complete description of the 2005 species prioritization process, please refer to Appendix D.

Once the NNHP Climate Change Vulnerability Index (CCVI) was applied to the 2005 priority species list, a new picture of priority began to emerge, placing much greater concern toward isolated endemic aquatic species with small population sizes, limited mobility and an immitigable dependency on water in nature. Terrestrial vertebrates for the most part exhibited relatively strong adaptability to the nature and degree of climate change being predicted; therefore, a relatively small number of terrestrial vertebrate species ranked at levels of concern more elevated than "presumed stable". All terrestrial vertebrates run through CCVI receiving scores of "moderately vulnerable," "highly vulnerable" or "extremely vulnerable" were automatically retained on the revised priority list.

One priority category that had not functioned as planned in the 2005 Plan was the "stewardship species" concept. In order to gain consensus among all stakeholders as well as recognize the tableau of avian conservation planning that had occurred in the previous decade, a "stewardship birds" category was created in the 2005 WAP to note Nevada's "stewardship responsibility" for birds that had been identified in one of the bird conservation planning efforts (Partners In Flight, U.S. Shorebird Conservation Plan, North American Waterbird Plan) either at the continental or regional scale but which did not otherwise rank as high concern in Nevada. Because the category neither enjoyed full SOCP status nor freedom from concern, most users of the Plan did not know what to do with it. Rather than engender respect and partnership, it mostly just caused confusion. "Stewardship" aquatic species, derived through the application of different criteria, were no more successful. The Revision Team decided to remove the "stewardship" classifications and identify only full-status priority species.

The 2005 Stewardship Bird list was next evaluated for species that should be retained as priorities and those that should be removed. Climate change vulnerability was preliminarily assessed by comparison to species already run through the CCVI. Species similar to birds scoring above "presumed stable" were processed through the CCVI. Species that demonstrated significant population declines in the USGS Breeding Bird Survey results (www.mbr-pwrc.usgs.gov/bbs/bbs.html) were also run through the CCVI. The same stepwise evaluation was also performed on all other avian species that were not included on the 2005 list. Since very few birds ranked CCVI scores above "presumed stable", additions to the list were made based on the severity of decline as reported by USGS, or in the case of species such as Golden Eagle, where specific management issues were anticipated to direct agency priority and resources.

Mammals and reptiles that were not on the 2005 priority list were assigned to the TNC Biophysical Settings (key habitats) as per their known habitat preferences and analyzed as to the predicted cumulative effect of climate change on their preferred habitats. Those species that demonstrated cumulative habitat impacts of an elevated nature were then run through the CCVI. Any mammal or reptile species that scored "moderately vulnerable," "highly vulnerable" or "extremely vulnerable" were automatically retained on the revised priority list. Some species that scored "presumed stable" were retained for the priority list because of relevant conservation concerns other than climate change.

As with terrestrial species, the "stewardship species" categorization for fishes was found over time to provide little utility and served primarily to create confusion for partners and in developing conservation planning priorities. Although the initial CCVI analysis provided a basic assessment of potentially changed vulnerabilities for the existing priority aquatic species list, additional CCVI review was also performed on aquatic species identified in the stewardship classification in 2005 and additional lower-tier native fish species which were not priority-ranked in 2005 but were known to occur in aquatic habitats known to be particularly vulnerable to near-term climate change scenarios such as mid- to low-elevation intermontane stream and river systems. This provided the basic analysis to review and update the aquatic priority species lists with primarily the addition of several endemic fishes which were shown to have a higher vulnerability through the new analysis.

APPROACH & METHODS: DEFINING NEVADA'S LANDSCAPE FOR WILDLIFE

The ecological framework for the 2005 Plan was based on Southwest ReGAP (SWReGAP) ecological systems (vegetative communities) and a very simple four-biome representation of the state – Great Basin, Mojave Desert, Columbia Plateau, and Sierra Nevada. The SWReGAP ecological systems were compiled into 22 broader biophysical groups named "key habitats" that approximated major habitat types as they were commonly perceived by Nevada's resource professionals and conservation community – sagebrush, Mojave shrub, pinyon-juniper, cliffs and canyons, etc. – and conservation strategy was developed for each key habitat and presented in the 2005 Plan in the key habitat chapters.

Terrestrial Ecological Framework

The unique challenges of climate change predictive analysis required the Revision Team to shift its primary ecological framework from SWReGAP to LANDFIRE because LANDFIRE has added classification of vegetation into the "characteristic" and "uncharacteristic" types critical to the measure of ecological departure. Specifically, four sources were used to develop new ecological systems now called "**Biophysical Settings**" or **(BpS's):**

1. LANDFIRE (2010a, b, c) is interpreted Landsat satellite imagery, which for each grid cell (pixel) includes: (1) the BpS type; and (2) the succession class or "S-Class" of the BpS type that currently occupies the grid cell. LANDFIRE's Existing Vegetation Cover (EVC) layer represents the average percent cover of existing vegetation for a 30-m grid cell. This layer was used to inform select non-reference classes from the BpS by S-Class layer.

2. Precipitation map from the PRISM (Parameter-elevation Regressions on Independent Slopes Model) group of Oregon State University that shows the distribution of precipitation across the United States based on modeled extrapolation of weather data among weather stations (Daly et al., 2008). PRISM is the USDA's official climatological data. These data were used to a) divide LANDFIRE's Blackbrush BpS between the thermic and mesic BpSs at the 9 inch precipitation zone and b)divide the big sagebrush complex into Wyoming Big Sagebrush semi-desert BpS (8-10 inch precipitation zone), Big Sagebrush-upland BpS (12-14 inch precipitation zone), and the Montane Sagebrush Steppe-mountain BpS (>14 inch precipitation zone).

3. Nevada Natural Heritage Program (NNHP) developed the Annual Grass Index layer, which is the estimated percent ground cover of non-native annual grasses interpreted from two captures of Landsat satellite imagery and field plots (Peterson, 2005). Also, NNHP's layer of known locations of invasive weeds (other than annual grasses) in Nevada served to inform select non-reference classes from the BpS by S-Class layer.

4. Southwestern Regional Gap Analysis Program landcover layer (Lowry et al., 2005) is interpreted satellite imagery of natural and semi-natural vegetation on the landscape. This layer was used to inform select non-reference classes from the BpS by S-Class layer.

The integration of these sources was accomplished by a three-step process:

1. After a review of all LANDFIRE BpS, minor BpS's were merged with larger ones, or ecologically-compatible BpSs that are difficult to separate by remote sensing were combined (e.g., Black-Low sagebrush and Inter-mountain Basins Semi-desert Shrub Steppe was nested in Mixed Salt Desert);

2. Then both the "concept" and the mapped distributions of all of the major vegetation (BpS) types that appeared in the LANDFIRE source were evaluated; and then

3. A set of queries or decision rules was written as to how those input data were to be depicted, pixel by pixel, on the output of the single merged map. These queries were designed primarily to inform the non-reference classes using the most current on-the-ground spatial information available.

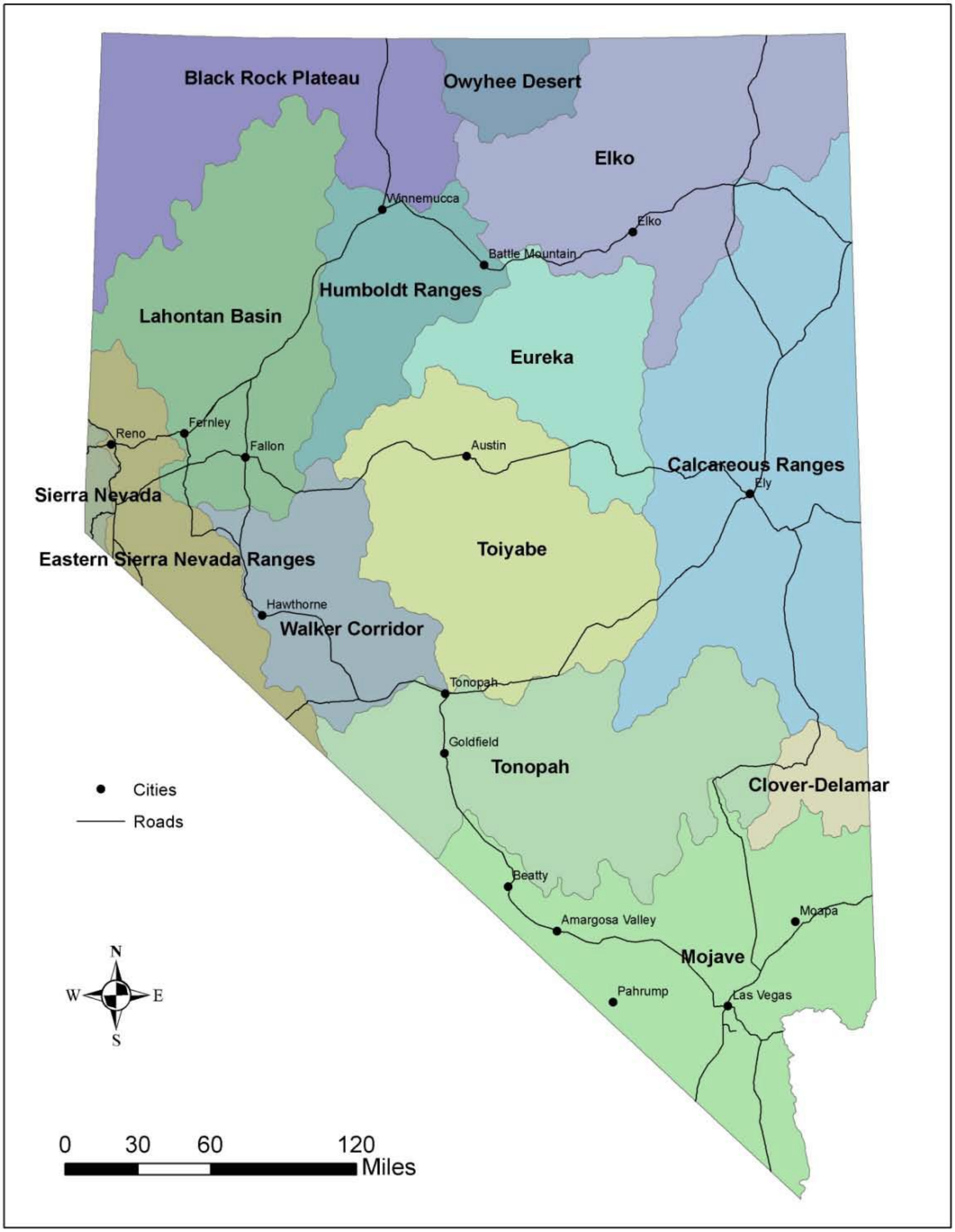
After some final field-informed adjustments, the BpS's used in the TNC climate change analysis were selected. A short description of each vegetation class by BpS used in the analyses is presented in the TNC Climate Change Report and summarized in Appendix C.

The 27 phytogeographic regions layer acquired from NNHP represented floristically and physiographically similar areas of Nevada. This layer was consolidated from 27 to 14 phytogeographic regions to facilitate modeling (Figure 2). The phytogeographic regions were consolidated into the Mojave, Clover-Delamar, Walker Corridor, Eastern Sierra Nevada, Sierra Nevada, Lahontan Basin, Humboldt Ranges, Toiyabe, Eureka, Calcareous Ranges, Elko, Tonopah, Owyhee Desert, and Black Rock Plateau. The Mojave was consolidated from 7 individual phytogeographic regions to one. The Calcareous region was consolidated from three individual phytogeographic regions, and Elko and Tonopah were both consolidated from two phytogeographic regions. Two phytogeographic regions that were not within the boundaries of Nevada were removed.

Table 1. Description of spatial layers used to develop the new Wildlife Action Plan ecological framework.

Spatial Data	***Spatial Resolution***	***Date***	***Creator***
Biophysical Settings	30 m	2010	LANDFIRE
Succession Class	30 m	2010	LANDFIRE
Precipitation	654 m	2006	PRISM
Landcover	30 m	2004	SWReGAP
Annual Grass Index	28.5 m	2004	NNHP
Weeds	Shapefile	2005	NNHP
Existing Vegetation Cover	30 m	2010	LANDFIRE

Figure 2. Consolidated phytogeographic regions of Nevada. Based on 27 original regions proposed by the Nevada Natural Heritage Program.



2005 vs. 2012 – Integrating Two Ecological Frameworks

The creation of the TNC phytogeographic regions for climate change analysis created several challenges for the Revision Team regarding the crosswalk between a simple four-ecoregion map with SWReGAP ecological systems to a 14-region map with LANDFIRE BpS's. One problem arose concerning the revision of the Key Habitat acreages reported by ecoregion in each Key Habitat. At the request of federal land management agency Team members, it was decided to continue to report key habitat acreages by the four broad ecoregions from 2005 – Great Basin, Mojave, Columbia Plateau, and Sierra Nevada – which required a clip of LANDFIRE by the four-ecoregion map. A crosswalk between SWReGAP ecological system and LANDFIRE BpS's was also provided for each key habitat chapter.

The revision of ecological systems to biophysical settings necessitated a slight shift in how the key habitats were defined. The 27 key habitats from the 2005 Plan have been reduced to 22 through the following changes:

- Mojave/Sonoran Warm Desert Shrub and Mojave Mid-Elevation Mixed Desert Scrub were combined into one chapter.
- Lower Montane Woodlands and Lower Montane Chaparral were combined into one chapter.
- Intermountain Rivers and Streams, Sierran Rivers and Streams, and Wet Meadows were combined into one chapter.
- Exotic Grasslands and Forblands was eliminated because the vegetative communities were reinterpreted as uncharacteristic classes of many other biophysical settings.

APPROACH & METHODS:
WILDLIFE EFFECTS ANALYSIS

Integration of Species and Habitat Analysis

The next task was to integrate the species with demonstrated climate change vulnerability to the biophysical settings for the purpose of translating the predicted habitat changes into wildlife species responses. Specific analyses using extensive survey data from the Nevada Bird Count were conducted for birds (see below), but much less habitat-specific data were available for mammals and reptiles, so models were created for them based on general natural history knowledge and expert experience. To the extent possible, we intended to demonstrate how species were particularly challenged by shifts, degradation or losses of their preferred habitats over the next 50 years. Because the TNC climate change analysis focused heavily on "ecological departure" of vegetative systems and the changes attributable to the invasion of exotic plants into native systems, our species-habitat associations also focused on our best estimates of wildlife species responses to the various "uncharacteristic classes" that defined ecological departure. One of the most important research needs identified as a result of this revision has been that of more specific knowledge of wildlife species tolerance/response to changes in their habitats incurred by exotic plant invasion, closing and opening of tree and shrub canopies, and species tolerance of conversion of shrub types to rabbitbrush, a common conversion among systems. This knowledge is critical in the adaptive management tracking and monitoring of climate change once this Revision takes effect.

In the evaluation of mammals and reptiles, we assessed wildlife species tolerance to uncharacteristic classes except in cases where we were fairly certain that the native plant community was severely reduced or replaced and the species in question was known to be strongly dependent on elements of that native plant community for either food or cover (Greater sage-grouse in sagebrush as an example). We had to make qualitative judgments as to whether a species would continue to occupy a habitat with low, moderate, or high invasion of exotic plants. We evaluated the species' response to relative changes in vegetative structure and how those changes would result in exposure to predation and the elements (sun, heat, cold, etc.). In some instances, species' responses to tree encroachment into non-tree habitats have been better studied than the invasion of annual grasses/forbs into the same habitats, so our predictions were thus better supported by existing research. The results of these analyses are reported in the "Possible Wildlife Responses to Climate Change" sections in each of the Key Habitat chapters.

Avian Responses

Great Basin Bird Observatory Climate Change Analysis

For modeling landbird population change, we used data from the first ten years of the Nevada Bird Count (NBC) and from recent landbird inventory projects in Nevada that used the same point-count design as NBC for assessing bird populations. Analyses were restricted to those priority species of the Wildlife Action Plan that are diurnal landbirds with relatively small breeding territories, because point count surveys are designed to estimate densities for these species. Species with large home ranges, waterbirds, shorebirds, and secretive marshbirds were not included in our analyses, nor were landbird species that were so rare in Nevada that reasonable density estimates could not be derived for their primary breeding habitats.

Bird Habitat Models

For modeling current bird habitat use, we used the raster map of current vegetation conditions from TNC (2011). The landbird data from the NBC and similar projects in Nevada were limited to observations within a 100 m radius distance from each survey point, because detectability of most landbirds decreases rapidly beyond this distance. A 100 m spatial buffer was created around each point and the percentages of each current vegetation cover type within that circle (3.14 ha) were calculated. Because of the heterogeneity of vegetation classes in most 100 m circles, a set of rules governing selection of the circles for use in calculating species densities for individual vegetation classes was created. (To review the point selection rules, please refer to the complete GBBO report.)

Bird density was calculated for each priority landbird species in each habitat type. For this, we calculated the average number of individuals (excluding fly-over observations) detected within 10 minutes and 100 m by taking the mean of multiple visits to each point. These numbers were then averaged over all points assigned to a particular habitat type, and extrapolated to the average detectable density per 40 ha. A working estimate of statewide population size was then estimated by multiplying the densities by the number of hectares currently in each habitat type, and summing over all habitat types in each of the 13 regions from the climate model, which can then be summed for the state. For some statewide habitat types, data for the Mojave region (which for the purpose of this report, included the Clover-Delamar region identified in TNC 2011) were separated from data for the Great Basin region, but most habitat types were largely restricted to one or the other.

Predictions of Climate Change Effects

The Team used current acreages and model projections for future acreages after 50 years of climate change for each condition class within biophysical settings (TNC, 2011) to project expected changes in landbird populations. These predictions carry the same limitations and assumptions as do the predictions for vegetation change, and also assume that habitat change will dictate most changes in bird populations (but see above for cautionary comments).

Projections for bird population change were calculated separately for the 13 regions in Nevada used in this analysis (for details on these regions, see TNC Climate Change Report, 2011). For birds with statewide breeding distributions, we summed habitat acreages across regions for one statewide total. Southern Nevada species were analyzed using only those appropriate regions (usually Mojave and Clover-Delamar). Some condition classes were projected to change greatly due to climate change, but some of these changes were not available in the current map, either because these classes are currently rare or because the available GIS layers cannot delineate them. In these cases, we made qualitative judgments about expected effects on the birds that occupy the changing habitats that were not mapped.

The results of the avian climate change response analyses are completely reported in the GBBO report, and results from the report are included in the "Possible Wildlife Responses to Climate Change" sections in each of the Key Habitat chapters where relevant.

Suitable Habitat Connectivity Climate Change Analysis

A fine-filter analysis of climate change effects on a roster of vegetative and spatial parameters with respect to bird distribution and suitable habitat connectivity is being conducted by a team of wildlife and geospatial ecologists operating under the aegis of the University of California, Davis as a special project for this Wildlife

Action Plan revision. The objectives of the project were to identify vegetative or landform characteristics that influence bird distribution on a small regional scale; assess the projected changes on those characteristics brought about by climate change; and evaluate the regional landscape's ability to provide alternate suitable habitat in accommodation of species' needs to shift distribution with climate change. A draft report will be made available in the final version of the WAP. The full preliminary report will be forthcoming in 2012 (Fleischman et al., *publication pending*).

Aquatic Habitats

Because the available TNC climate change analysis focused primarily on "ecological departure" of vegetative systems and associated changes to native terrestrial habitats, it provided limited utility for assessing changes to aquatic systems and associated effects on resident native aquatic species, particularly fishes. For a number of reasons it was not possible to develop more sophisticated modeling tools for identifying aquatic system effects at a detailed level, and a relatively coarse-filter approach was used to evaluate predicted climate change effects. After identifying watersheds containing priority aquatic species of concern for each key habitat association, available on-line tools were used to assess predicted changes for temperature and precipitation at a Hydrologic Unit (HUC8) level, using High A2 Ensemble Average GCM data sets for percentage departure through 2050, consistent with the analysis approach used for aquatic CCVI assessments. Although precipitation models in particular exhibit high uncertainty across much of the area of analysis this did allow some level of assessment of projected change in key climate change components likely to affect aquatic habitat suitability and allowed some evaluation of potential seasonal changes in aquatic system functions because of projected temporal shifts in precipitation and early spring onset, particularly important for the assessment of future conditions in stream and river habitats. These assessment results at the HUC or hydrologic basin level then were manually interpreted to deductively infer likely future effects on aquatic habitats and aquatic species based on known distributions.

APPROACH & METHODS: CONSTRUCTING CONSERVATION STRATEGY

Once the threats to wildlife conservation posed by climate change or other agents of change were identified, strategies to reverse or mitigate the effects of those threats were solicited from technical expert groups, taken from the 2005 Plan, other conservation plans, or the literature wherever possible. The strategies, activities, treatments, prescriptions, programs, and initiatives were often unchanged from the 2005 Plan for the species persisting on the priority list from 2005. New species sometimes required new creative thinking, but more often than not could be grouped with a species or set of species already prioritized by the Plan. A feature of the TNC habitat analysis was the gathering of regional ecological restoration focus groups to construct restoration, remedial, and preventive prescriptions for action specific to their own regions based on their own expertise and experience.

Once the basic prescriptive approaches were identified, the Revision Team strove to set quantified, measurable objectives to set the progress marks for the applications of those prescriptions. Where ecological departure of an ecological system (biophysical setting) was of major concern and had been quantified for the 50-year period of analysis, objectives aimed at reversing, stabilizing, or minimizing the rate of ecological departure of the ecological system were developed for the immediate 10-year period following approval of the Revision (2012-2022). A general finding of the climate change projections was that the period between 40 and 50 years from now would witness the greatest increment of change toward the 50-year projected outcome, and often the first 10-year period (that relevant to this revision) would witness the least. Setting up the monitoring framework to measure climate change effects was much more the need during this first 10-year period, and sometimes in terms of actually observing physical change on the landscape.

We also strove to construct quantified, measurable objectives for species population management in concert with each habitat management strategy. The detail of population information for different taxa controlled our ability to develop detailed objectives. Because our knowledge about the different priority species varies, we had to incorporate quantification parameters in line with the level of detail of our knowledge. The most highly developed population estimates for wildlife in Nevada occur for game mammals that are counted annually out of helicopters for the purpose of informing highly sophisticated harvest models and tag recommendations. Following game mammals, our skills in estimating breeding bird populations have been greatly enhanced by the analysis of 40 years of USGS Breeding Bird Survey data and also the analysis of ten years of Nevada Bird Count data. Both datasets are featured in the "Nevada Comprehensive Bird Conservation Plan" revised by Nevada Partners In Flight (facilitated by Great Basin Bird Observatory) in 2010. For game mammals and many breeding birds on the priority list we were able to construct quantified population objectives based on these survey results, and did so whenever we could.

For bird species where we had adequate data indicating regional or continental trend, but lacked data rigorous enough to project meaningful population estimates for Nevada, we set directional objectives based on increasing, stabilizing, or reversing trend depending on the severity and nature of the reported decline. Priority was usually given to regional trend over continental trend.

For most nongame mammals and reptiles it was difficult to generate population estimates. However, presence/absence monitoring technology has progressed significantly since 2005 and monitoring protocols that generate "occupancy rates" based on multiple visits to networks of sample sites are becoming more and more useful for understanding and tracking species status. The development of occupancy survey protocols for small mammals in sagebrush (Nevada WAP Sagebrush Indicators Technical Team, 2010) allowed us to develop objectives for “detectable levels” for tracking species status.

As with terrestrial species, strategies, activities, treatments, prescriptions, programs, and initiatives were largely unchanged from those developed for the 2005 Plan for aquatic species carried forward from the 2005 priority list, and new species added from the current analysis generally could be grouped with a species or set of species previously prioritized. The level of degradation of aquatic habitats supporting priority aquatic species in Nevada remains substantial because of both physical alteration and the presence of undesirable nonnative species, and specific substantive threats to these habitats identified in the 2005 plan such as future groundwater development and invasive species remain largely unabated. To the extent that potential climate change effects identified in the analysis such as increased thermal input from air temperature rise and altered streamflow regimes resultant from temporal changes in precipitation and modified runoff patterns will modify aquatic habitat quality for priority aquatic species, these will be modifiers that to some extent will just amplify the impacts of existing threats. For this reason in many cases predicted climate change inputs did not substantially alter existing proposed actions, prescriptions and conservation targets, but place increased emphasis on the importance of those targets and prescriptions because their effective implementation generally will increase the resiliency of aquatic systems in the face of projected climate related effects.

APPROACH & METHODS: REVISION AND REVIEW PROCESS

Similar to the 2005 WAP draft process, NDOW contracted with the Nevada Audubon Director of Bird Conservation to serve as editor and principal author of the 2012 Revision. Duties of the editor included writing, editing, and draft layout design leadership throughout the draft process. Audubon Society personnel also provided conservation planning and design support as well as performing a major role in the public review. All members of the Revision Team either took on individual writing assignments or first-line text review duties during the creation of the review draft.

Species Vulnerability Assessment Expert Review

Species' range maps and natural history information were obtained from a number of sources including the Nevada Wildlife Action Plan (WAP) (Wildlife Action Plan Team, 2006), the NNHP Biotics database, The Revised Nevada Bat Conservation Plan (Bradley et al., 2006), Atlas of the Breeding Birds of Nevada (Floyd et al., 2007), The Nevada Comprehensive Bird Conservation Plan (GBBO, 2010), NatureServe Explorer, federal agency documents (e.g., USGS professional reports or published studies, USFWS Recovery Plans, Federal Register), field guides, and expert input.

Assessments were completed for a representative group of species within each taxonomic group. After these initial CCVI scores were calculated by NNHP, an expert workshop was held (December 2009 in Reno) to solicit feedback and comments from biologists working throughout Nevada. The two-day workshop was well-attended and included representatives from federal (BLM, EPA, NPS, USFS, and USFWS) and state (NDOW, NNHP) agencies, a non-profit organization (TNC), and academia (UNR). Highly constructive comments and feedback were obtained from the attendees on the scoring of the factors, and additional species information was also obtained to better inform the assessments. All feedback and comments were incorporated into the CCVI for each species and scores were recalculated.

Climate Change Management Strategy Development

TNC and NDOW staff held workshops in Carson City twice, Ely, and Las Vegas to seek expert knowledge on ecological system management for the Calcareous, Eastern Sierra Nevada, Elko, Lahontan, Mojave, and Walker regions. The goal was to develop coarse and representative management strategies to abate detrimental climate change effects and order of magnitude costs for regions belonging to different ecoregions. Ecological systems chosen for management were: aspen-mixed conifer, aspen woodland, blackbrush mesic and thermic, creosotebush-bursage, Jeffrey pine, mixed conifer, low-black sagebrush, montane riparian (non-carbonate), montane sagebrush steppe-mountain site, and Wyoming big sagebrush semi-desert. Proposed management strategies were very variable in type and cost among regions and agencies.