Chapter 2
APPROACH

This chapter addresses the methodology and rationale employed in identifying species indicative of the diversity and health of New Mexico's wildlife (**Element 1**) and in designating species of greatest conservation need (SGCN) subset. It addresses the approach employed in developing information about the distribution and abundance of SGCN (**Element 1**), designating and locating key habitats (**Element 2**), describing problems affecting species or their habitats (**Element 3**), and in developing conservation actions (**Element 4**). In addition, it presents a summary of the opportunities for broad agency and public involvement provided to date (**Elements 7 and 8**).

ORGANIZATIONAL STRUCTURE

In August 2003, the Director of the New Mexico Department of Game and Fish (NMDGF) designated the Comprehensive Wildlife Conservation Strategy (CWCS) core planning team comprised of the NMDGF's deputy and assistant directors, division chiefs, planner, and area operations chiefs. The core planning team assigned NMDGF taxa experts and technical teams to assist in CWCS development activities. The core planning team and the technical teams also sought expertise in this regard from outside the Department. In June 2004, NMDGF engaged the Center for Applied Spatial Ecology (CASE) with the New Mexico Cooperative Fish and Wildlife Research Unit (NMCFWRU) at New Mexico State University to assist in data acquisition, information management, and compilation (Table 2-1). With comments and contributions from many other agency, tribal and private cooperators that participated in CWCS partnering and public involvement events, this document represents considerable efforts and contributions of more than 210 individuals.

Table 2-1. Members of New Mexico Department of Game and Fish, New Mexico Cooperative Fish and Wildlife Research Unit, University of New Mexico, and New Mexico State Parks that served on the Core Planning Team or Technical Teams.

Person	Position	Task
Lief Ahlm	Assistant Chief, NE Area Operations	Core Planning Team, Contributing Author
Ken Boykin	Project Leader, SWReGAP, NMCFWRU	SWReGAP Coordinator, Contributing Author, Geographic Information Systems
Sandra Brantly	Museum of Southwestern Biology, UNM	Arthropod Technical Team
Stephanie Carman	Aquatic Species Recovery Coordinator, CSD	Contributing Author
Steve Cary	N.M. State Parks Nat. Res. Planner	Arthropod Technical Team
Terry Enk	Mammologist, Conservation Services Division	Mammal Technical Team
Lisa Evans	Federal Aid Coordinator, NMDGF	Core Planning Team - Past Member
Randy Floyd	Aquatic Habitat Specialist, Cons. Services Divisiom	Contributing Author
Marty Frentzel	Chief, Public Information & Outreach, NMDGF	Core Planning Team,
Eric Frey	Fisheries Specialist, NE Area Operations	Fish Technical Team, Contributing Author

Table 2-1 Cont.

Person	Position	Task
Brian Gleadle	Assistant Chief , NW Area Operations	Core Planning Team, Arthropod Technical Team, Contributing Author
Bill Graves	Planner, NMDGF	Core Planning Team, CWCS Coordinator, Contributing Author, Contributing Editor
Mark Gruber	Editor, Public Information and Outreach	Contributing Editor
Richard Hansen	Assist. Chief - Warm Water, FMD	Fish Technical Team, Contributing Author
Roy Hayes	Chief, SE Area Operations	Core Planning Team, Bird Technical Team
Bill Hays	NE Area Operations Chief	Core Planning Team - Past Member
Jerry Jacobi	Dragonfly Expert, NM Highlands Univ., Ret.	Arthropod Technical Team
Lisa Kirkpatrick	Chief, Conservation Services Division	Core Planning Team, Amphibian /Reptile Tech. Team, Molluscs / Crustacean Tech. Team, Contributing Editor
R. J. Kirkpatrick	Chief, Wildlife Management Division	Core Planning Team
Brian Lang	Invertebrates, Conservation Services Division	Molluscs / Crustacean Tech. Team, Contributing Author
David Lightfoot	Museum of Southwestern Biology, UNM	Arthropod Technical Team
Veronica Lopez	Research Specialist, CASE, NMCFWRU	Geographic Information Systems, Contributing Author
Pat Mathis	Game Manager / Habitat Specialist	Bird Technical Team
Julie McIntyre	Museum of Southwestern Biology, UNM	Arthropod Technical Team
Tim Mitchusson	Migratory Birds, Wildlife Management Division	Bird Technical Team
Charlie Painter	Reptiles, Amphibians, Cons. Services Division	Amphibian /Reptile Tech. Team,
Yvette Paroz	Endangered Fish, Conservation Services Division	Contributing Author
Leland Pierce	BISON-M, GIS, Conservation Services Division	Geographic Information Systems
Dave Propst	Endangered Fish, Conservation Services Division	Fish Technical Team, Contributing Author
Luis Rios	Chief, SW Area Operations	Core Planning Team, Mammal Technical Team
Luke Shelby	Assistant Director	Core Planning Team
Mike Sloan	Chief, Fisheries Management Division	Core Planning Team, Fish Technical Team
Tod Stevenson	Deputy Director	Core Planning Team
Jim Stuart	Species Recovery Planner, Cons. Services Div.	Mammal Technical Team, Amphibian /Reptile Tech. Team
Robin Tierney	LOSS Supervisor, Wildlife Management Division	Contributing Author - Past Member
Janell Ward	Assistant Chief, Wildlife Habitat, CSD	Contributing Author
Mark Watson	Habitat Specialist, Conservation Services Division	Bird Technical Team, Mammal Technical Team, Contributing Author
Darrel Weybright	Big Game Grant, Wildlife Management Division	Mammal Technical Team
Sandy Williams	Endangered Non-Game Birds, CSD	Bird Technical Team
Kendal Young	Project Leader, CASE, NMCFWRU	CWCS Coordinator, Contributing Author, Contributing Editor Geographic Information Systems

IDENTIFICATION OF SPECIES OF GREATEST CONSERVATION NEED

Congressional guidelines require that each state's Comprehensive Wildlife Conservation Strategy identify and focus upon species the state finds to be of greatest conservation need (SGCN). For vertebrate, mollusc, and crustacean SGCN we began by identifying species indicative of the diversity and health of the state's wildlife, including low and declining populations as seem appropriate and species of high recreational, economic, or charismatic value. We subsequently designated indicative species found to be associated with key habitats as SGCN. Little is known about the arthropods of New Mexico other than crustaceans. However, through consultation with a variety of sources, we also identified a number of SGCN of the Insecta, Arachnida, Chilopoda, Diplopoda, and Entognatha classes. The following is an account of these processes.

New Mexico's SGCN are species that are indicative of the diversity and health of the state's wildlife that are associated with key habitats, including low and declining populations, and species of high recreational, economic, or charismatic value.

Indicative Vertebrate, Mollusc, and Crustacean Species

The Biota Information System of New Mexico (BISON-M, http://fwie.fw.vt.edu/states/nm.htm, NMDGF 2005a) database contains accounts of species in New Mexico, Arizona, Colorado, Utah, Texas, Oklahoma, and the bordering states of Mexico. The New Mexico Department of Game and Fish and the Fish and Wildlife Information Exchange developed the BISON-M database, with contributions from the US Bureau of Land Management, US Fish and Wildlife Service, US Forest Service, US Bureau of Reclamation, US Army Corps of Engineers, New Mexico Land Office, and New Mexico Natural Heritage Program (University of New Mexico), and the Conservation Management Institute. By applying three filters to the BISON-M database (Fig. 2-1), the NMDGF identified vertebrate, mollusc, and crustacean species that are indicative of the diversity and health of New Mexico's wildlife.

Species in New Mexico

The Bison-M database has biological information on greater than 1,400 species. Our first filter was to exclude all species in the BISON-M database that do not occur in New Mexico, retaining 1,166 species for further consideration.

Criteria to Identify Indicative Species

New Mexico's 1,166 species were sorted taxonomically and technical teams examined them for characteristics that might prove useful as criteria for identifying indicative species. Teams employed scientific literature, existing plans, and expert opinion to inform their considerations and to identify potential indicative species. Their deliberations (Appendix B) resulted in a second filter of standardized criteria (Table 2-2) that was used to select environmentally responsive species as well as those that have high recreational, economic, or charismatic values. Species received one point for each criterion met and those with total scores greater than or equal to 1 were retained. Approximately 676 species were excluded through this process, resulting in a set of 490 mammals, birds, fish, reptiles, amphibians, molluscs, and crustaceans considered to be

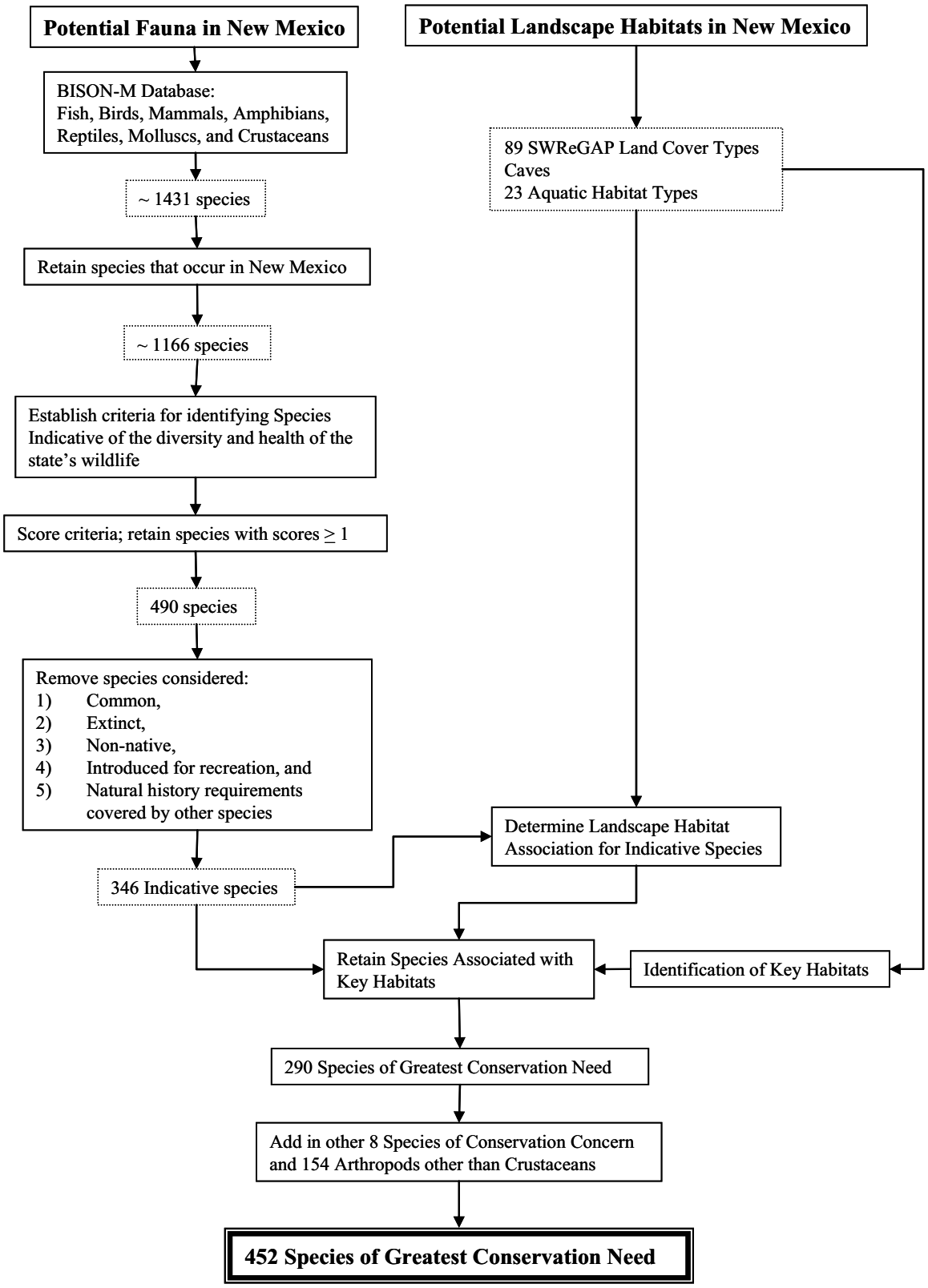

Figure 2-1. Approach employed to identify Species of Greatest Conservation Need in New Mexico.

indicative of New Mexico's diverse life zones, habitats, and natural heritage (Fig 2-1). Among these were state and federally listed species, candidate species of concern, game species with high recreational value and documented population declines, and other species of high conservation interest because of endemism or vulnerability.

Species indicative of New Mexico's diverse life zones, habitats, and natural heritage included 346 fish, birds, mammals, amphibians, reptiles, molluscs, and crustaceans.

Remove Common Species

The list of species resulting from scoring criteria for species that occur in New Mexico was then re-evaluated by each taxonomic team and it was decided to remove species considered common, extinct, non-native, and those that were introduced for recreation or whose natural history requirements were covered by other species (Fig 2-1). A total of 144 species was removed using these criteria (Table 2-3). The remaining 346 species are considered indicative of the diversity and health of New Mexico's wildlife (Appendix C).

Table 2-2. Criteria (one point per criterion) used to identify species indicative of New Mexico's diverse life zones, habitats, and natural heritage.

Criteria	Definition
Declining	Species that exhibits significant long-term declines in habitat and/or numbers, and are subject to a high degree of threat, or may have unique habitat or behavioral requirements that expose them to great risk.
Vulnerable	Usually abundant, may or may not be declining, but some aspect of their life history makes them especially vulnerable (e.g. migratory concentrations, or rare/endemic habitat).
Endemic, Disjunctive, or Keystone	Populations that are restricted to an ecoregion (or small geographic area within an ecoregion, or depend entirely on a single area for survival. This category includes populations that are geographically isolated from other populations and species that contribute to ecosystem function in a unique and significant manner through their activities.
Wide-Ranging	Species that depend on vast areas, such as wolves, grizzly bears, pike minnow, and migratory mammals, birds, bats, and insects.
Recreational, Economic, or Charismatic	Species with recreational (hunted or fished), economic, or charismatic appeal.

Table 2-3. Number of species considered extinct, exotic, common, or that were introduced for recreation, or their natural history requirements covered by other species identified.

Removal Criteria	Species Removed
Species considered extinct	1
Non-native species	4
Species introduced or stocked for recreation. Populations are widespread and stable when natural reproduction occurs	25
Species is common with little to no threats	33
Species natural history requirements are covered by other species	81

Indicative Species Landscape Habitat Associations

The Southwest Regional Gap Analysis Project (SWReGAP) modeled 125 land cover types across New Mexico, Arizona, Colorado, Nevada, and Utah (SWReGAP; http://fws-nmcfwru.nmsu.edu/swregap/), 89 of which occur in New Mexico (Appendix D). NMDGF also recognized caves as an important habitat type in New Mexico and included this habitat type for species associations.

In addition to land cover mapping, SWReGAP predicted habitat associations for 833 vertebrate species that reside, breed, or use habitat for a substantial portion of the their life history in the five state region (SWReGAP; http://fws-nmcfwru.nmsu.edu/swregap/). Species habitat associations, identified by reviewing peer-reviewed and technical documents and consulting species experts, were cross-walked to SWReGAP land cover classes. NMDGF species experts reviewed and, where necessary, corrected resultant matrices of species habitat associations by the 89 New Mexico land cover types and caves. Habitat associations for indicative species (primary subspecies level) that were not included in the 833 vertebrate species modeled by SWReGAP were constructed in a similar manner by SWReGAP, NMDGF and CASE. Further, NMDGF identified 23 aquatic habitats in New Mexico (Appendix E). Aquatic species habitat associations were populated to these 23 aquatic habitat types. Additional information recorded for aquatic species included the 4-digit hydrologic unit and elevation range to estimate geographic distribution.

Identification of Key Habitats

In order to focus conservation actions on those habitats and communities most essential to conserving New Mexico's SGCN, we entered into a process of designating key habitats from among the 113 habitat types identified in New Mexico (89 land cover types mapped by SWReGAP, 23 aquatic habitats, and caves). We first aggregated several similar SWReGAP land cover types. Sixteen riparian land cover types were grouped into a Riparian class (Appendix F). Further, Rocky Mountain Montane Mesic and Dry-Mesic, Conifer Forest and Woodland were grouped into one habitat. The Chihuahuan Piedmont Semi-Desert Grassland and the Chihuahuan-Sonoran Desert Bottomland and Swale Grassland types were combined as Chihuahuan Semi-Desert Grassland. The Madrean Pine-Oak and Conifer-Oak Forest and Woodlands were also aggregated as one habitat type. For the aquatic habitats, several habitat types were also aggregated (Appendix G). Ephemeral ponds, small reservoirs and tanks were combined into one habitat type. Further, perennial spring/seeps and marsh/cienegas were combined. After aggregations were completed, there were still 83 possible habitat types in New Mexico. Those found by technical teams to have one or more of the following properties were designated as key habitats:

- Important to the biodiversity of New Mexico,
- Important to endemics or obligate species of New Mexico,
- Captures a broad range of indicative species,
- Adds unique species to state fauna,
- Hosts a variety of scarce or threatened wildlife,
- Threatened by land uses/management practices,

- Limited or has been significantly reduced in New Mexico,
- Habitat type is unique to New Mexico, Southwest, US, or worldwide,
- Key breeding or foraging habitat for species of concern,
- Hosts wide-ranging species that are not found in other habitats,
- Supports species with isolated or relict distributions in New Mexico,
- Habitat functions as a refuge or indicator of the quality of the system, and
- Functioning habitat; habitat has greater ecological value.

Ten key aquatic habitats and nine key terrestrial habitats were thus identified (Table 2-4). Key aquatic habitats ranged from Perennial Large Reservoirs to Ephemeral Marsh/Cienegas and key terrestrial habitats encompassed riparian, forest and woodland, shrubland, and grassland communities.

Species of Greatest Conservation Need

Vertebrates, Molluscs, and Crustaceans

Nineteen key landscape habitat types were identified:
- 9 terrestrial, and
- 10 aquatic.

Of the 346 vertebrate, mollusc, and crustacean species considered indicative of the diversity and health of New Mexico's wildlife (Appendix C), technical teams found 290 to be associated with key habitats and identified these as SGCN. There were an additional eight indicative species of conservation concern that were not associated with key habitats (Table 5-19). These species were included for a total of 298 vertebrate, mollusc, and crustacean SGCN (Appendix H). These eight species are addressed under Additional Species of Greatest Conservation Need, Chapter 5.

Table 2-4. Key aquatic and terrestrial habitats in New Mexico.

Aquatic Habitats	Terrestrial Habitats
Perennial Large Reservoir	Chihuahuan Semi-Desert Grassland
Perennial 1st and 2nd Order Stream	Intermountain Basins Big Sagebrush Shrubland
Perennial 3rd and 4th Order Stream	Madrean Encinal
Perennial 5th Order Stream	Madrean Pine-Oak/Conifer-Oak Forest and Woodland
Perennial Tank	Riparian
Perennial Marsh/Cienega/Spring/Seep	Western Great Plains Sandhill Sagebrush Shrubland
Ephemeral 1st and 2nd Order Stream	Western Great Plains Shortgrass Prairie
Ephemeral Natural Catchments	Rocky Mountain Alpine-Montane Wet Meadow
Ephemeral Man-Made Catchments	Rocky Mountain Montane Mixed Conifer Forest and Woodland
Ephemeral Marsh/Cienega	

Additional Arthropods

Arthropods of New Mexico other than crustaceans are relatively poorly known and the current list of additional arthropod SGCN is biased toward those taxonomic groups for which we have some information. An extensive inventory of New Mexico arthropods (terrestrial and aquatic insects and other terrestrial arthropods) is needed before all New Mexico taxa can be addressed with confidence. We are aware of approximately 50 undescribed arthropod species, most of

which are narrow endemics that have been recently discovered in New Mexico as a result of local biological inventory studies and collecting by taxonomic researchers. We anticipate future discoveries of undescribed taxa, as well as new geographic distribution and ecological information for many more described and undescribed species.

The technical team consulted a number of sources to inform its identification of arthropod SGCN. Federal (US Fish and Wildlife Service) and state (NMDGF, New Mexico Natural Heritage Program) agencies, USGS Northern Prairie Wildlife Research Center Online, and NatureServe listings were searched for arthropod taxa of conservation concern. Federal and state protection status and ratings also were obtained from those listings. Former federal threatened and endangered candidate species listed prior to 1996 were searched for Candidate 2 Species that were dropped from Federal listings in 1996 for lack of biological/ecological information (February 28, 1996; 61 FR 7596). Taxa of limited geographic distributions, including local endemic species, and taxa restricted to habitats that are threatened or potentially threatened by human caused environmental disturbance, were obtained from experts for various arthropod taxonomic groups, scientific literature, and the New Mexico Natural Heritage Program database. Lists of arthropods harvested for commercial trade were obtained from regional online commercial insect vendors. We subsequently designated 154 additional arthropods of the classes Insecta, Arachnida, Chilopoda, Diplopoda, and Entognatha as SGCN (Appendix H) on the basis that they meet one or more of the following criteria:

- Present and/or historical species (Federal Candidate 2 Species) listed by Federal and State natural resource agencies as species of conservation concern (endangered, threatened, sensitive, or species of concern), or

- Species known to be represented by few geographically and environmentally restricted, isolated, and/or declining populations, including rare species that are known to be harvested for commercial trade purposes, and/or

- Species restricted to habitats that are threatened or potentially threatened in the foreseeable future by human caused environmental disturbance, and/or

- Species of significant natural heritage value to New Mexico.

New Mexico's Species of Greatest Conservation Need (SGCN) consist of 298 fish, birds, mammals, amphibians, reptiles, molluscs, and crustaceans, and 154 arthropods (other than crustaceans), for a total of 452 SGCN.

SGCN ABUNDANCE AND DISTRIBUTION

In New Mexico, there is little quantified data estimating wildlife populations. Indeed, some species were selected as SGCN because of unknown population status. Describing the current distribution of species presents similar challenges, as species have not been inventoried across the entire state. We therefore relied on information provided by other groups and organizations for estimating the abundance and distribution of New Mexico's SGCN.

SGCN Abundance

We used the NatureServe (http://www.natureserve.org) State (S) and National (N) conservation status codes as an estimator of abundance for SGCN. Global (G) conservation status codes were not used because the global status for a large percent of the SGCN was unknown. NatureServe provides information about the conservation status, taxonomy, distribution, life history, and habitat requirements of species. This database has been developed over the past 30 years, and includes information from NatureServe, its natural heritage member programs, and a large number of collaborators in government agencies, universities, natural history museums, botanical gardens, and other conservation organizations. The standardized methods for gathering, managing, and analyzing biological and ecological data employed by NatureServe allow conservation status codes to be compared among organisms and across political boundaries. Conservation status assessments are based on the best available information and consider a variety of factors such as abundance, distribution, population trends, and threats. Status assessments should reflect current conditions and understanding. NatureServe and its member programs strive to update these assessments with new information from field surveys, monitoring activities, consultation, and scientific publications at least once a year and status assessments are based on a combination of quantitative and qualitative information (http://www.natureserve.org). Species conservation status codes are designated based on:

- Total number and condition of occurrences (e.g., populations);
- Population size;
- Range extent and area of occupancy;
- Short and long-term trends in the above factors;
- Scope, severity, and immediacy of threats;
- Number of protected and managed occurrences;
- Intrinsic vulnerability; and
- Environmental specificity.

NatureServe conservation status codes for New Mexico SGCN were adjusted by NMDGF based on their professional knowledge and experience.

NatureServe conservation status ranks are assigned a numeric scale from one to five, ranging from critically imperiled (1) to demonstrably secure (5) (Table 2-5). Species that are possibly extirpated are not given a numeric value. Species experts with the NMDGF reviewed the conservation status codes for all SGCN in New Mexico. Conservation status ranks were adjusted for the CWCS in New Mexico based on their professional knowledge and experience. Conservation status codes for SGCN are provided in Appendix H. State and

National conservation status ranks for SGCN were summarized into four groups (Table 2-6) to expedite abundance summaries provided in the Statewide Assessment and Strategies and the Assessments and Strategies for SGCN and Key Habitats chapters.

Table 2-5. Conservation status rank definitions provided by NatureServe (http://www.natureserve.org). Status codes can be applied to State and National scales.

Numeric Rank	Conservation Status Rank Definitions
H	**Possibly Extirpated** (Historical)—Species or community occurred historically in the nation or state/province, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20-40 years. The NH or SH rank is reserved for species or communities for which some effort has been made to relocate occurrences, rather than simply using this status for all elements not known from verified extant occurrences.
1	**Critically Imperiled**—Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
2	**Imperiled**—Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
3	**Vulnerable**—Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
4	**Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
5	**Secure**—Common, widespread, and abundant in the nation or state/province.

Table 2-6. Conservation status ranks summarized into groups to facilitate New Mexico's SGCN abundance summaries for the CWCS.

			National Level				
	Conservation Status Ranks and Codes		Critically Imperiled	Imperiled	Vulnerable	Apparently Secure	Secure
			1	**2**	**3**	**4**	**5**
State Level	Possibly Extirpated	**0**	Species that are both state and nationally vulnerable, imperiled, critically imperiled or possibly extirpated.			Nationally secure species, but State vulnerable to imperiled	
	Critically Imperiled	**1**					
	Imperiled	**2**					
	Vulnerable	**3**					
	Apparently Secure	**4**	Secure State species, but National vulnerable to imperiled			No immediate threats to species	
	Secure	**5**					

SGCN Distribution

Terrestrial Vertebrate Species

The Southwest Regional Gap Analysis Project (SWReGAP) modeled potential habitat for 833 vertebrate species in New Mexico, Arizona, Colorado, Nevada, and Utah (SWReGAP; http://fws-nmcfwru.nmsu.edu/swregap/). Species habitat models are based on the concept of wildlife habitat relationships, in which are described resources and conditions present in areas where a species persists, reproduces, or otherwise occurs. These modeled relationships predict, and depict spatially, areas of potentially suitable habitat. Modeling of each predicted species habitat was informed by consulting peer-reviewed and technical documents and species experts.

Species associations with land cover, elevation, slope, aspect, and hydrology were modeled in a Geographic Information System (GIS) environment. Model input variables were combined in a Boolean overlay to predict areas of suitable habitat within New Mexico. The 8-digit hydrologic units were used to constrain habitat associations based on a species geographic range. Species experts internal and external to NMDGF reviewed the draft predicted habitat models. Their corrections were incorporated into the final habitat models. Predicted habitat models for SGCN that were not included in the 833 vertebrate species modeled by SWReGAP (primary subspecies considerations) were constructed in a similar manner.

Aquatic Vertebrate Species

Spatial depictions of aquatic vertebrate species distributions were created by using information on aquatic habitat associations developed by NMDGF personnel. The National Hydrography Dataset (NHD) (http://nhd.usgs.gov) was used to spatially depict aquatic habitats. The NHD is a 1:100,000 scale digital spatial data set that contains information about surface water features such as lakes, ponds, streams, rivers, springs and wells. The 4-digit hydrologic units and suitable elevations within those hydrologic units were used to estimate species geographic range. Habitat associations and estimated geographic range were incorporated into a GIS environment and a Boolean overlay technique was used to model the predicted SGCN habitat in a manner similar to that employed for terrestrial species.

Mollusc, Crustacean, and Other Arthropod Species

Accurate spatial depictions of suitable habitats for molluscs, crustaceans, and other arthropods in New Mexico are not available. Many of these species are endemics and only occur in one mountain range or in some cases on one mountain. Spatial scale issues make modeling fine scale habitats difficult. There are currently no useful data sources that depict ephemeral habitats or marsh, springs, seeps, or cienegas, or perennial ponds. Future research and survey efforts should address this information gap.

IDENTIFICATION OF FACTORS INFLUENCING SPECIES AND HABITATS

Assessment of factors that influence species and habitats is central to resource agencies' statutory mandates to manage, protect, and conserve wildlife. This process requires basic biological knowledge of species' life history, habitat requirements, and population demographics. Understanding the interaction and ecological role that a species, population, or assemblage may play in any given ecosystem relative to resource management (past, current, and future) is also required. Assessments of such factors are broadly-based and intuitively-derived perceptions of outcomes (Wood and Armitage 1997). These perceptions may be documented by direct experience or by drawing from past examples at various spatial scales (Niemi *et al.* 1990).

Our assessment of factors that influence species or habitats was primarily focused at the habitat scale, as these factors directly influence wildlife communities and SGCN populations. Our assessment was based on review of peer-reviewed and technical documents, professional knowledge, by consulting species experts, and advice obtained from public forums. The NMDGF's assessment was derived from a framework provided by Salafsky *et al.* (2003), whose approach was to identify factors that influence habitats and group them into general categories to facilitate broader analyses. We also identified individual factors that most influence the persistence of each SGCN (Appendix I). Factors that influence species were considered statewide, but were not cartographically depicted.

Assessment of factors that influence species or habitats was primarily focused at the habitat scale, as these factors directly affect wildlife communities and SGCN populations.

In our assessment of factors that influence species and habitats, we primarily assess those practices that are harmful to wildlife at certain levels of use or extent. It should be understood that it is the manner in which a human activity or practice is conducted that determines if it has a negative or positive effect on wildlife populations. We recognize that many human activities across today's landscapes have the potential to be either beneficial or detrimental to wildlife. Many factors that influence New Mexico landscapes are based on legal and accepted practices.

To allow for statewide spatial analyses, factors that influence habitats were identified for the 89 land cover types mapped by SWReGAP, the 23 aquatic habitats identified by the NMDGF (Appendix D and E), and caves. We adapted eight categories of factors that influence habitats (Table 2-7) presented in Salafsky *et al.* (2003). Within these categories, 43 possible generic factors that may influence habitats were identified (Appendix J). Definitions for each factor are presented in Appendix K.

The spatial scope and severity of each factor per habitat type were scored based on guidelines provided by Salafsky *et al.* (2003) (Table 2-8). Numeric magnitude scores were calculated by adding spatial scope and severity. Thus, total magnitude scores for each generic factor ranged from 2-8. Magnitude scores of all generic factors were summed within categories to facilitate analyses of factors that affect habitats across the state. Further, we summed magnitude scores of each of the 43 generic factors within each key habitat in New Mexico to provide a basis in understanding the possible synergistic effects, and where we might need further clarification on the outcomes of these factors. We also mapped these cumulative magnitude scores for each

landscape habitat type in ArcGIS 9.0 to provide a broad spatial reference of factors that may influence habitats in New Mexico, and enhance our understanding of geographic areas where synergistic effects of potential factors may influence some habitats more than others.

Calculation of Magnitude Scores for each Generic Factor
Spatial Scope + Severity = Magnitude
(1 to 4) + (1 to 4) = (2 to 8)

Calculation of Cumulative Magnitude Score per Habitat
Sum magnitudes scores for all 43 generic factors for each habitat type.

Highest Possible Cumulative Score per Habitat =
43 (General Factors) * 8 (highest possible magnitude score) = 344.

Table 2-7. Description of categories of factors that influence habitats used in the CWCS for New Mexico. Descriptions derived from Salafsky *et al.* (2003).

Category	Description of Category
Abiotic Resource Use	Human extraction of non-biological resources.
Consumptive Biological Use	Human harvesting or use of biological resources from an ecosystem that removes the resources from the system.
Habitat Conversion	Total loss or destruction of natural habitat.
Invasive Species	Human linked introduction and spread of species from one ecosystem to another. Includes alien or exotic species plant and wildlife species and escaped native species.
Modification of Natural Processes and Ecological Drivers	Human caused changes in natural systems and overarching ecosystem drivers, e.g., drought.
Non-Consumptive Biological Use	Human use of biological resources in an ecosystem in a way that does not remove the resources from the system.
Pollution	Human caused introduction and spread of unwanted matter and energy into ecosystems. Includes chemical, biochemical, thermal, radiation, and noise pollution.
Transportation Infrastructure	Development of long narrow corridors for transporting people, goods, and energy.

Table 2-8. Numeric scores (categorical measurement) given to each threat identified for each SWReGAP habitat type in New Mexico. Scores and definitions from Salafsky *et al*. (2003).

Variable	Continuous Measurement	Categorical Measurement	Comments
Spatial Scope	Area threatened expressed in hectares or as a % of the total possible project area	4 = Throughout (>50%) 3 = Widespread (15 – 50%) 2 = Scattered (5 – 15%) 1 = Localized (< 5%)	Calculated as % of possible area (i.e., water pollution is % of aquatic habitat at a site, not entire site)
Severity	Actual measure of reduced target viability/integrity (e.g., nesting success, stream temperature)	4 = Serious damage or loss 3 = Significant damage 2 = Moderate damage 1 = Little or no damage	Independent of area; the degree to which a threat has an impact on the viability/integrity of targets within the project area within 10 years.

IDENTIFICATION OF CONSERVATION ACTIONS

Strategies, or conservation actions in CWCS terminology, are the broad approaches or interventions that will be employed to overcome a problem or take advantage of an opportunity so as to bring about attainment of a desired outcome. One or more species-or-habitat-based conservation actions have been developed through professional knowledge or literature review and presented herein to address any one problem or opportunity. Conservation actions were constructed based on: 1) SGCN, 2) condition of key habitats, 3) problems affecting species or habitats, 4) information gaps that limit our ability to make informed conservation decisions, 5) research, survey, and monitoring needs that would enhance our ability to make conservation decisions, and 6) desired future outcomes for habitats or SGCN (Fig. 2-2). The Assessment and Strategies for SGCN and Key Habitats (Chapter 5) provides descriptions of each of these components for key habitats within each ecological framework.

After identifying the SGCN associated with the key habitat of interest within a particular ecological framework, we began the thought process for developing conservation actions when we described the relative condition, or current state, of key habitats in terms of their ability to support SGCN (Fig. 2-2). Current condition may be thought of as the extant result or effect of past land use decisions. Describing these conditions begins to suggest *restorative* conservation actions that might be appropriate, such as reconnecting fragmented/disjunctive habitats.

Next, we identified factors that may adversely affect SGCN or their habitats (Fig. 2-2). These are essentially the "threats" that may destroy, degrade, or otherwise impair the biodiversity or natural processes that sustain them. They are the underlying causes that create current or future condition. Problems identified facilitated our later development of *interventions*, conservation actions to preclude or mitigate their effect. Though past problems may in part be responsible for the current condition of the habitat, problem and condition are not equivalents.

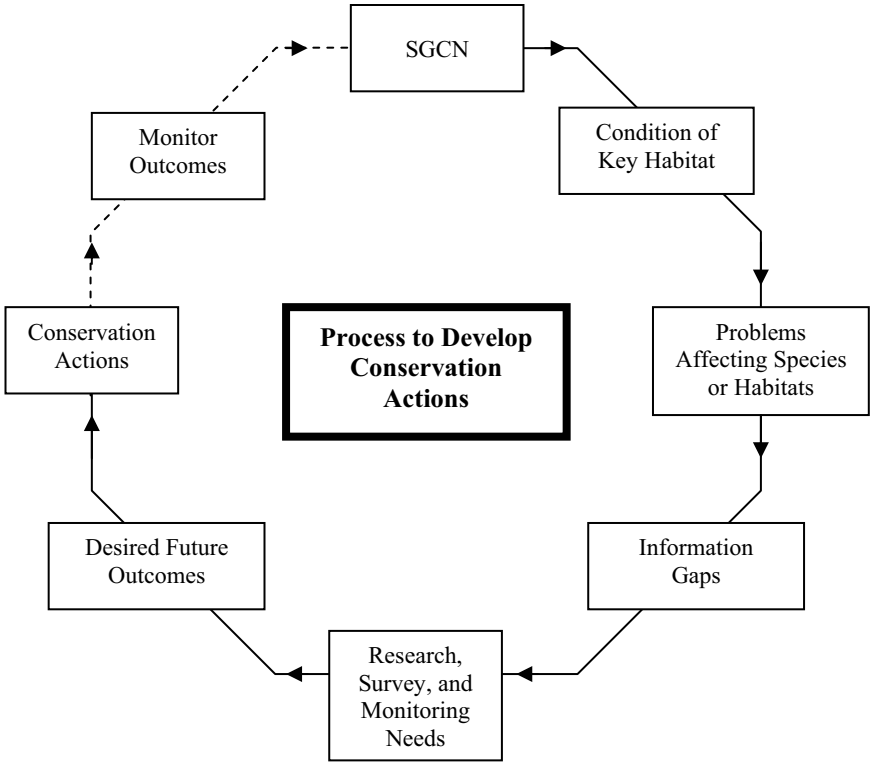

Figure 2-2. Process used to develop conservation actions for the CWCS for New Mexico.

We then identified information gaps that limit our ability to accurately assess the situation and/or develop effective conservation actions (Fig.

2-2). These are often matters of scale and scope or cause and effect such as "What is the extent and configuration of fragmentation in a particular habitat?" or "How are sand dune lizards and their habitat affected by a single well pad?" Information needs often became apparent when attempting to describe habitat condition and identifying problems. Information gaps provided the basis for identifying and rationalizing research, survey, and monitoring needs. Research, survey, and monitoring needs, when fulfilled, may help us to better understand our situation and develop effective conservation actions.

Desired future outcomes describe the ultimate conditions we would like to exist in the future. We also stated some intermediate outcomes, such as having some needed policy in place, that may serve as milestones to progress toward the ultimate outcome. Desired future outcomes are consistent with the overall CWCS outcome that the nation's (and of course New Mexico's) biodiversity is conserved to the extent that no more species need be listed as threatened or endangered.

Conservation Actions articulate the means by which we will overcome problems and attain the desired future outcomes. Our conservation actions are intentionally broad, directional, and nonspecific so as not to constrain our selection of means for implementing them. For example, a conservation action such as "Develop regulations which will protect the female component of the bear population" allows for many different regulatory approaches, e.g., closing the season, delaying opening until females are denned, prohibiting the taking of females, or closing the season when a quota for females is taken. Most people might agree that we should protect females, but some may object to the way in which we do it because of adverse impacts upon their interests. A broad strategy, while delineating the rationale that subsequent actions must satisfy, provides room for finding the specific actions all interests can live with. Whichever regulatory actions we eventually find acceptable, the strategy requires that they protect females. Tasks for implementing conservation actions will be specified, scheduled, staffed, and funded in operational plans.

Conservation actions propose what could be done without consideration of agency, department, financial or workforce capacities to implement them. These considerations are made during operational planning.

Because plans provide the means of coordinating work across organizational and jurisdictional boundaries our conservation actions set forth all necessary interventions; not just those to be performed by organizational units within NMDGF. Conservation actions may include explicit needs for law enforcement, information and education, land acquisition, access development, information technology, habitat management or other functions and are not limited to those over which the NMDGF has direct control or authority, because many agencies and other interests will ultimately plan and implement operational actions of the CWCS. Further, conservation actions do not give consideration to NMDGF's financial or workforce capacities to implement them. No commitment of money or manpower to any conservation action is therefore made or implied until such time as NMDGF and cooperators choose to implement it through operational planning and budgeting processes, in concert with pertinent collaborators and partners.

IDENTIFICATION OF KEY AREAS FOR CONSERVATION ACTION

The process we employed in developing the CWCS for New Mexico also provided the foundation to identify potential key areas for focusing biodiversity conservation efforts. Spatially explicit predicted habitat distribution models for aquatic and vertebrate SGCN were developed indicating areas in New Mexico that host a great diversity of terrestrial and aquatic SGCN. Synergistic effects of factors that influence habitats were modeled to indicate areas and key habitats that may be greatly altered by multiple factors. Stewardship data depicting landscapes with long-term protection from anthropogenic degradation were obtained from SWReGAP. These variables, when combined, can give some indication as to which landscapes may be key areas for focusing conservation efforts.

We created a spatial model indicating potential key areas for conservation efforts by giving the four model input variables described numeric values from 1-4 (Table 2-9). These models were combined in an additive Boolean overlay to predict potential key areas for conservation efforts within New Mexico. The resulting analysis produced a spatial model of values that ranged from 4-16. Landscapes with higher scores are areas that are within key habitats, have a high number of terrestrial and aquatic SGCN taxa, may be potentially altered by synergistic effects that influence habitats, and lack long-term legally-binding management plans protecting them from anthropogenic degradation. These landscapes were identified as key areas to consider when applying conservation efforts.

Table 2-9. Criteria used to code model inputs to numeric values from 1-4 to identify landscapes that may be key areas for focusing conservation efforts.

	Four Input Models			
Numeric Values of Input Models	Key habitats[1]	Terrestrial and aquatic SGCN diversity[2] (SGCN Taxa Modeled)	Synergistic effects of factors that may influence habitats[3] (Total Magnitude Score)	SWReGAP land status categories[4] (Status Code)
1	Not Present	44-59	0-40	1 (e.g., Wilderness Areas)
2		60-76	41-80	2 (e.g., National Park Lands)
3		77-93	81-120	4 (e.g., Private lands)
4	Present	94-109	120-165	3 (e.g., Multiple use lands)

[1] See Chapter 2, Identification of Key Habitats section for details. SGCN diversity was assigned to the 8-digit HUCs as described for the species distribution models.

[2] See Chapter 4, SGCN Abundance section for details.

[3] See Chapter 2, Factors Influencing Species and Habitats section for details.

[4] See Chapter 3, Land Stewards section, Table 3-3, for details. Ranks of land status categories were modified from SWReGAP original ranks because multiple use lands typically have long-term legally binding management plans and are areas that have high opportunity for collaboration between federal, state, and local land managers.

OPPORTUNITIES FOR AGENCY AND PUBLIC INVOLVEMENT

The CWCS agency and public involvement/partnering process began in May and June 2003 with separate meetings with representatives of The Nature Conservancy and Natural Heritage New Mexico to explore opportunities for partnering and sharing information. NMDGF made its first public presentation about the CWCS to the State Game Commission in October 2003. Several articles followed that were placed in 30 newspapers with a total circulation of 332,000 explaining the CWCS initiative and inviting people to let us know of their interest in participating. An early draft of the CWCS was placed on the NMDGF website and people were asked to let us know their opinions by completing an online survey or simply sending us an e-mail. In addition, separate presentations about the CWCS were made to the NM Wildlife Federation Conference and the Native American Fish and Wildlife Society. We conducted three forums for potential partners from local, state, federal, and tribal governments and non-governmental organizations representing recreation, conservation, agricultural, and energy development interests. A fourth forum was held exclusively for tribal interests. Forums were held in each of the four areas of the state primarily to orient and solicit input from county commissioners, local Natural Resources Conservation Service (NRCS) staff, and some additional agricultural interests. Two additional forums were held to assure sportsmen's groups opportunity for awareness and participation. Just over 400 individuals were invited to these 10 forums, including State Game Commissioners, and 112 individuals attended. Forum participants represented such diverse interests as:

NM Farm and Livestock Bureau
Eddy County Farm Bureau
Carlsbad Sportsmen's Club
NM Wild Turkey Federation
Natural Resource and Conservation Service
Dona Ana Co. Commission
NM Department of Agriculture
Southwest Environmental Center
Otero County Grazing Association
Bureau of Land Management
Fisheries and Wildlife, NMSU
Museum of Southwestern Biology, UNM
Playa Lakes Joint Venture
The Nature Conservancy
Cannon Air Force Base
US Forest Service
US Fish and Wildlife Service
Acoma Pueblo
Isleta Pueblo
Sandia Pueblo
Northern Pueblos Agency, BIA
Southern Pueblos Agency, BIA
Southwest Consolidated Sportsmen
Mesilla Valley Flyfishers
Grant Co. Farm and Livestock Bureau
NM State Parks
CS Ranch
Bell Ranch
South Valley Alliance
NM Cattle Growers
NM Wool Growers
NM Wildlife Federation
NM State Game Commission
Navajo Nation
BIA Natural Resources, Mescalero
Santa Ana Pueblo
Santo Domingo Tribe
Pueblo of Zuni
NM Natural Heritage Program
Turner Enterprises
Leopold Education Project
People for Native Ecosystems
Governor's Office
NM House of Representatives
Sandia Mtn. Bear Watch
NM Highlands Wild Lands Network Project
Audubon Society
Picacho Gun Club

Rocky Mountain Elk Foundation
Quail Unlimited
Society of American Foresters
Mule Deer Foundation
Wild Turkey Association
NM Trout
NM Council of Outfitters and Guides
Trout Unlimited

In addition, through other presentations, e-mails, and phone conversations the NMDGF has exchanged information with such groups as Amigos Bravos, Friends of the Wild Rivers, Animal Protection of NM, Defenders of Wildlife, The Sierra Club, the Wilderness Society, the NM River Otter Working Group, the Albuquerque Wildlife Federation, the New Mexico Farm and Livestock Bureau, the NM Federal Lands Council, and several unaffiliated individuals. In all, the scope, focus, and content of this document were influenced by the direct involvement of over 170 individuals external to NMDGF who provided valuable technical and socio-economic insights and constructive criticism from diverse and sometimes conflicting perspectives. Regional coordination has been fostered through participation in multi-state project grants and events associated with CWCS development.

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The listing herein of agencies, institutions, conservation organizations, sportsmen associations, agriculture interests, other interests, or individual participants should **not** be taken to imply that they agree with all portions of the CWCS or with the CWCS initiative in general.

The Department also participated in the 2004 Wildlife Values in the West Survey (Teel and Dayer, 2005), which contains several questions pertaining to public attitudes on conserving New Mexico's biodiversity. Of 5002 surveys mailed to New Mexicans 859, were completed and returned. Results indicate that about 75% of New Mexicans view conserving our state's biodiversity as quite to extremely important. Another 23% view conserving our biodiversity as slightly to moderately important. Only 2% find such conservation unimportant. A majority (89%) of respondents feel it is important to manage and conserve wildlife that are not hunted or fished and 68% feel it is quite to extremely important to increase populations of endangered species. About 82% of New Mexicans feel it is quite to extremely important to protect and improve lands and waters used by wildlife and 76% feel it is quite to extremely important to maintain sufficient water in our lakes and rivers to support water-dependent wildlife. About 89% of New Mexicans agree that fish and wildlife are a benefit to all of society and that paying for their conservation should be the responsibility of all New Mexicans. A large proportion (78%) disagrees with the notion that people who only view or appreciate wildlife and do not hunt, fish, or trap should not have to pay for fish and wildlife conservation. About 84% of respondents agreed that hunting, fishing, and wildlife viewing activities have a strong positive effect on state and local economies.

75% of New Mexicans view conserving our state's biodiversity as quite to extremely important.

Our agency and public involvement efforts not only produced many useful technical suggestions and expressions of support but also revealed a number of potential issues. New Mexico Farm and Livestock Bureau representatives expressed concern about the potential of the CWCS to

impact agricultural operations, add to the burdens already placed upon landowners, and cause private property rights to be usurped. They are especially concerned that agriculture not be incorrectly implicated in adversely affecting the condition of key habitats and the status of SGCN through unsubstantiated references to the effects of grazing. Some agricultural interests are also concerned that the identification of arthropod SGCN may interfere with their need to control insects. Believing the CWCS needs further review and revision, the Agricultural Resources and Programs Division of the New Mexico Department of Agriculture requested an extension of the time for CWCS consideration and increased interaction with a broader constituency group to assist in its completion.

Tribal representatives, though interested in the potential to partner in CWCS development and implementation, expressed concerns about the inequity they perceive in funding for tribal wildlife grants, the potential obstructive effect of sovereignty issues, and that revealing information about the presence of SGCN on tribal lands might precipitate federal land use constraints through critical habitat designations. Some private landowners share this last concern with respect to their properties.

New Mexico State Parks Division representatives expressed concern that our efforts to restore native species not conflict with the availability of exotic sport fish popular with the angling publics visiting park facilities. The Department will continue to engage all of the above entities to help resolve these and other issues of CWCS implementation.

80% of New Mexicans:

- Feel it is quite to extremely important to protect and improve lands and waters used by wildlife,
- Feel it is quite to extremely important to maintain sufficient water in our lakes and rivers to support water-dependent wildlife,
- Agreed that hunting, fishing, and wildlife viewing activities have a strong positive effect on state and local economies.