Development of Science Priorities for the Desert Landscape Conservation Cooperative: A Comprehensive Assessment of Science Needs

By

Desert LCC Science Working Group

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Development of Science Priorities for the Desert LCC: A Comprehensive Assessment of Science Needs

Introduction

The Desert Landscape Conservation Cooperative (LCC) Science Working Group was tasked by the Desert LCC Steering Committee to conduct a comprehensive assessment of science needs over the Desert LCC region and to prioritize those needs to guide the allocation of future resources towards meeting those science needs. To accomplish this task, the Science Working Group identified 553 science needs from forty published technical documents and resource assessments over the Desert LCC region, six outreach meetings and workshops, and personal communication. Priority needs were then identified through criteria established by the Steering Committee in January, 2012. This report describes the process that was used to identify and prioritize science needs for the Desert LCC. Further, this report presents a list of priority science needs approved by the Steering Committee and describes the comprehensive science needs assessment that served as the basis for establishing these priorities.

The Science Working Group is recommending 23 priority science needs that fall into four categories: Terrestrial, Water, Cultural, and Monitoring. These categories will be further refined through ongoing Science Working Group science prioritization, scoping, and strategic planning processes (e.g., inclusion of water policy, aquatic resources, social science, and socioeconomics within existing categories). The priority science needs within categories were organized into first and second tiers. Tier-one science needs should be generally considered the priority, however depending on specific budget opportunities or project objectives; it is helpful to have both tiers available for funding flexibility.

These priorities will not likely be addressed simultaneously or through the same funding mechanisms. Partners within the LCC may choose to focus on priorities that specifically meet certain needs of a particular interest. Moreover, the Steering Committee may wish to focus resources on particular needs as the urgency to meet a certain goals changes. Monitoring needs are listed separately from the other categories because there are several long-term monitoring programs that may be well- positioned to meet these needs (e.g., the National Park Service Inventory and Monitoring Networks, the U.S. Fish and Wildlife Service National Wildlife Refuge Inventory and Monitoring Program, and the Long-Term Ecological Research programs).

The top science needs were identified out of 553 needs. The priority science needs (p 2-3) were drawn from this list of 46 top science needs that best met the criteria established by Steering Committee in September 2011 (Table 1, page 9). This larger list provides context for recommended science priorities.

The next steps for the science priorities are as follows:

1. Identify existing information that has addressed or is addressing science priorities.
2. Identify science projects that are currently underway that address science needs.
3. Identify opportunities to facilitate science efforts across agencies and organizations.
4. Provide funding opportunities that are targeted to meet specific science priorities.
5. Collaborate with the Southwest Climate Science Center and address science needs through long-term monitoring programs.
6. Re-evaluate science priorities annually and revisit list of priorities every three to five years.

Recommended Science Priorities for the Desert LCC

Terrestrial Resources

First tier

- Develop spatial models of predicted shifts in the distribution and composition of ecosystems and major plant communities in response to climate change.
- Investigate the effects of climate change on ecosystem elements, including plants, vertebrates, and invertebrates (especially pollinators), and evaluate the relative vulnerability of different elements.
- Identify key habitat corridors to preserve migration pathways and genetic diversity as land use changes become more prevalent, as well as preserving the future need for corridors and refugia that would enable species to persist and/or to shift distributions in response to climate change.
- Establish scientifically-sound best management practices for riparian restoration, including time of restoration activities, water needs, control of invasive plans, and use of local seed to encourage the full complement of the desired ecological condition.

Second tier

- Investigate the effects of climate variation on ecosystem processes and interconnected landscapes (e.g., uplands adjacent to riparian).
- Provide more accurate spatially-explicit models of stressor distributions.
- Provide a sensitivity analysis of ecosystem metrics in response to climate change impacts, particularly those that are more sensitive to extremes or variability.
- Investigate and model the potential physiological responses of species to climate change.

Water and Aquatic Resources

First tier

- Investigate climate change impacts to surface water and groundwater dependent habitats and species.
- Investigate the interactive impacts of climate change and water management approaches to water availability and natural and cultural resources.
- Investigate climate impacts to future water supply for humans and ecosystems.
- Predict potential impacts to water supply and quality due to changes in the timing and magnitude of climatic events.

Second tier

- Investigate the combined impacts of climate change and land management (e.g., brush control, forest thinning, burning) on watersheds.
- Improve modeling methodologies for predicting water availability through better understanding of snowpack dynamics and agricultural water use.

Cultural and Socioeconomics

First tier (only one tier)

- Evaluate the potential social and economic vulnerability of different human communities to climate change (e.g., Native American, urban, agricultural).
- Evaluate the efficacy of different types of incentive programs, both punitive and non-punitive, to promote conservation among landowners.
- Identify potential impacts of climate and other stressors to the persistence of plants and animals that are important to tribal and indigenous communities and on traditional cultivation of corn and other crops.
- Research and compile past and current indigenous and tribal management practices for maintaining productive populations of desert plants.
- Conduct a climate vulnerability assessment of archeological resources to identify those resources which are most vulnerable, causes of vulnerability, and possible ways to mitigate and/or adapt to anticipated impacts.

Monitoring

First tier

- Identify and initiate monitoring for the priority species of conservation concern and invasive species that might extend or shift range.

Second tier

- Monitor habitat changes in relation to changes in species' populations in order to build better habitat suitability models and to better understand the effects of stressors.
- Select a small suite of indicator/keystone species within each of the 3 deserts (Mojave, Sonora, and Chihuahua) that would be monitored consistently.
- Monitor selected sensitive ecosystems and their species (e.g., dune systems, sky islands, and springs).

Comprehensive Assessment of Science Needs

Background

In November 2010, an ad-hoc Science Sub-Committee for the Desert LCC completed a rapid assessment of science needs (Appendix A) that provided a general understanding of the types of information needs that were shared by Desert LCC partners. This assessment resulted in the collation of 115 science needs that were drawn from fifteen documents and five outreach meetings and that were prioritized using a set of criteria that the Science Sub-Committee developed. The rapid assessment was useful because it resulted in the collation of numerous significant science needs and enabled Desert LCC partners to test a process for identifying science priorities. Shortcomings of the rapid assessment were identified, which included a relatively small number of referenced documents, a relatively narrow breadth of scientific expertise represented on the Science Sub-Committee, and limited criteria used for identifying priorities.

To overcome the identified shortcomings, the Steering Committee asked the Science Working Group to conduct a more comprehensive assessment of Desert LCC science needs. In September 2011, the Steering Committee approved membership of a Desert LCC Science Working Group (Appendix B), and this group identified a process for conducting a comprehensive assessment of science needs that built from the strengths and lessons learned from the rapid assessment. The Science Working Group membership was based on a broader base of scientific expertise than the original Science Sub-Committee. The working group increased the number of reports from which science needs would be extracted from fifteen to forty. A new set of criteria was developed by the Science Working Group for prioritizing science needs and subsequently approved by the Steering Committee.

Objective

The assessment will help set priorities for future funding of science needs beyond 2012. As of February, 2012, the Science Working Group had collated over 550 science needs that were drawn from state wildlife action plans, partnership strategy documents, T &E recovery plans, Desert LCC outreach meetings, climate change workshops, and input from individual scientists, managers, and tribal members. In order to evaluate and rank the science needs, the Steering Committee needed to adopt a set of criteria that the Science Working Group could apply to these science needs.

The comprehensive science needs assessment consisted of 4 steps:

1. Extract science needs from reports, workshops, and direct communication from partners;
2. Develop criteria for scoring the science needs;
3. Apply the criteria prioritize science needs; and
4. Identify priority needs through an online survey and discussion among Science Working Group members.

Step 1: Identify science needs

The Science Working Group collated 553 science needs from partnership documents , state wildlife action plans, Threatened and Endangered Species (T &E) recovery plans, Desert LCC outreach meetings, climate change workshops, and input from individual scientists, managers, and tribal members.

Appendix C provides a list of documents from which science needs were extracted, the names, dates, and locations of all workshops, and the names and agencies of all individuals that submitted science needs. Needs derived from published reports and documents, as well as workshops and individual contributions, are located in an online database at http://dlcc.mojavedata.gov. This database lists the report, author, date, specific need, grouping (e.g., terrestrial, water, etc.), geographic scope, and topic area. To view the full information, please contact the Desert LCC Science Coordinator.

Members of the Science Working Group entered each of the 553 science needs into an online database that was created and maintained by the Mojave Desert Ecosystem Program. The database indicated the source of the science need, the source date, and the source type (publication, workshop, individual). The full science need was then copied and pasted into the database, along with the page number (if it came from a publication) so that it could be revisited if necessary for context. Each science need was assigned to one or more of the following topic areas identified by the Steering Committee in September, 2011: water, ecosystems, wildlife populations, wildlife habitat, soils, stressors, monitoring, cultural, and tools/communication. Each science need was also described from a list of approximately forty sub-topics or keywords, such as connectivity, disease, human water, restoration, and vulnerability.

The full list of 553 science needs will continue to reside in the database and can be used at any time to aid in the decision making process when allocating resources towards meeting science needs within the Desert LCC. For example, if an agency or organization has funds for developing decision support tools, the database can be queried to get information on the types of decision support tools that would be most useful to partners. The database can be used to extract all science needs related to only one of the three principal deserts (Mojave, Sonora, or Chihuahua), or to a species of interest (e.g., desert tortoise or Sonoran pronghorn). Because there is a column for date, the database can be continually updated, and only science needs that fall within a certain date range might be selected for future priority setting.

Step 2: Establish criteria for scoring science needs

The Steering Committee developed a list of possible criteria through a brainstorming session at their meeting in Albuquerque, NM in September, 2011. The Science Coordinator then combined these criteria with a list of criteria used to rank science needs during the 2010 rapid assessment, and consolidated redundancies among similar criteria.

This resulted in a preliminary list of 16 criteria. Members of the Science Working Group then evaluated the usefulness of each criterion in an online survey in early December, 2011. Each participant (N = 11) rated each criterion as to whether it was (1) “highly important”; (2) “somewhat important”; (3) “neutral”; or (4) “not useful or could result in undesirable ranking” of the science needs. Participants were also invited to submit new criteria for evaluation after the survey.

Results of the survey indicated a strong preference for five of the criteria, moderate to no preference for seven, and aversion to four criteria. Two of the criteria received full support from all participants of the online survey. Participants also submitted five new criteria for consideration (Appendix D).

A sub-committee consisting of the Science Coordinator and four members of the Science Working Group evaluated the survey results and selected eight criteria for ranking science needs. These were then

discussed and approved by the full Science Working Group in December 2011. Five of the criteria are those that had the highest support based on results from the on-line survey. Two were moderately-rated criteria as recommended by the sub-committee, and one is a new criterion called Preserves Knowledge. These criteria and associated bullets are listed below. The bullets are either elaborations of the main theme or considerations to make when ranking a science need. A science need does not have to meet all of the bullet statements under a criterion in order to rank high.

During the January 12, 2012 conference call, the Steering Committee discussed and approved these criteria.

In February 2012, the Science Working Group tested the criteria on a subset of science needs to see if the criteria produced expected results. One of the criteria, "preserves knowledge", resulted in the broadest range of scores and the most confusion over its meaning. Some participants felt than any form of data collection could be viewed as "preserving knowledge", whereas most participants felt that it only applied to the preservation of traditional knowledge, historic information, and data that could be lost if not archived. Also, participants found it difficult to assign a numeric value that assessed the degree to which the science need would preserve knowledge. Participants clarified that "preserves knowledge," should be "preserves historic or cultural knowledge," and agreed that it was better integrated under criteria number 3 ("ecological and/or cultural significance) and criteria number 7 ("role as a building block"). In addition, however, this criteria was retained as a "yes/no" sorting mechanism that could be utilized later to identify which science needs have the added value of preserving historic or cultural knowledge.

Criteria for Ranking Desert LCC Science Needs

(bullets serve as examples, not sub-criteria)

1. Mission/goals
    - Relates to broad scale stressors such as climate change or land use change
    - Provides information relevant to adaptive management of resources and adaptation to climate change
    - Provides information relevant to climate mitigation through carbon sequestration or energy use reduction
    - Provides information on natural and cultural resources of the Desert LCC

2. Scope
    - Broad geographic extent of the original science need
    - Broadly recognized as a need by numerous partners
    - Broad applicability of results to numerous partners or within several disciplines
    - Provides opportunity to integrate with other science needs, to address more complex issues

3. Ecological and/or cultural significance
    - Improves understanding of species, landscapes, stressors
    - Improves understanding of indigenous worldviews and other stakeholders' perceptions
    - Preserves historic or cultural knowledge, e.g.:
        - Oral history

- Traditional ecological knowledge
- Tribal and indigenous perceptions of landscapes and processes
- Cultural perceptions of landscapes and resources, including traditional ranching
- Cultural sites
- Historic photos
- Data stored on outdated media

4. Urgency
   - There is a limited window of opportunity to address this science need
   - Addresses a species , an ecological community, or a human community that is on the brink of undesired change
   - Addresses a critical situation that needs immediate attention

5. Applicability
   - Provides useful tools for on-the-ground management
   - Provides useful tools and strategies for climate change adaptation
   - May have specific applicability to tribes or is useful to tribes

6. Scalability
   - Scalable up – one of many, similar small-scale science needs that can be addressed together and rolled up. This includes inventory and monitoring needs.
   - Scalable down – a broad scale science need that can be downscaled to address local conditions

7. Role as a building block
   - Provides a critical step for addressing other science needs
   - Contributes to landscape baseline data
   - Could potentially contribute to long-term monitoring
   - Preserves historic or cultural knowledge, e.g.:
     - Oral history
     - Traditional ecological knowledge
     - Tribal and indigenous perceptions of landscapes and processes
     - Cultural perceptions of landscapes and resources, including traditional ranching
     - Cultural sites
     - Historic photos
     - Data stored on outdated media

8. Preserves historic or cultural knowledge
   - Scored as Yes if the science need would be filled by preserving existing knowledge or information, as opposed to contributing new information. Used to tag science needs that relate to traditional knowledge, historical significance, or archiving needs.

Step 3: Apply the criteria to identify top science needs

The Science Working Group met in Tucson on February 13-14, 2012 to identify priority science needs from the full list of science needs. The group agreed to use a scale of 0 – 4 to apply each criterion, except for criterion 8 which was simply applied as yes/no. The group tested the criteria on a subset of science needs to help calibrate the range of responses among individuals. Following this exercise, the Science Working Group separated into four breakout groups with approximately 135 science needs assigned to each group.

The meeting participants agreed that it would be impossible to score all science needs within their breakout group within the available time. For efficiency, the participants agreed to reduce the list by focusing on the science needs that generally seemed to fit the criteria, without going through the scoring process for each specific science need; rather, broad level science needs that captured multiple, specific , science needs were developed and scored. Each breakout group developed scores for each science need identified (Table 1). It is important to recognize that the scores shown in Table 1 may be indicative of priorities within each category but can't be used to compare across categories.

Table 1 shows the priority 46 science needs identified by all four breakout groups combined. The list originally contained 56 science needs, but 10 science needs were sufficiently similar to other science needs across breakout groups that they were combined, and the final wording was changed to ensure that the specific intent of each science need was incorporated into the wording of the combined version.

Table 1. The top 46 science needs and their criteria scoring. Scores can be compared within the table sub-topics because each sub-topic was scored by the same set of people in a breakout group setting. Scores cannot be compared between sub-topics because they were scored by different breakout groups.

TERRESTRIAL RESOURCES								
Science Need	**Mission & Goals**	**Scope**	**Signi-ficance**	**Urgency**	**Applic-ability**	**Scal-ability**	**Building Block**	**Total (max = 28)**
Climate effects on ecosystems and species								
Model predicted changes in ecosystem composition and distribution from climate change (includes range shift modeling)	3.5	3.75	4.0	3.0	3.5	3.75	3.5	25
Investigate the effects of climate change on ecosystems, plant communities, vertebrates and invertebrates (especially invertebrate pollinators) and evaluate which ecosystems and taxa are most vulnerable to climate change	4.0	3.6	3.8	3.2	3.2	2.8	3.4	24.2
Investigate the effects of climate variation on interconnected landscapes and ecosystem processes	4.0	3.8	3.6	3.0	3.2	3.2	3.4	24.2
Investigate and model the effects of climate change on fire regimes	4.0	3.6	3.8	3.6	3.8	3.4	3.4	25.6
Investigate the effects of climate change on invasive species	4.0	4.0	3.8	3.4	3.6	3.0	3.2	25
Investigate the interactive effects of forest management activities and climate change on forest ecosystems and hydrology	3.8	3.8	3.6	2.8	3.0	3.0	3.4	23.2
Investigate and model potential physiological responses of species to climate change								23.0
Identify potential adaptation strategies for species in response to predicted climate change effects	4.0	4.0	4.0	2.8	3.6	3.2	2.8	24.4

Science Need (Terrestrial, continued)	**Mission & Goals**	**Scope**	**Signi-ficance**	**Urgency**	**Applic-ability**	**Scal-ability**	**Building Block**	**Total (max = 28)**
Estimate the relative contribution of biotic crusts, different vegetation types, and soils toward total carbon sequestration in arid environments. Compare the contribution of these components to the potential contribution of underground carbon storage.	4	4	4	2	1	4	4	23
Provide information on which environments and processes are sensitive to climate change mean values, and which are more sensitive to extremes or variability	4	4	4	2	1	4	4	23
Develop conceptual approaches to tailor the climate change message for different cultural and socio-economic groups so that people are motivated to respond effectively.	4	4	0	4	4	4	0	20
Baseline inventories								
Create baseline maps of vegetation	3.75	3.75	3.25	3.0	3.5	3.5	3.75	24.5
Provide updated distribution maps for species of conservation concern	3.25	3.0	3.0	3.5	3.0	2.25	2.75	20.75
Provide more accurate spatially explicit models of stressor distributions	3.5	3.25	3.25	3.25	3.25	3.25	3.75	23.5
Build a central database that identifies the distribution of aquatic invasive species in relation to sensitive habitats and species of conservation concern								xx
Provide a seamless soil type/texture mapping across Desert LCC at fine spatial scale (1 km). This is a key building block to understanding water holding capacity, soil erosion, and potential shifts in plant communities.	4	4	2	2	1	4	4	21

Corridors and connectivity								
Identify key habitat corridors to preserve migration pathways and genetic diversity	3.5	3.75	3.75	3	2.75	2.75	2.75	22.25
Identify refugia and corridors that could enable species to adapt to climate change	3.8	3.8	3.6	3.0	3.6	2.6	2.6	23.0
Identify key areas on the U.S. - Mexico border where wildlife crossings are particularly important or significant.	3.0	3.25	3.0	3.5	3.75	2.75	3.0	22.25
Identify seasonal connectivity between specific breeding and nonbreeding locations of migratory birds.	3.0	3.75	3.0	2.5	3.0	2.25	2.25	19.75
Other terrestrial science needs								
Conduct landscape-scale analyses of both vegetation communities and landscape features to provide a coarse filter for identifying conservation areas.	3.5	3.75	3.5	3.0	3.75	2.5	3.75	23.75
Establish scientifically sound best management practices for riparian restoration including timing of restoration activities, water needs, control of invasive plants, and use of local seed to encourage a full complement of the desired ecological condition or community.	2.75	3.0	3.0	3.0	3.5	2.25	2.0	19.5
Conduct a comprehensive analysis of the environmental effects of energy development in the Desert LCC: wind, solar, oil & gas, hydro, and geothermal.	4	4	4	4	3	4	4	27
Conduct a sensitivity analysis of how and which decisions regarding land, water, or energy uses could result in major long-term changes	4	4	4	3	2	4	3	24
Identify the effects of stressors (primarily climate change, invasive species, and land uses) on soil formation, erosion, and fertility.	4	4	4	3	1	4	4	24

WATER AND AQUATIC RESOURCES								
Science need	**Mission & Goals**	**Scope**	**Signi-ficance**	**Urgency**	**Applic-ability**	**Scal-ability**	**Building Block**	**Total (max = 28)**
Investigate climate change impacts on future water supply for humans and ecosystems	4	4	4	4	4	4	4	28
Investigate climate change impacts to surface water and groundwater dependent habitats and species	4	4	4	4	4	4	4	28
Predict potential impacts to water supply and quality due to changes in the timing and magnitude of climatic events	4	4	4	4	4	4	4	28
Investigate the interactive impacts of climate change and land management (brush control, forest thinning, burning) on watershed hydrology	4	4	4	4	4	4	4	28
Investigate the effects of water management and policy (including managed flows and releases, and reclaimed water) on aquatic resources	4	4	4	4	4	4	4	28
Investigate the effects of different flow regimes on the abundance and potential expansion of aquatic invasive species (fish, Quagga mussels, salvinia) and riparian invasive plants (tamarisk).								26
Initiate or complete research that will help us better manage the threats of Bd (disease) and non-native predators on amphibians.								26
Improve modeling methodologies for predicting water availability through better understanding of snowpack dynamics and better estimation of agricultural water use.	3	4	4	3	2	4	4	24
Develop communication and education tools related to water use and management	4	4	4	3	2	3	3	23
Improve current water monitoring programs to provide more strategic data collection	2	3	2	3	2	1	4	17

Investigate the effects of water use by renewable energy development on ecosystems.	2	2	3	3	2	3	1	16
CULTURAL RESOURCES								
Science Need	**Mission & Goals**	**Scope**	**Signi-ficance**	**Urgency**	**Applic-ability**	**Scal-ability**	**Building Block**	**Total (max = 28)**
Evaluate the potential social and economic vulnerability of different human communities to climate change (e.g., Native American, urban, agricultural)	4	4	2	2	1	4	4	21
Evaluate the efficacy of different types of incentive and disincentive programs to promote conservation among landowners.	4	4	0	3	3	4	1	19
Identify potential impacts of climate and other stressors on the persistence of plants and animals that are important to tribal and indigenous communities, and on traditional cultivation of corn and other crops	4	3	3	2	1	2	3	18
Research and compile past and current indigenous and tribal management practices for maintaining productive populations of desert plants								24
Conduct a climate vulnerability assessment for archeological resources to identify which are most vulnerable, the causes of vulnerability, and possible ways to mitigate the anticipated effects.								24
MONITORING								
Science Need	**Mission & Goals**	**Scope**	**Signi-ficance**	**Urgency**	**Applic-ability**	**Scal-ability**	**Building Block**	**Total (max = 28)**
Select a small suite of indicator/ keystone species within each of the 3 major deserts that would be monitored in a	4	4	4	2	1	2	4	21

consistent way across each specific desert								
Monitor selected sensitive ecosystems and their species: dune systems, sky islands, springs	4	2	4	3	1	2	4	20
Partner with the National Phenology Network to contribute to phenology monitoring.	4	3	3	2	1	3	4	20
Monitor habitat changes in relation to changes in species' populations in order to build better habitat suitability models and to better understand the effects of stressors	4	2	4	2	2	2	4	20
Identify and initiate monitoring for the priority species of conservation concern and invasive species that might extend or shift range from Mexico into the U.S. (This will require collaboration with Mexico to identify most likely species).	4	2	4	3	1	2	3	19

Step 4: Identify priority science needs

After the Tucson meeting, an online survey was created containing the 46 top science needs identified at the Tucson meeting. Members of the Science Working Group were asked to select a subset of the top science needs that they felt should be carried forward to the Steering Committee as science priorities. In order to ensure that terrestrial, aquatic, and monitoring science needs were given equal weight, the members were asked to select top science needs within each category rather than across categories. Rather than include cultural resource science needs in the online survey, all five of the top cultural resource science needs were carried forward as priorities.

After the survey was completed, the Science Working Group convened by phone to discuss survey results. The group evaluated the scores and saw that within each category, there were obvious break-points in the number of points that each science need received. These break-points served to divide the list of science priorities into two tiers.

Future applications of the comprehensive science needs assessment

The immediate purpose of the comprehensive science needs assessment is to identify priority science needs within the Desert LCC. The voices of numerous managers, scientists, and conservationists have been heard through the process of extracting science needs from existing documents, workshops, outreach meetings, and individuals. From this extensive list, the Science Working Group has identified priority science needs by applying criteria that reflect the goals of the LCC, importance of the science needs to managers, and the relative urgency, applicability, and scalability of each science need.

The next steps for the science priorities are as follows:

1. **Identify existing information that has addressed or is addressing identified science priorities.**
   Science Working Group members are aware of existing research and products that address aspects of the science priorities. The Science Working Group can ensure that Desert LCC partners are aware of this information through a Desert LCC portal that would link each science priority to the suite of existing products that address it.

2. **Identify science projects that are currently underway that could fill the science needs.**
   The Desert LCC Steering Committee can invite partners to submit science projects that are currently underway that specifically address science priorities. This would provide opportunities to increase the success of ongoing projects through additional funding support or form of collaboration.

3. **Identify opportunities to initiate new science efforts across agencies and organizations.**
   The Desert LCC steering committee can serve as a forum for initiating new collaborations across partners that build on the strengths of different agencies and organizations.

4. **Provide funding opportunities that are targeted as specific science priorities.**
   Any agency or organization in the Desert LCC can choose to offer available funds in support of priority science needs through a funding opportunity announcement, a request for proposals, or an interagency or cooperative agreement. At the present time, the Bureau of Reclamation is the

primary agency providing funding opportunities; however, other agencies and organizations need to invest in addressing science priorities that do not receive Reclamation funding.

5. **Address the science priorities through the Southwest Climate Science Center and through long-term monitoring programs.**
   The list of top science needs (Table 1) are divided into sub-topics that include climate, baseline inventories, and monitoring in order to communicate these science needs directly to the Southwest Climate Science Center , GIS mapping services, and a variety of long-term monitoring programs that are funded to meet particular types of science needs. These entities may be able to address specific science priorities through their funding mechanisms or through collaborations with one or more agencies and organizations in the Desert LCC.

6. **Review the science priorities annually and refresh the list approximately every three years.**
   The process of collating science needs was a major effort that took several months, and the database of science needs can serve to inspire science projects for many years. However, science priorities will shift over time in response to new information and new challenges. Therefore, we recommend that science priorities are reviewed and reestablished approximately every three to five years.

APPENDIX A: Rapid Science Needs Assessment

2010-2011

BACKGROUND

In November 2010, an ad-hoc Science Sub-Committee for the Desert LCC conducted a rapid assessment of science needs in order to get a general understanding of the types of information needs that were shared by LCC partners. This process began shortly after the Desert LCC was established, at a time when the Bureau of Reclamation and the Fish and Wildlife Service were jointly conducting outreach meetings to assess partnership interest in the LCC.

The sub-committee was comprised of volunteers from a number of agencies and organizations within the Desert LCC, and most members were self-selected. The sub-committee began the assessment by identifying reports, documents, and workshop summaries that mentioned science needs for natural resource management within the boundaries of the Desert LCC. Individuals within the sub-committee collated the science needs that were listed in these documents and then grouped the needs into several topic areas for efficiency.

The topic areas were presented to participants of 5 outreach meetings in the fall of 2010, to allow the attendees to add more science needs to each of the topic areas. At the first meeting, participants also identified an additional topic area (soils) that was then carried forward to all subsequent outreach meetings. The combination of 15 reports and 5 outreach meetings resulted in the identification of 120 science needs across 10 topic areas.

The sub-committee developed a set of 8 criteria in order to assess priorities among the science needs. The topic areas were divided among sub-committee members, with 1-3 members per topic area, and members individually used the criteria to rank the priorities of all science needs within a specific topic area. For topic areas evaluated by 2-3 people, the average value for each science need served as the science need's rank within that topic area. In general, sub-committee members only ranked science needs within one topic area, and the sub-committee did not attempt to rank the relative importance of topic areas.

The Science Coordinator evaluated the range of scores across all science needs and identified cut-off points between high, medium, and low ranks. This enabled the science needs within each topic area to be placed within one of the ranking categories. This process was completed in November, 2010, and was documented in outline/bullet form in a file called Desert LCC Science Needs: Rapid Assessment by the Science Sub-Committee.

AN EVALUATION OF THE SCIENCE NEEDS ASSESSMENT PROCESS

The rapid assessment was useful because it resulted in the collation of numerous significant science needs, and it enabled partners to test a process for ranking science priorities. The advantages and shortcomings of the assessment are listed here so that we can learn from this experience before starting the process of a comprehensive science needs assessment.

Advantages

- Most sub-committee members were highly familiar with the science-management interface (e.g., scientists who worked on management issues and managers with strong science backgrounds).
- Most of the science needs were from published documents that reflected careful thought by multiple authors.
- The use of topic areas helped avoid competition between different sciences areas (e.g., water, plant and wildlife habitat, or infrastructure).
- Most of the science needs were broad in scope and therefore could apply to large geographic areas or to the entire LCC.

Shortcomings

- The sub-committee did not represent the full range of science areas or the full range of partnership perspectives. For example, none of the sub-committee members were cultural resource specialists, and there were no members from universities, state agencies or tribes. Only one member was from Mexico.
- Important science needs in existing documents may have been missed because 1) they were not clearly worded; 2) they were clearly worded but buried in surrounding text; or 3) they were not recognized as science needs by the sub-committee member due to perspective or experience.
- Some potentially important nuances were lost when specific science needs were combined into generalized statements for the sake of efficiency.
- The criteria used to rank science priorities were subject to interpretation, and the sub-committee members did not have time to calibrate their individual interpretations.
- Some topic areas were ranked by only one individual, and very rarely did an individual work on more than one topic area. Therefore, variation in response between topic areas was high.
- Science needs that ranked low were often necessary steps to achieving the science needs that ranked high.

Lessons Learned

- The new Science Working Group (Science Working Group) represents a broad range of science areas, including cultural resources. Members will be drawn from federal (U.S. and Mexico) and state agencies, tribes, NGOs, and universities, but will represent specific science areas rather than source of employment.
- Group members will ensure that the science needs from the 15 original documents were accurately reported and that no science needs within the scope of the Desert LCC were missed.
- The list of documents will be broadened.
- Existing criteria will be evaluated for effectiveness, and new criteria will be added if needed.
- The group will explore approaches for displaying dependencies between different science needs (e.g., “G” needs to be done before accomplishing “B”).
- The use of each criterion will be calibrated across Working Group members before ranking begins.
- Each topic area will be evaluated by at least 3 members.

PROPOSED PROCESS FOR A COMPREHENSIVE ASSESSMENT OF SCIENCE NEEDS

The Science Working Group will be charged with conducting a comprehensive assessment of science needs for the Desert LCC, including a process that ranks the science needs according to potential funding priorities. This assessment will be completed by June 2012, or a date that will make it available prior to the spring meeting of the Steering Committee.

The comprehensive assessment will build from the strengths of the rapid assessment and strive to overcome the identified shortcomings. The process will consist of three major steps: collating science needs, creating evaluation criteria, and ranking science priorities. The multi-stakeholder Desert LCC Steering Committee will provide input at each of these steps in the process to ensure that these management perspectives are incorporated into the identification of needs and criteria, and, ultimately, that there is consensus within the Steering Committee on the priority needs for the Desert LCC.

Collating Science Needs

Members of the Science Working Group will identify documents that are relevant to the scope of the Desert LCC science needs assessment but were not included in the rapid assessment, such as state wildlife action plans, tribal reports, and outcomes from workshops. To be relevant to the task, the science needs within these documents should be related to the effects of climate change, land use change, or broad scale landscape issues on any natural or cultural resource within the Mojave, Sonoran, or Chihuahuan Desert. Science needs that pertain to small, local areas can be included if the results can be applied to other localities. Science Working Group members will volunteer to look through one or more of the documents to identify science needs stated in the document. In addition, Science Working Group members will revisit the original 15 documents used in the rapid assessment to ensure that science needs were accurately recorded and that relevant science needs were not overlooked.

The Science Working Group will draw science needs from three additional sources of stakeholder input: two outreach meetings that occurred in December 2010 after the rapid assessment was completed, and input from the Steering Committee during their upcoming meeting in September, 2011. After the collation process, the Science Working Group will determine whether to use the topic areas of the rapid assessment or develop a different structure for organizing the science needs. The Steering Committee will review the final list of source documents and will also provide input to the structure used for organizing the science needs.

Developing Evaluation Criteria

The Science Working Group will assess the criteria used in the rapid assessment and modify, drop, or add criteria as needed. The group will also explore ways to highlight dependencies and relationships between science needs. The group will test the subjectivity of each criterion by applying each to a subset of the science needs and looking for the variation in rank scores generated by each criterion. If the Science Working Group concludes that the spread in scores for any of the criteria is unacceptable, those criteria will either be dropped or reworded. The Steering Committee will review and approve the final list of criteria.

Ranking Science Priorities

Ideally, the process of ranking science needs will take place during a face-to-face meeting so that Science Working Group members have a greater opportunity to calibrate their personal styles of ranking. The meeting would begin with one or more ranking exercises to enable members to self-calibrate their rank outcomes. After the group is comfortable with the ranking process, a minimum of 3 Science Working Group members will rank all science needs within a topic area, and each member will apply ranks within a minimum of 2 topic areas. The topic areas, or whatever form of organization that the Science Working Group uses to group science criteria, will not be ranked. For example, the topic of water-related science needs will not be ranked relative to wildlife or to cultural resources. The ranking will only occur inside of each topic area.

After each science needs has a numerical rank, the Science Working Group will assess the ranking process to look for inconsistencies or irrational rank orders that ignore a necessary flow of events. The Science Working Group will then look for clustering of rank scores that suggest breaks for high, moderate, and low categories. These categories will be presented to the Steering Committee for evaluation and approval, and the Steering Committee will use the final, approved product for funding priorities.

Periodic review to identify new or emerging needs

The product from the comprehensive science needs assessment will guide the funding priorities of the Steering Committee for a minimum of two years. However, because natural and cultural resource managers frequently face new challenges that require new forms of information, the science needs assessment will need to be periodically updated. The need for an update will either be recommended by the Science Working Group or requested by the Steering Committee. At that time, the Science Working Group will recommend whether to continue with the process outlined here, or to create or modify the process as needed.

Timeline for accomplishing the comprehensive science needs assessment. Completion date assumes Steering Committee approval of that process step.

PROCESS STEP	ANTICIPATED COMPLETION DATE
Collate Science Needs	January 2012
Develop Evaluation Criteria	February 2012
Develop Ranked Priorities	April 2012
Steering Committee Approval	Spring Meeting 2012

APPENDIX B. Desert LCC Science Working Group Members

NAME	TITLE	AGENCY/ORG	LOCATION	SCIENCE EXPERTISE
Christina Vojta	Desert LCC Science Coordinator	US Fish and Wildlife Service	Flagstaff, AZ	
Sergio Avila	Conservation Program Manager	Sky Island Alliance	Tucson, AZ	Mammalogist
Carol Beardmore	Science Coordinator	US Fish and Wildlife Service, Sonoran Joint Venture	Phoenix, AZ	Avian ecologist
Leanna Begay	Climate Change Coordinator	Navajo Nation	Window Rock, NM	Climate change
John Bradford	Landscape Ecologist	US Geological Survey, Southern Rockies LCC	Flagstaff, AZ	Landscape Ecologist
Margarita Caso	Director of Ecosystem Conservation	Mexico National Institute of Ecology	Mexico City, MX	Conservation Planner, Mexico
Deborah Finch	Program Manager, Desert and Shrubland Ecosystems	US Forest Service, Rocky Mountain Research Center	Albuquerque, NM	Aridlands Ecologist
Gary Garrett	Fisheries Biologist	Texas Parks and Wildlife	Mountain Home, TX	Aquatic ecologist, desert fish
Juan Carlos Guzmán	Coordinator	Chihuahuan Desert Grassland Alliance	Chihuahua, MX	Socio-economics, land use planning
Matt Leivas	Agricultural Director	Chemehuevi Tribe	Havasu Lake, CA	Traditional Ecological Knowledge
Teresa Lewis	Leader, Dexter Fish Health Center	US Fish and Wildlife Service	Dexter, NM	Aquatic Animal Health
W. Paul Miller	Hydrologic Engineer	Bureau of Reclamation	Boulder City, NV	Hydrologist, large rivers
Andrew Rhodes	Director of Climate Change Strategies	CONANP	Mexico City, MX	Climate specialist

Wayne Robbie	Regional Soil Scientist & Inventory Coordinator	US Forest Service, Southwest Region	Albuquerque, NM	Soil Scientist
Aimee Roberson	Fish and Wildlife Biologist	US Fish and Wildlife Service	Alpine, TX	Structured Decision Making
Esther Rubin	Terrestrial Research Program Manager	Arizona Game and Fish Department	Phoenix, AZ	Population ecologist
Kurt Russo	Executive Director	Native American Land Conservancy	Palm Springs, CA	Cultural Resource Specialist
Cecil Schwalbe	Research Biologist	US Geological Survey	Tucson, AZ	Herpetologist
Abe Springer	Professor, Hydrology	Northern Arizona University	Flagstaff, AZ	Hydrologist, ground-surface relationships
James Weigand	Ecologist	Bureau of Land Management	Sacramento, CA	Socio-economics, recreation

APPENDIX C. Science Needs Sources

The Science Working Group extracted science needs related to climate change and other stressors from published reports and documents, located in an online database at http://dlcc.mojavedata.gov. This database lists the specific need, grouping (e.g., terrestrial, water, etc.), geographic scope, and topic area. For more information or to view this information, please contact the Desert LCC Science Coordinator.

Arizona Department of Game and Fish (2012). Arizona Wildlife State Action Plan (http://www.azgfd.gov/w_c/cwcs_downloads.shtml).

Brekke, L.D., et al. (2009) Climate change and water resources management—A federal perspective: U.S. Geological Survey Circular 1331, 65 p. (http://pubs.usgs.gov/circ/1331/).

Bureau of Land Management (2006). Amargosa River Area of Critical Environmental Concern Implementation Plan (http://www.blm.gov/ca/pdfs/barstow_pdfs/amargosa_ea/Complete.pdf).

Bureau of Land Management (2009). Draft Science Plan for the Agua Fria National Monument.

Bureau of Land Management (2011). BLM National Landscape Conservation System Desert LCC Priority (provided by Lara Douglas, BLM National Landscape Conservation System Director).

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Bureau of Land Management (2011). Ironwood Forest National Monument Science Needs (provided by Darrell Tersey).

Bureau of Land Management and USDA Forest Service (2011). Santa Rosa / San Jacinto National Monument Science Needs.

Bureau of Reclamation (2007). Appendix U of Final Environmental Impact Statement for Colorado River Interim Guidelines for Lower - Basin Shortages and Coordinated Operations for Lakes Powell and Mead: Climate Technical Work Group Report (http://www.usbr.gov/lc/region/programs/strategies/FEIS/index.html).

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California Partners in Flight (2009). Version 1.0. The Desert Bird Conservation Plan: a Strategy for Protecting and Managing Desert Habitats and Associated Birds in California (http://www.prbo.org/calpif/plans.html).

California State Parks (2005). Anza-Borrego Desert State Park - Final General Plan and Environmental Impact Report (http://www.parks.ca.gov/pages/21299/files/final--002tableofcontents.pdf).

Coalition for Sonoran Desert Protection (2002). Economic Benefits of Protecting Natural Resources in the Sonoran Desert (http://www.sonorandesert.org/uploads/files/economicreport.pdf).

Conservation Biology Institute for The Nature Conservancy (2009). Framework for Effective Conservation Management of the Sonoran Desert in California (http://consbio.org/products/reports/a-framework-for-effective-conservation-management-of-the-sonoran-desert-in-california).

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Desert Managers Group (2010) Desert Managers Group Five-Year Plan (www.dmg.gov/documents/PLN_Five_Year_DMG_051002.doc).

Fleming, J.B., (2005). Hydrologic characteristics of the Agua Fria National Monument, central Arizona, determined from the reconnaissance study: U.S. Geological Survey Scientific Investigations Report 2004–5163. (http://pubs.usgs.gov/sir/2004/5163/pdf/SIR2004-5163.pdf).

Four Forest Restoration Initiative (2011). Four Forest Restoration Initiative: Stakeholders' Initial Science Needs Assessment. (http://fourforestrestorationinitiative.org/pdfs/documents/collaboration/SciNeedsAssessmentRpt_FINAL_040411.pdf).

Hughson, D.L., et. al. (2011). Natural resource mitigation, adaptation and research needs related to climate change in the Great Basin and Mojave Desert: Workshop Summary: U.S. Geological Survey Scientific Investigations Report 2011-5103 (http://pubs.usgs.gov/sir/2011/5103/pdf/sir20115103.pdf).

Marshall, et al. (2000). An Ecological Analysis of Conservation Priorities in the Sonoran Desert Ecoregion. Prepared by The Nature Conservancy Arizona Chapter, Sonoran Institute, and Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora with support from Department of Defense Legacy Program, Agency and Institutional partners (http://east.tnc.org/east-file/23/SonoranPlan.pdf).

Meredith, R., et al. (eds) (1997). Climate Variability and Change in the Southwest: Impacts, information needs, and issues for policy making. Final Report of the Southwest Regional Climate Change Symposium (http://www.gcrio.org/NationalAssessment/southwest/swclimatereport.pdf).

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Partners in Flight (2010). Saving Our Shared Birds: Partners in flight Tri-National vision for landbird conservation (http://www.savingoursharedbirds.org/).

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Randall, J. M., et al. (2010). Mojave Desert Ecoregional Assessment. The Nature Conservancy (http://conserveonline.org/workspaces/mojave/documents/mojave-desert-ecoregional-2010/@@view.html).

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Texas Parks and Wildlife (2011). Texas Conservation Action Plan - Chihuahuan Desert and Arizona-New Mexico Mountains Ecoregions Handbook (http://www.tpwd.state.tx.us/landwater/land/tcap/handbooks.phtml).

The Nature Conservancy (2011). Policy Options for Water Management in the Verde Valley, Arizona (http://www.verdevalley.org/Policy%20Ops%20for%20Water%20Mgmt%20Verde%20Valley.pdf).

US Army Corp of Engineers, et al. (2011). Science Strategy for the Bill Williams River Corridor.

US Department of Energy, Basic Energy Sciences Advisory Committee (2008). New Science for a Secure and Sustainable Energy Future: A Report from the Basic Energy Sciences Advisory Committee (http://www.sc.doe.gov/bes/reports/files/NSSSEF_rpt.pdf).

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US Fish and Wildlife Service, et al. Condensed Threatened and Endangered Fish Species Recovery Plan Science Needs.

US Fish and Wildlife Service (2009). Chiricahua Leopard Frog Spotlight Species Action Plan (http://ecos.fws.gov/docs/action_plans/doc3046.pdf).

US Fish and Wildlife Service. 2011. Draft Recovery Plan for the Mexican Spotted Owl (*Strix occidentalis lucida*), First Revision (http://ecos.fws.gov/docs/recovery_plan/FR00000557-%20BP031995%20Draft%20MSO%20Recovery%20Plan%20First%20Revision.pdf).

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Wotkyns, S. (2011). Southwest Tribal Climate Change Workshop. Report from September 2011 Workshop. Flagstaff, AZ: Institute for Tribal Environmental Professionals. (http://www4.nau.edu/itep/climatechange/tcc_SWProj.asp).

Partners were asked to provide their science needs at the following Desert LCC outreach meetings and workshops:

Desert LCC outreach meeting, Henderson, NV 8/17/10
Desert LCC outreach meeting, San Bernardino, CA 8/19/10
Desert LCC outreach meeting, Tucson, AZ 9/21/10
Desert LCC outreach meeting, Alpine, TX 9/23/2010
Desert LCC outreach meeting, Las Vegas, NV 10/23/10

Science needs were provided by the following individuals:

Carol Beardmore – Sonoran Joint Venture, Fish and Wildlife Service
Greg Beatty – Fish and Wildlife Service, lead for Southwestern willow flycatcher
Deborah Finch – Rocky Mountain Research Station, U.S. Forest Service
Kirsten Gallo - Chihuahuan Desert Network, National Park Service
Grant Harris – Fish and Wildlife Service, National Wildlife Refuges
Debra Hughson - Mojave Desert Network, National Park Service
Lacrecia Johnson – Fish and Wildlife Service, National Wildlife Refuges
Ken Nussear – U.S. Geological Survey
Aimee Roberson – Fish and Wildlife Service
Duane Pool - Rocky Mountain Bird Observatory
Unknown - Navajo Nation
Christina Vojta – Fish and Wildlife Service

APPENDIX D. Preliminary Criteria for Evaluating Science Needs

Approved by the Desert LCC Steering Committee
Conference call - January 12, 2012

Objective

The Desert LCC Steering Committee asked the Science Working Group to conduct a comprehensive assessment of Desert LCC science needs by April, 2012. The assessment will help set priorities for future funding of science needs beyond 2012. As of February, 2012, the Science Working Group had collated over 550 science needs that were drawn from state wildlife action plans, partnership strategy documents, T &E recovery plans, Desert LCC outreach meetings, climate change workshops, and input from individual scientists, managers, and tribal members. In order to evaluate and rank the science needs, the Steering Committee needed to adopt a set of criteria that the Science Working Group could apply to these science needs.

Process

The final criteria that the Science Working Group proposed to the Steering Committee were established through the following process. First, the Steering Committee developed a list of possible criteria through a brainstorming session at their meeting in Albuquerque in September, 2011. The Science Coordinator then combined these criteria with a list of criteria used to rank science needs during the 2010 rapid assessment, and consolidated redundancies among similar criteria. The result was a list of 16 criteria (Table 2).

Members of the Science Working Group evaluated the usefulness of each criterion in an on-line survey in early December, 2011. Each participant (N = 11) rated each criterion as to whether it was (1) highly important; (2) somewhat important; (3) neutral; or (4) not useful or could result in undesirable ranking of the science needs. Participants were also invited to submit new criteria for evaluation after the survey.

Results of the survey indicated a strong preference for five of the criteria, moderate to no preference for seven, and aversion to 4 criteria. Two of the criteria received full support from all participants of the online survey. Participants submitted 5 new criteria for consideration (Table 2, page 28).

A sub-committee consisting of the Science Coordinator and four members of the Science Working Group evaluated the survey results during a conference call in late December, 2012. Members of the sub-committee made several observations about the criteria during this evaluation:

1. By rephrasing the top five criteria as one- or two-word phrases, some of the secondary criteria could be subsumed under the top five criteria as bullets.
2. Some of the apparently undesirable criteria would be better for ranking project proposals rather than science criteria.
3. The desire for inclusivity of tribal values could be included in one of the top five, as well as under a new criterion called “Preserves Knowledge”, as explained under Results.

The sub-committee discussed two criteria that relate to tribal values:

1. Does the science need have added value to tribes and traditional land uses?
2. Is the science need constructed in a manner that includes Native American concepts of geographical space and landscapes?

Results from the on-line survey indicated that the first criterion could result in undesirable ranking because it could result in some important science needs being ranked low simply because they are not related to tribes and traditional land uses. The second criterion was new and therefore required an evaluation by the sub-committee. The sub-committee affirmed a need for inclusivity of Native American values when ranking the science needs, and acknowledged that tribes are in immediate need of climate change science because tribes are disproportionately affected by climate change. Also, traditional ecological knowledge has a role when addressing climate change and other broad-scale stressors. However, neither of the proposed criteria seemed to completely address these aspects. Therefore, the sub-committee recommended that tribal values be included in three of the top five criteria as follows. The criterion named Ecological Significance was broadened to Ecological and/or Cultural Significance. Under the criterion named Urgency, a bullet was added to address human communities, as well as species and ecosystems that are on the brink of collapse. Under the criterion named "Applicability", a bullet was added to address applicability to tribal lands. A new criterion was proposed, called "Preserves Knowledge". It evaluates whether a science need contributes to the conservation of knowledge, including oral histories, traditional ecological knowledge, indigenous perceptions of landscapes, cultural sites, historic photos, and data stored on outdated media.

The Science Working Group reviewed the recommendations of the sub-committee and provided input that has been incorporated into this document. One suggestion by a Science Working Group member that was not incorporated is that the criterion, "Feasibility" be retained rather than dropped. The Steering Committee will want to consider whether this criterion, along with other criteria that were dropped, should be incorporated into the final list.

Results

As described earlier in this document, the Science Working Group then selected eight criteria for ranking science needs.

Table 2. Evaluation of the preliminary 16 criteria, based on an on-line survey conducted by the Science Working Group (11 participants) and an evaluation performed by a sub-committee of the Science Working Group. Criteria are presented from highest to lowest survey results.

CRITERIA	% SURVEY RESPONSES, HIGHLY + SOMEWHAT IMPORTANT	% SURVEY RESPONSES, UNDESIRABLE	COMMENTS
Relationship to goals and objectives of the LCC (e.g., is it related to climate change or other broad-scale stressors?)	100	0	Retained as "Mission/goals"
Can results be broadly applied, even if science need was narrowly focused?	100	0	Retained as "Scope"
Ecological significance – How well will this information improve our understanding of species, habitat, landscapes, and stressors?	91	0	Retained but broadened: "Ecological and/or cultural significance"
Immediacy of the need – is this information urgently needed?	90	0	Retained as "Urgency"
Applicability for on-the-ground management – will it provide useful techniques or tools?	82	0	Retained as "Applicability"
Geographic Scope of the Science need	82	0	Is a bullet under "Scope"
Does it have value in the future, if not immediately?	82	0	Dropped. Future value would be difficult to determine. May fit better as a criterion for evaluating project proposals.
Does it provide a critical step to get to other science needs?	72	0	Retained as "Building block"
Contributes to landscape baseline data	64	0	Is a bullet under "Building block"
Scalability – can the information be scaled up?	63	0	Retained as "Scalability"

CRITERIA	% SURVEY RESPONSES, HIGHLY + SOMEWHAT IMPORTANT	% SURVEY RESPONSES, UNDESIRABLE	COMMENTS
Broad practicality for conservation community – will this information contribute to diverse interests and responsibilities of LCC partners?	55	0	Is a bullet under "Scope"
Feasibility – how difficult will it be to address the science need, and are other steps needed first in order to make it more feasible?	54	0	Difficult to assess science needs with this criterion. May be better as a criterion for evaluating project proposals.
The next four criteria all had some level of negative responses by the Science Working Group			
Will this science need generate data that can be rolled into long-term monitoring or into other designs?	72	9	Ability to serve as long-term monitoring should not be a criterion for all science needs. However, it has value so it is now a bullet under both "Scalability" and "Building block"
Is the science need prevalent through numerous documents and workshops? (numerical tally of number of docs with this science need)	54	18	Science needs that are frequently mentioned in older documents may have already been filled. Emerging issues that are infrequently stated may be more important. Is now a bullet under "Scope".
Is it cost-effective to address this science need?	45	9	Cost will depend on how thoroughly the science need is addressed (coarse or fine scale). May be better as a criterion for evaluating project proposals.
Does the science need have added value to tribes and traditional land uses?	36	27	Science WG may not know this for each science need. However, value to tribes is important so it is captured as bullets under 4 other criteria.

CRITERIA	% SURVEY RESPONSES, HIGHLY + SOMEWHAT IMPORTANT	% SURVEY RESPONSES, UNDESIRABLE	COMMENTS
The next four criteria were new ones proposed by Science Working Group members during the survey			
Inclusivity-Is the science need constructed in a manner that includes Native American concepts of geographical space and landscapes?	New - not evaluated during survey		Included as a bullet under "Ecological and/or cultural significance" and under "Preserves Knowledge"
Will the science need provide information relevant to adaptive management of resources and related to climate change and other broad-scale stressors?	New - not evaluated during survey		Is now a bullet under "Mission/goals".
Relevance for recovery efforts of T&E species	New - not evaluated during survey		No criterion should pertain to a specific topic area. This is now a bullet under "Urgency"
Relevance to securing future supplies of essential human needs (especially water)	New - not evaluated during survey		No criterion should pertain to a specific topic area. Is now implied under "Urgency"
Relevance to reducing energy consumption, reducing carbon emissions, and carbon storage on the part of human communities	New - not evaluated during survey		Not necessary to evaluate all science needs by this criterion, but it has value. It is now a bullet under "Mission/goals"
Contributes to the preservation of ecological or cultural knowledge	Added by the sub-committee as a way to address indigenous and other cultural values, as well as data preservation		Proposed as a new criterion.