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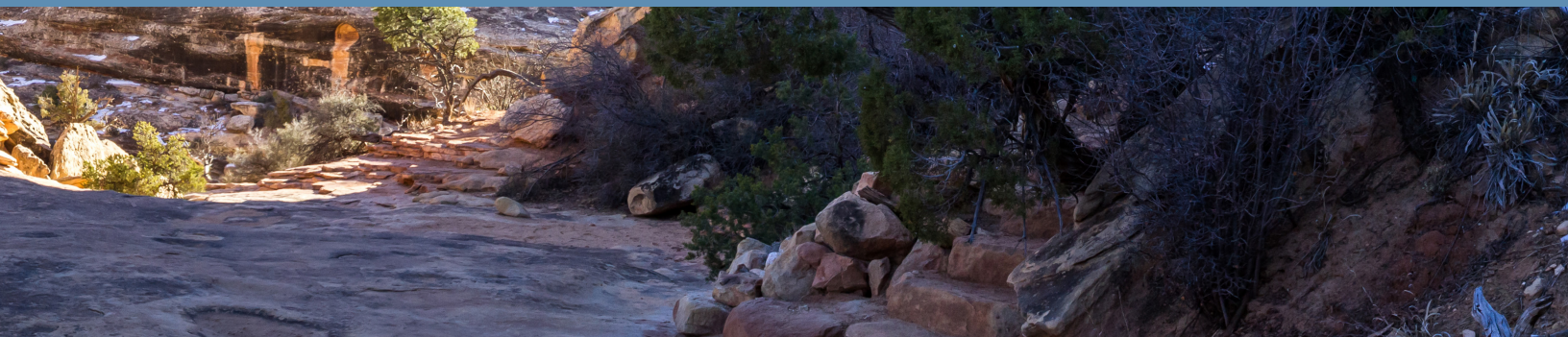
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TOWARD EFFECTIVE ACTIONABLE SCIENCE:

2019 Stakeholder Needs Assessment
Final Report



LIST OF ACRONYMS

ACS	Arizona Conservation Strategy
AZ	Arizona
AZGFD	Arizona Game and Fish Department
BCI	Body Condition Index
CA	California
CO-CAT	Coastal Ocean Climate Action Team
DOI	United States Department of Interior
IRB	Institutional Review Board
LCC	Landscape Conservation Cooperative
MOU	Memorandum of Understanding
NDOW	Nevada Department of Wildlife
NV	Nevada
OPC	Ocean Protection Council
SW CASC	Southwest Climate Adaptation Science Center
SWAP	State Wildlife Action Plan
UDWR	Utah Department of Wildlife
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UT	Utah
WUI	Wildland-Urban Interface

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The assessment process outlined in the report was designed for internal program evaluation and was supported through this cooperative agreement between the Institute of the Environment at the University of Arizona in Tucson, Arizona and the SW CASC. The information included in this report is an initial step toward integrating stakeholder needs in future SW CASC strategic plans that includes identification of management science priorities and needs. The grant's principal investigator, Dr. Gregg M. Garfin, and coprincipal investigator Dr. Arin C. Haverland, conducted this assessment from September 2017 to February 2019.

The authors would like to thank the SW CASC leadership and staff, the SW CASC stakeholders, and Dr. Kristin VanderMolen (Desert Research Institute) and Sarah Randall (University of Arizona), for their contributions to the assessment process.

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1 | ADMINISTRATIVE INFORMATION

TOWARD EFFECTIVE ACTIONABLE SCIENCE: STAKEHOLDER NEEDS ASSESSMENT

Project Title: Toward Effective Actionable Science: Stakeholder Needs Assessment

Cooperative Agreement Number: G17AC00285

Project Performance Dates: 9.1.17 to 2.28.19

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2 | PUBLIC SUMMARY

In 2018, to help fulfill the Southwest Climate Adaptation Science Center's (SW CASC) mission of developing useful science products for natural resource managers, researchers conducted a rapid assessment of science and information needs of Southwest natural resource managers in Arizona, California, Nevada and Utah. Researchers assessed (a) stakeholder research, data and information needs, (b) communication and engagement preferences, (c) training and extension needs, and (d) identified partnership and collaboration barriers and opportunities.

The researchers gathered data through 6 structured listening sessions, 24 interviews, and 88 web-based survey responses. Project outputs include an updated resource manager contact database, catalog of state natural resource agency management plans, and a synthesis of management science needs and priorities. The researchers developed a repeatable, robust process for rapidly assessing stakeholder needs.

Four overarching research themes emerged, pertaining to the influence of climate on: the combination of snow, water resources, drought and their effects on habitat; stand-replacing fires; rapid and overwhelming introductions of invasive species; wildlife diseases. Regional stakeholders seek relevant climate science synthesis and assessments, examples of successful adaptation strategies, synthesis of multiple data streams, and guidance on implementing climate-informed strategies. Barriers include lack of research fit with resource management temporal and spatial scales, and lack of stakeholder capacity to assimilate climate science into practice.

The assessment recommends that the SW CASC focus on the emerging science themes, with attention to data, science communication, synthesis and assessment product needs, and the complex intersection of climate and non-climate factors and resource management. The SW CASC can play a significant role in convening practitioners and researchers to assess climate impacts on habitat, connectivity, and species. Outcomes from this assessment include improved communication with state natural resource agencies; increased understanding of the SW CASC stakeholder science needs; enhanced capacity for the SW CASC to conduct needs assessments, and relationships to seed a knowledge network.

3 | PROJECT SUMMARY

3.1 PROJECT BACKGROUND

The SW CASC aims to work in partnership with natural resource management communities, and to understand and help meet their highest priority science information and product needs regarding climate change impacts and land-use changes. The June 2017 Five-Year External Review of the SW CASC (henceforth, “the Review”) noted that the SW CASC could improve its abilities to meet its aims by assessing stakeholder science needs and priorities more regularly and systematically, and specifically emphasized the need for engaging with regional stakeholders more closely and effectively. The Review also placed importance on garnering frequent feedback and input to clearly articulate management priorities that inform the SW CASC’s science portfolio. The need for fostering stronger relationships with stakeholders, alongside working closely with stakeholders on communication and training in how to make use of SW CASC science to inform decisions, was also stressed in the review.

The Review pointed out six key areas in which the SW CASC could improve its interactions with stakeholders, and its effectiveness in the development and delivery of actionable science to natural resource managers, planners, and professionals. The Review defined the following characteristics for actionable science to meet stakeholder needs:

- *It is relevant to management policy (but not prescriptive).*
- *It directly reflects expressed needs of constituents.*
- *It is understandable to managers and science users.*
- *It is accessible to users at the times and places they need it.*
- *Users and producers work together from the start.*
- *Its usefulness to managers and to society is subject to evaluation.*

The Review went on to outline four steps that lead to the production of actionable science by researchers and practitioners: “(1) identification of management priorities and needs, (2) support for scientific research directed toward those priorities, (3) communication and implementation of the science to meet those priorities, and, (4) evaluation of the success of the process.” Close collaboration and strategic communication are essential to the fulfillment of these steps. The research outlined in this report supports step 1, and will be used to assist SW CASC develop a broad-scale communications strategy, and to highlight challenges, near-term expectations, and opportunities.

3.2 SUMMARY OF THE RESEARCH PROCESS

This research was purposely designed as an internal assessment of the SW CASC stakeholder science needs and was specifically carried out as research to serve as an initial step in evaluating the degree to which state natural resource agency management (referred to in this report as “stakeholders”) could be engaged by the SW CASC, and sought to address the aforementioned gaps, specifically through a structured yet rapid assessment of:

- Stakeholder science needs and priorities,
- Perceptions regarding effective coproduction of science,
- Preferences on communication and engagement to improve the effectiveness of science-practitioner partnerships, and
- Needs for training and extension to enhance the use of science information and science communication products.

The project team used a social science mixed-methods process which leveraged inputs from listening sessions, interviews, and a web survey to assess a variety of land and natural resource managers’ perceptions, to probe deeply in areas that require nuanced explanations, and to be nimble and opportunistic, when needed. Facilitated listening sessions and one-on-one interviews provided preliminary information on needs and informed the structure and content of the web-based communication and training preferences survey instrument. The survey further substantiated the results from the listening sessions and interviews and conveyed the preferences for future training and communication.

Listening sessions and interviews were crucial to the assessment and, while labor intensive, proved to be essential for examining preferred modes of engagement to increase the effectiveness of science coproduction and the SW CASC-stakeholder partnerships (Figure 1). Our process has increased understanding of the SW CASC stakeholder science needs; enhanced capacity for the SW CASC to conduct future needs assessments; and provided a foundation of relationships to seed a knowledge and learning network—with an overarching goal of improving climate and land change information flows and increasing the use of scientific information to inform resource management decisions.



FIGURE 1. INTERACTIONS WITH STAKEHOLDERS AS PART OF THE ASSESSMENT PROCESS.

Outcomes resulting from this project include improved communication with the state agencies, increased understanding of the SW CASC stakeholder science needs, enhanced capacity for the SW CASC to conduct future needs assessments, and a stronger foundation of relationships to seed a knowledge and learning network. These outcomes will empower the SW CASC by improving climate and land change information flows and increasing the use of stakeholder relevant scientific information to inform resource management decisions. A forthcoming peer reviewed publication is in progress and a webinar highlighting the state of climate science in the Southwest is also planned.

Results of this assessment summarize key research needs that offer insights across state borders, and shared ranges and watersheds making our approach and findings applicable to the SW CASC as well as natural and cultural resource managers.

3.3 SUMMARY OF KEY FINDINGS

Collectively, the results of this rapid assessment will inform the development of a new version of the SW CASC’s Strategic Science Agenda and help ensure the SW CASC is well-positioned to serve its key stakeholders into the future. Table 1 summarizes the inputs used for this assessment and the number of interactions with stakeholders by category. Appendices A-C reflect the structured listening session agenda (Appendix A), listening session and semi-structured interview questions (Appendix B), and communication and training preferences survey (Appendix C).

TABLE 1. SUMMARY OF INPUTS AND INTERACTIONS WITH STAKEHOLDERS DURING THE ASSESSMENT.

	Open Ended Interviews	Structured Listening Sessions	Communication & Training Preferences Survey
Number of Events	24 interviews	6 sessions	130 invitees
Number Of Individuals	27 interviewed	87+ attendees	88 respondents = 68% response rate

Overarching Science Research Themes identified through the listening sessions and interviews include:

- Stand-replacing fire
- Overwhelming introductions of invasive species (aquatic and rangeland)
- Climate influences on Diseases
- Snow Pack/Snow Melt/Snow Drought impacts on habitats

Key findings of this assessment have been organized in this report by SW CASC operations areas (research, synthesis and assessment, outreach and engagement, communications), and by recently articulated SW CASC science priorities. Data synthesis, information, guidance and research needs identified through the listening sessions, interviews, and survey include:

- Translation of data into useable formats (data synthesis)
- Habitat connectivity information (research)
- Impacts on specific habitats or species (research)
- Examples of successful adaptation strategies (synthesis and assessment)
- Synthesis reports on latest climate science (synthesis and assessment)
- Guidance on implementing climate in to agency planning and decision making (guidance)
- Guidance on facilitation of conversations between agency staff and communities (guidance)

4 | REPORT BODY

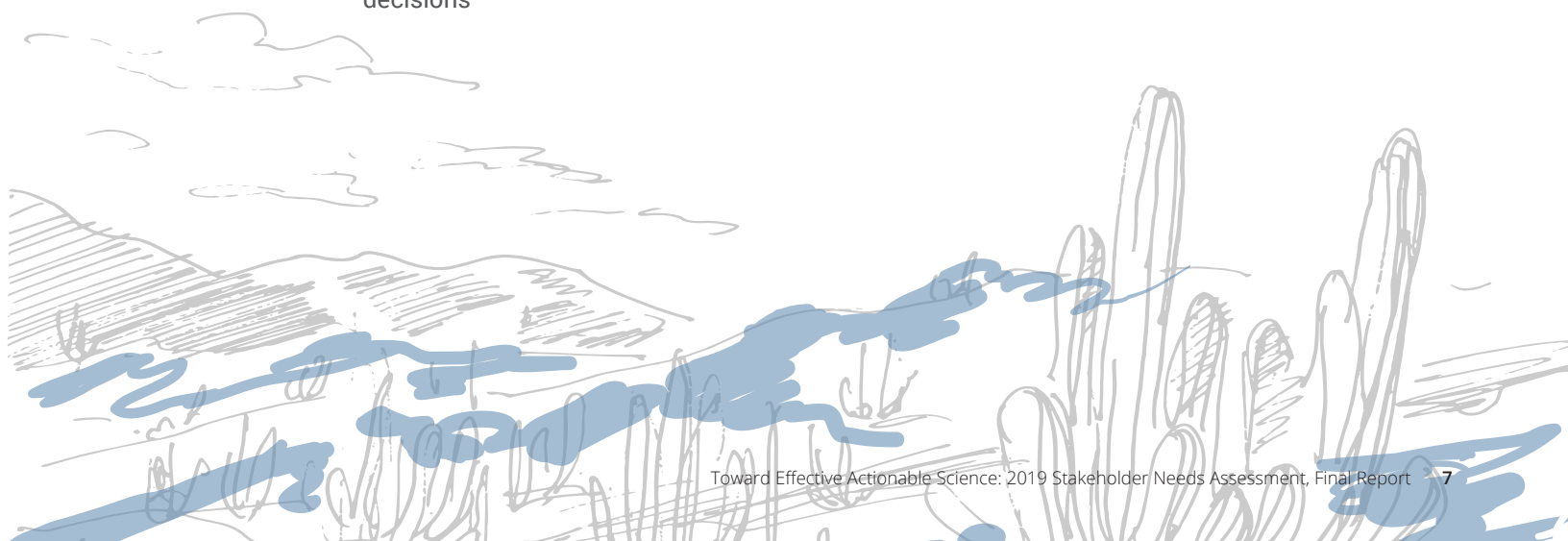
4.1 PURPOSE AND OBJECTIVES:

The purpose of this internal evaluation was to conduct a rapid structured assessment of stakeholder science priorities, needs, and perceptions to a) inform the development of science products, b) generate management strategies through coproduction, and c) foster productive scientist-practitioner relationships.

The project focused specifically on state wildlife agencies within the SW CASC region. This domain includes Arizona, California, Nevada, and Utah. Outcomes of the project will be useful to other boundary organizations, including the broader N-CASC and R-CASC network, Landscape Conservation Cooperatives (LCCs) and other organizations aiming to improve the effectiveness of developing science to inform the basis for resource management decisions. Research was conducted as part of a cooperative agreement, and the anticipated audience for this research is the USGS leadership of the SW CASC hosted at the University of Arizona.

The primary objectives of the project were defined as:

1. Assess natural resource management communities' highest priority science information needs
2. Garner and assess resource managers', planners', and other relevant practitioners' perceptions regarding challenges and opportunities for co-producing science that will meet the aforementioned needs, and meet needs for timely and useful products
3. Collect feedback and assess resource managers' needs for and preferred modes of communication and iterative engagement, in order to increase the effectiveness of SW CASC science-society partnerships
4. Collect feedback and assess resource managers' needs for communication, training, and extension in order to enhance the use of SW CASC science products to inform decisions

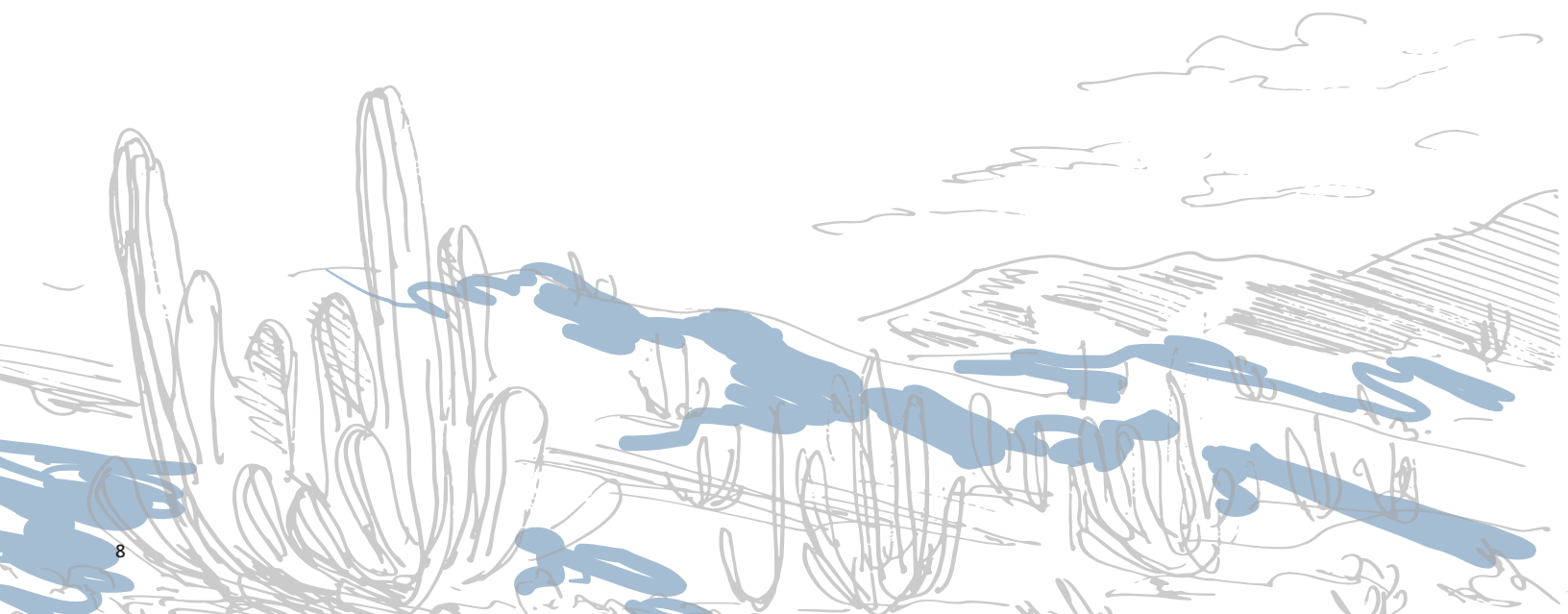


4.1 PURPOSE AND OBJECTIVES CONTINUED

The four assessment objectives were met through a progression of activities, including a series of initial semi-structured phone and in-person interviews conducted with individuals representing various land and resource management agencies and organizations in the states of Arizona, California, Nevada, and Utah. After identifying the appropriate individuals to meet with, the researchers traveled to all four states to lead and facilitate a total of six structured three-hour in-person assessment sessions with various land and resource management agencies and organizations. These intensive assessment sessions were conducted with Arizona Game and Fish Department in March 2018, followed by Utah Division of Wildlife Resources, and Nevada Department of Wildlife in May and June 2018, respectively, and concluding with the California Natural Resources Agency and the California Department of Fish and Wildlife, in August 2018. Actions used to demonstrate the primary research objectives as completed during the performance period are listed in Table 2.

TABLE 2. SUMMARY OF OBJECTIVES BASED TASKS PERFORMED DURING THE ASSESSMENT PROCESS.

	Objective based task	Demonstrated by
Objective 1	Assessment of highest priority science needs	Listening sessions and interviews
Objective 2	Garner perceptions of challenges and opportunities	Listening sessions and interviews
Objective 3	Collect feedback on preferred modes of communication and iterative engagement	Listening sessions and web survey
Objective 4	Collect feedback on training and use of science products	Listening sessions and web survey



STATE-BY-STATE LISTENING SESSIONS

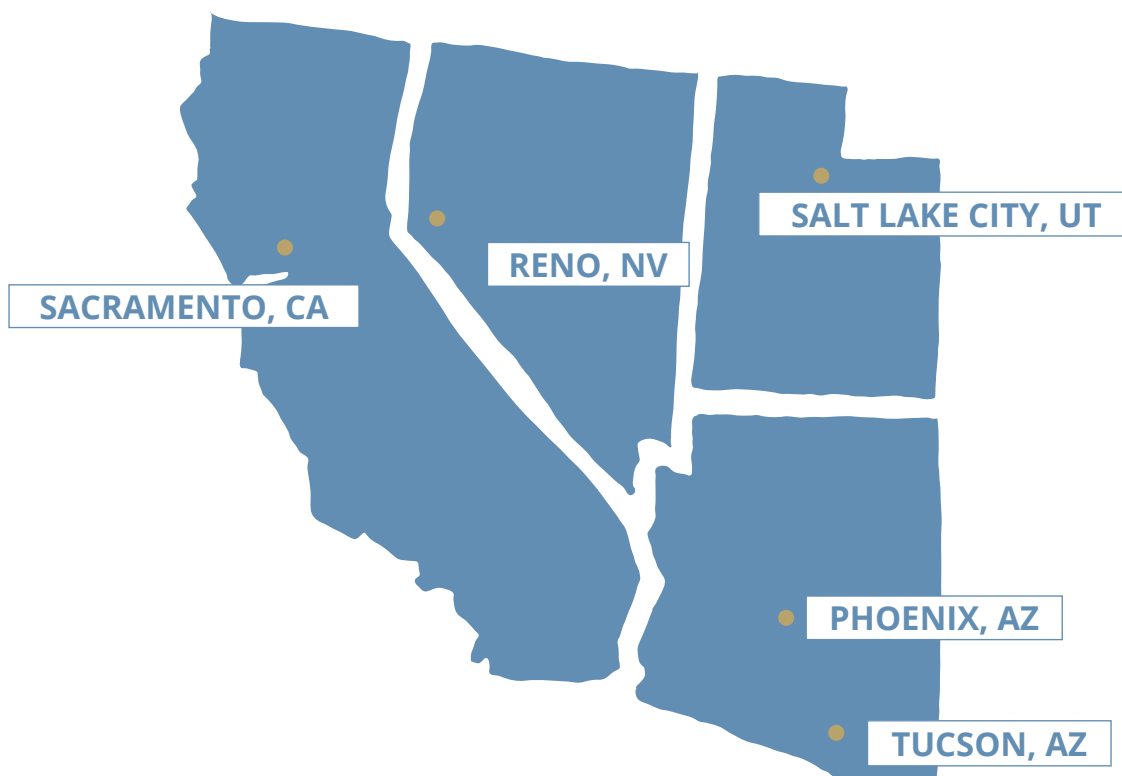


FIGURE 2. MAP OF MEETING LOCATIONS WITHIN THE SW CASC REGION.

The in-person assessment sessions were featured as informational exchange meetings, during which the researchers listened to participants as they shared their priorities, needs and perceptions about their current and potential use and integration of climate science. These targeted participant observations were also used to identify additional interview candidates and to inform the design of the online survey which was later used to substantiate preliminary findings from listening sessions. Supplemental semi-structured interviews were also conducted, and information gleaned from these interviews was then used to enhance the structure and focus of the web survey. A map of the study area is shown in Figure 2.

Results of this assessment will be used to support the SW CASC in fostering stronger relationships with managers and stakeholders to become more responsive to the real-world needs of land and resource managers in the Southwest.

4.2 ORGANIZATION AND APPROACH

Literature and Primary Source Document Review

Research on this project began through review of primary source documents, such as existing strategic plans and state wildlife action plans, as well as review of agency websites, agency authored website materials, and agency specific reports generated by managers and various partnering stakeholders (Appendix D). These initial steps proved to be indispensable for identifying agency jurisdictions and responsibilities, as well as for determining key individuals on management teams.

Gathering of background information and logistical preliminary activities leading up to the listening sessions began in September 2017, followed by listening sessions, interviews and deployment of a web survey in 2018, and concluding with analysis and reporting activities leading up to the project end date in February 2019. The assessment work plan is shown in Table 3.

TABLE 3. ASSESSMENT WORK PLAN DURING THE PROJECT PERFORMANCE PERIOD.

	2017				2018												2019	
Activity	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Background Research	■	■	■	■	■	■	■	■										
Planning and Scheduling				■	■	■	■	■	■									
Interviews						■	■	■	■	■	■	■	■	■	■			
Web Survey Development												■	■	■				
Web Survey Deployment													■	■	■	■		
Listening Sessions						■	■	■	■	■	■	■						
Analysis												■	■	■	■	■		
Reporting Efforts																■	■	■
Final Report Submitted																		■

Structured Listening Sessions

Each of the six facilitated listening sessions consisted of two distinct phases, an information exchange phase and a participatory phase, as described below.

Phase 1: Steps in the Information Exchange Process

1. Purpose: create a welcoming and inviting tone, and to provide a neutral and balanced atmosphere for introducing and emphasizing the purpose and primary functions of the agencies, and the SW CASC—as partners.
2. Method: formal presentations and participant observation.
3. *Research staff presentation*: description of agency missions, needs and priorities to the SW CASC researchers. This provided an opportunity for the researchers to observe as participants described their current roles and responsibilities as well as day to day decision making processes.
4. *SW CASC presentation*: overview of the history, leadership, mission, capacity and goals of the SW CASC, by the Principal Investigator.
5. Clarifying questions and answer period.

Phase 2: Steps in the Participatory Process

1. Purpose: Process information that was exchanged by all presenters in the earlier informational exchange phase.
2. Method: Roundtable discussion, participant observation and questions designed to elicit understanding of the use and integration of science into decision making and management duties.

This phased and synergistic process provided a unique opportunity for dynamic discussion; as one individual listened to the next, ideas were proposed, then built upon and formalized and prioritized in real time. In some cases, this process highlighted the need for further internal conversations that needed to take place at the agency level before being able to state what else is needed, and in other cases the process was able to elucidate a “wish list” of resources and specific next steps by the end of the listening session.

4.2 ORGANIZATION AND APPROACH CONTINUED

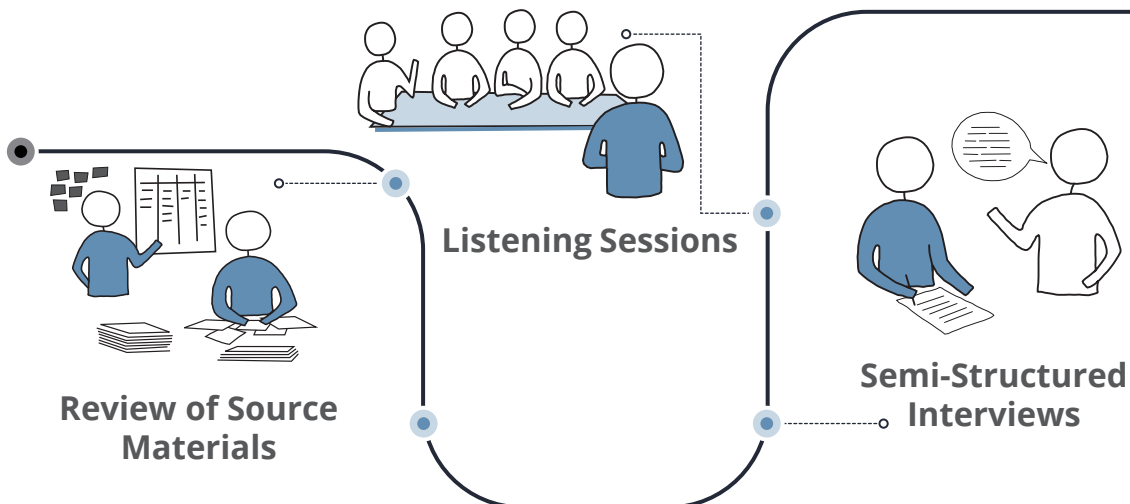
Semi-Structured Interviews and Communication Preferences Web Survey

When resource management stakeholders could not attend in-person sessions, we contacted these individuals and followed up with phone interviews. Additional follow-up interviews informed the structure and brevity of the web-based survey. The web-based survey was shared with existing and newly suggested contacts and was purposely designed to avoid survey fatigue, and focused solely on substantiating communication and training preferences that were identified during the interactions between the research team and stakeholder participants. In accordance with human subjects Institutional Review Board (IRB) protocol, identification of semi-structured interview and survey participants was not recorded, and participation was voluntary.

The overall assessment process focused primarily on individuals working for state natural resource management agencies; however, the researchers also interacted with individuals who partner or frequently work with state agencies.

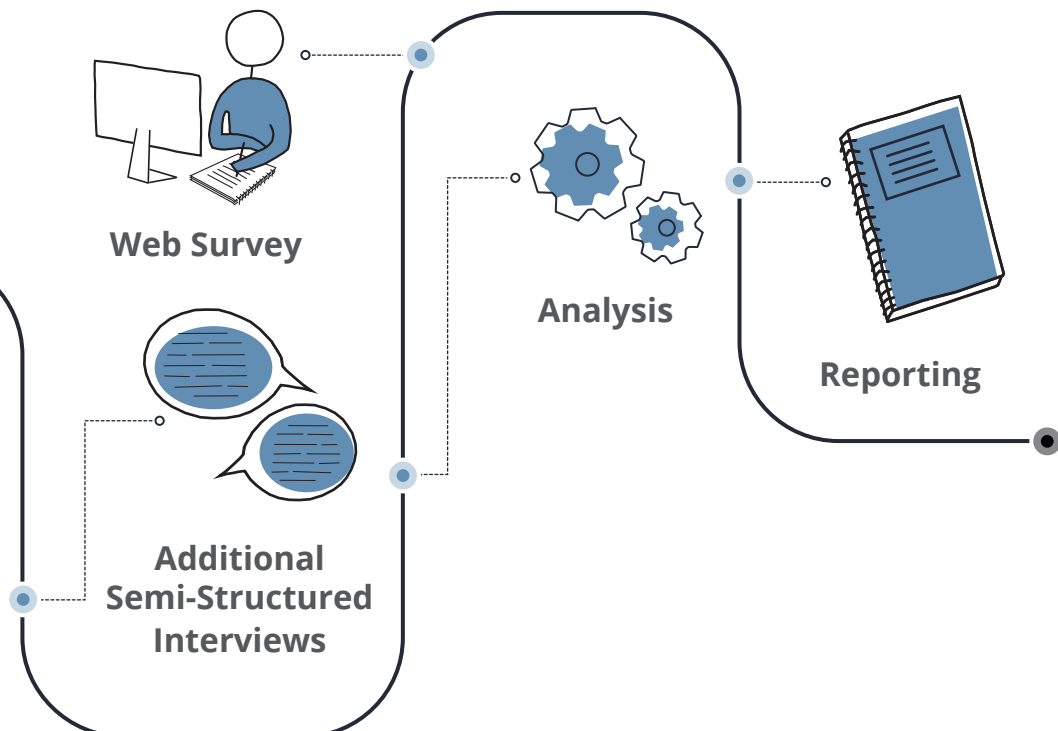
The aforementioned research process shown in Figure 3 was chosen specifically as a rapid engagement strategy for identifying stakeholder needs and priorities. The inputs and interactions were previously summarized in Section 3.3, and we envision the results of this process being used as part of the SW CASC overarching goals to foster collaborative partnerships and continue stakeholder engagement.

FIGURE 3. STAKEHOLDER NEEDS ASSESSMENT PROCESS



We were able to follow this needs assessment process in Arizona, Nevada and Utah, with California being the exception. The assessment process in California required a considerably larger effort, in terms of understanding the mosaic of roles and responsibilities, and further identifying the key management to engage with within the primary agencies of CA Department of Fish & Wildlife (CDFW)/CA Natural Resources Agency (CNRA)/Ocean Protection Council (OPC): Coastal Ocean Climate Action Team (COCAT). The complexity encountered by the research team stemmed from requiring additional listening sessions and the following:

- CDFW has multiple layers of land and resource management spanning 7 regions: Northern, North Central, Bay/Delta, Central, South Coast, Inland Desert, and Marine
- CDFW and CNRA have overlapping management responsibilities
 - » E.g., OPC is a state and federal consortium, nested under CNRA, which leads CA climate mandates and initiatives in tandem with CA Coastal Commission, CA Coastal Conservancy, CA Office of Planning and Research, CA Ocean Science Trust, the CA Science Advisory Committee, and others.



4.3 RESULTS AND FINDINGS

SW CASC Region Management Needs

The research team worked with stakeholders to identify overarching science priorities which have climate implications across the SW CASC region. Management needs were found to be highly associated with products that deliver:

- Translation of data into useable formats
- Habitat connectivity information
- Impacts on specific habitats or species
- Examples of successful adaptation strategies
- Synthesis reports on latest climate science
- Guidance on implementing climate in to agency planning and decision making
- Guidance on facilitation of conversations between staff and communities

Questions asked by study participants within the SW CASC Region focused on Best Science for Informed Decision Making:

1. How do we use adaptive management to cope with climate change uncertainty?
2. How might climate information assist us in prioritizing what tools, resources and practices to implement?
3. How will the use of climate information help us to understand the ways in which growing population will affect aquatic and terrestrial wildlife systems and our planning for and management of those systems?
4. What characteristics create climate savvy and resilient corridors?
5. How can we relate the need for linkages and corridors to climate change (under the National Environmental Policy Act) to bolster funds and actions for mitigation?
6. How might the integration of climate science help us to know more about status of habitat, restorations, translocations, habitat fragmentation recreational access, project evaluation, and inform management decisions?
7. As needs are co-identified, how would a request for climate info be funneled and then translated to action?
8. How might climate information be used to understand activities associated with expansion of urban centers, trade, commerce, and transportation that lead to increased air, soil and water pollution as well as increased human-wildlife interactions?

SW CASC Region Emerging Science Priorities

Upon review of information from all of the listening sessions, four top priorities with actionable science linkages emerged: stand-replacing fire, introductions of invasive species that overwhelm the typical functioning of the ecosystem or strain the capacity of an agency to respond, climate change influence on disease, and snow pack/snow melt/snow drought impacts on habitats. Here the authors suggest the associated actionable science with each of the top four identified priorities.

I. Stand-replacing fire

Actionable science is needed for:

- Understanding connectivity of treatments for management, e.g., effectiveness of prescribed fires as a mechanism to help trees survive prolonged drought
- Predictive tools that consider a wide range of time scales and scenarios
- Understanding shifts in vegetation by elevation in changing fire regimes
- Understanding how invasive and non-native species will fare in changing fire regimes, e.g., how might fire regimes impact migration and reproduction patterns of certain species?

II. Overwhelming introductions of invasive species (aquatic and rangeland)

Actionable science is needed for:

- Understanding how to build resilience into systems for priority species
- Identifying and protecting long-term network refugia
- Eradication of invasive species related to seasonal, annual and longer term temperature and precipitation changes

4.3 RESULTS AND FINDINGS CONTINUED

III. Climate influences on diseases

Actionable science is needed for:

- Linking wildlife health/disease vectors to climate change; e.g., is the proliferation/die-off of a certain species due to warming/drying conditions, as well as an abundance of specific plants that thrive in warmer/drier conditions and may be toxic to certain species?
- Linking spread of diseases with increased temperatures and fewer frost days
- Addressing pathogens, exotic parasites, fungal infections and ticks that affect native or game species and/or humans in the Southwest. Examples include investigating livestock transmission of diseases to native ungulates such as bighorn sheep, how native frog populations have been decimated by the introduction of the fungal disease chytridiomycosis, and the spread of West Nile Virus, Chronic Wasting Disease, diseases causing die-offs such as pneumonia, whirling disease, rabies, distemper, white-nose syndrome, hantavirus, ranaviruses, amphibian chytrid fungus, and various avian diseases such as trichomonas in doves.

IV. Snow pack/snow melt/snow drought impacts on habitats

Actionable science is needed for:

- Protecting native aquatic species, in the face of increasing water temperatures in streams and reservoirs
- Informed decisions on which aquatic species will be best suited for changing hatchery conditions, e.g. changes in peak runoff, base flows, nutrient loads
- Planning for changes in hatchery corridors and long-term viability of streamflow
- Proactive management in terms of migration, e.g., when to relocate rangeland species, how to manage herd size, and when to set out additional water troughs or create more green space for cooling/shading
- Making the most informed decision on seeding, e.g., if we understand snow pack/snow melt/snow drought and stream flow, then proactive decisions can be made regarding the degree to which we should seed fish or not
- How human activities/development/water delivery impact habitats of non-game species

SW CASC Stakeholder Communication, Engagement, and Training Preferences

Over a three-month period, responses were collected via a brief web survey through which participants anonymously indicated communication, engagement and training preferences. The web survey received a 68% response rate (n=88), and served as a follow-up activity to substantiate preliminary findings from the semi-structured interviews and listening sessions as summarized in Appendix C.

The majority of the respondents self-identified as being affiliated with a state agency, with a smaller percentage identifying as affiliated with a consortium meaning that they identify as working with both state and federal agencies, and a smaller percentage identified as NGO or non-profit that frequently partners with a state agency. Common threads, across all participants, were (a) the need for funding, (b) the desire for in-person training, (c) where possible to have in-house training brought to their location so that they could easily attend and have an opportunity to participate in follow-up discussions and brainstorming.

Stakeholder preferences on communication, engagement and training opportunities were garnered through the web survey and were similarly assessed during interviews and in-person listening sessions. From all three inputs, two top priorities, or requests, emerged as follows:

1. A “State of the Knowledge” presentation or webinar was the top request,
2. A training and informational exchange event tailored to sharing how climate science was being integrated across the region.

Where do managers get assistance on climate-related topics?

Respondents to the web survey also reported that current climate assistance is primarily sought through partnering with LCCs, academic experts, CASCs and partnering nonprofits and NGOs such as The Nature Conservancy. This points to the need to broaden outreach efforts by the SW CASC and perhaps the need to highlight extension efforts as future outreach products are developed.

What training modalities do managers prefer?

In terms of training, respondents preferred interactive engagement, such as workshops, webinars and professional meetings over static use of peer reviewed journals.

4.3 RESULTS AND FINDINGS CONTINUED

Interactive formats focus on engagement, which serves as a catalyst for revitalizing partnerships and offers a starting point for initiating science coproduction, with manager and researchers working together from the onset.

What assessments do managers value?

When asked to prioritize various kinds of assessments to provide information that could be used to inform decisions, resource managers gave their highest rankings to climate vulnerability assessments for habitats and watershed-scale assessments for adaptation planning (Appendix C). Translation of climate assessments for use in public outreach and messaging was also identified as a high priority. Landscape-scale assessments for adaptation, and climate vulnerability assessments for species, garnered high priority rankings from more than half of survey respondents. More than half of survey respondents rated assessments for working with tribal communities and climate vulnerability assessments for infrastructure as a medium priority.



4.4 CONCLUSIONS AND RECOMMENDATIONS

Primary science needs of the SW CASC-region participants in this assessment were evaluated through (a) overarching science themes from in-person listening sessions elaborated in Section 4.3, (b) a list of primary science-related needs from the online survey instrument, and (c) a list of science priorities, based on match between needs expressed by stakeholders and priorities listed in the most recent SW CASC Science Agenda. From examination of these sources, the following needs were expressed by natural resource managers in the SW CASC region:

Overarching Science Research Themes (From Listening Sessions, Interviews)

- Stand-replacing fire
- Overwhelming introductions of invasive species (aquatic and rangeland)
- Climate influences on diseases
- Snow pack/snow melt/snow drought impacts on habitats

Data synthesis, information, guidance and research needs (From Web Survey)

- Translation of data into useable formats (data synthesis)
- Habitat connectivity information (research)
- Impacts on specific habitats or species (research)
- Examples of successful adaptation strategies (synthesis and assessment)
- Synthesis reports on latest climate science (synthesis and assessment)
- Guidance on implementing climate in to agency planning and decision making (guidance)
- Guidance on facilitation of conversations between agency staff and communities (guidance)

Emerging needs (All data gathering instruments, matched with the SW CASC Science Priorities)

- Understanding of climate change impacts on water availability and quality, especially in the context of (a) increased societal demands for water, (b) sufficient water to maintain wildlife populations at the interface with urban areas, and (c) fire-prone ecosystem challenges at the wildland urban interface (research)
- Integrating data from snow pack, snow drought, and snow melt to manage the health and wellness of populations in specific areas where populations are dependent on

4.4 CONCLUSIONS AND RECOMMENDATIONS CONTINUED

or influenced by snow and snow-fed water sources; managers especially noted big game species that are linked to funding associated with tagging and permitting practices (research, data synthesis)

- Improving multi-scenario fire models that account for stand-replacing fire, prescribed fire, tree mortality, fire intensity and frequency, and vegetation responses (research)
- Integrating water and temperature data for fisheries and aquatic species, especially as applied to seeding practices and hatchery management (data synthesis)
- Guidance on creating relevant climate change-related messaging for conversations with the general public (communications, guidance)
- Guidance on communicating climate science to special interest groups, tribes and indigenous communities (communications, guidance)
- Integrating climate science across existing and planned watershed and landscape conservation efforts (research, information)
- Understanding how climate change will impact habitat connectivity and migration corridors, on various scales (research)
- Understanding how climate change will impact species: native versus non-native and invasive, obligate versus facultative, game and non-game, threatened and endangered, and spread of diseases by species (research)
- Increased understanding of coastal biomes, coastal impacts, ocean acidification, sea surface temperature and sea-level rise in areas such as the California coastline, where coastal marine life overlaps with terrestrial and aquatic species (research)



4.4.1 NEEDS

Making sense of the needs assessment data

To make sense of the multiple streams of data gathered in this assessment and to provide recommendations to the leadership of the SW CASC, findings were organized by the SW CASC operations areas (research, synthesis and assessment, outreach and engagement, communications), and by recently articulated SW CASC science priorities.

Research

Climate-related actionable science research needs are most closely related to areas of current or anticipated impacts, including modeling and prediction of impacts. Overarching research needs include:

- The occurrence of fire and knock-on impacts of fire to watersheds, habitat, and species, and associated fire and impact modeling and prediction
- The availability of water, as mediated through changes to snow hydrology and precipitation patterns and timing
- Climate-related impacts to specific species and their habitats, including effects on invasive species
- Climate-related impacts to ecosystems, at a landscape scale, including effects on ecosystem processes, connectivity, and migration corridors
- The intersections between climate and non-climate factors, including factors such as urban expansion and activities, development, pollution, and knock-on effects on wildlife, and transportation infrastructure

Synthesis and Assessment

Climate-related actionable science needs articulated by participants in this study include synthesis, assessment, and guidance reports and consultations (i.e., interaction with scientists). Specific needs include:

- Synthesis and updates on recent and regionally-relevant climate science, including “State of the Knowledge”
- Synthesis and updates on implementation and evaluation of climate adaptation strategies
- Synthesis and assimilation of climate-related data (e.g., snow hydrology, streamflow, stream temperatures) with wildlife-related data and observations, with special emphasis on data format issues and climate parameters that are meaningful to natural resource managers

4.4.1 NEEDS CONTINUED

Outreach and Engagement

- In-person knowledge exchange and discussion of topics such as:
 - » Adaptive management and climate change uncertainty
 - » The intersection of climate and non-climate factors that increase pressures on wildlife and habitat
 - » Implementing climate information in planning and decision-making, including determination of prioritization of resources and strategies
- Strengthening networks of resource managers, CASC scientists, academic and other researchers, non-governmental and non-profit organizations
- Extension of science results and climate-related management practice case studies

Communications

- Content and guidelines on climate science communication with agency staff, communities, and commissions



4.4.2 PRIORITIES

Research

Based on remarks by the natural resource managers who took part in this assessment, we identified four priorities for SW CASC research:

1. Factors contributing to stand-replacing fires and improved prediction of these fires, along with the impacts of stand-replacing fire on various aspects of ecosystem function;
2. Introductions of invasive species that overwhelm the typical functioning of the ecosystem or strain the capacity of an agency to respond;
3. Climate change influences on animal and plant diseases;
4. Improved understanding of the effects on habitats of changes to snow pack, snow melt, and snow drought.

Synthesis and Assessment

Top priorities for synthesis and assessment products included:

1. Data syntheses related to snow hydrology and water temperature
2. Synthesis and assessment of integration of climate science into watershed- and landscape-scale conservation initiatives, which dovetails with needs for assessments of successful implementations of adaptation strategies
3. Up-to-date assessments of the latest place- or region-specific climate science

Outreach and Engagement

1. In-person meetings, briefings, trainings
2. Fact sheets and science summaries

Communications

Guidance and products for communicating climate change science to members of the public, interest groups (e.g., hunter and anglers; fish and wildlife commissions) and tribal communities, were among the most mentioned needs for communication. The top priorities were:

1. communication guidelines, to convince the aforementioned groups of the needs to adjust fish and wildlife operations, in the face of current and future climate changes
2. materials with facts and figures to support climate communication, written and presented in a manner that is easy for laypeople to digest, but backed by a foundation of credible and legitimate science

4.4.3 BARRIERS

The assessment process indicated a set of barriers that natural resource managers may face in working with the SW CASC. Perceived overarching barriers to working with SW CASC include:

- Practitioners operate at multiple spatial and temporal scales, and these scales often do not match the scales articulated in research papers and assessments (e.g., research often encompasses large regional scales, whereas managers require information on particular basins or parameters; research uses coarse temporal resolutions that are not relevant to management decisions)
- Natural resource managers and practitioners often act reactively, because agency missions require them to adhere to plans and priorities articulated in current management protocols; agency practitioners must often respond to current and short-term demands of the general public
- In some cases, agencies and organizations are required to work with prescribed partners, or to use specified prediction models, or they must use funding that is earmarked for specific activities. Thus, working with SW CASC would require creative approaches and partnerships to address the aforementioned constraints.
 - » Such approaches might include making efforts to reach out to prescribed partners, comparative research on model approaches and/or research where the goal is to examine model sensitivities to climate changes, and so on, and working with liaisons to these agencies, to find ways to use CASC funding and resources to supplement information provided through prescribed channels,
- Each state, and the natural resource management agencies within each state, have varying needs, budgets, capacities; thus, it is unlikely that all agencies will be able to partner equally with the SW CASC
- Although managers have flexibility, mostly within active treatments, they often lack sufficient capacity to assimilate new information and implement novel strategies
- Natural resource management stakeholders were often unaware of the existence of the SW CASC, and were often unclear on the role, mission and extent of services available through the SW CASC

Barriers specific to key SW CASC operational areas include:

Research

- Lack of capacity to assimilate climate data into operational practice (e.g., unusable formats, ill-defined parameters)
- Lack of funding or capacity to engage in the co-production of actionable science
- Mismatch of research needs with SW CASC, due to high specificity

Synthesis and Assessment

- Mismatch of synthesis and assessment product needs with SW CASC, due to high sub-regional, species, or temporal specificity

Outreach and Capacity Building

- Lack of intermediaries, such as Landscape Conservation Cooperatives
- Lack of human resource capacity to engage with SW CASC
- Lack of SW CASC ability to provide substantial in-person engagement

Communications

- Lack of guidance and or ease in communicating climate change science with key constituencies



4.4.4 OPPORTUNITIES

In general, we found that participants in this study were often unaware of the existence of the SW CASC, and were often unclear on the role, mission and extent of services available through the SW CASC. The lack of awareness provides an important opportunity for the SW CASC to communicate more widely, vigorously, and strategically. It also reinforces key points from the Review, which mentioned that the SW CASC could improve its interactions with stakeholders, and its effectiveness in the development and delivery of actionable science to natural resource managers, by improving the accessibility of SW CASC science, motivating collaborations through user needs, and by working with users of SW CASC science from the initiation of research projects.

Opportunities specific to key SW CASC operational areas include:

Research

- Policy initiatives, such as the 2018 update to the Safeguarding California Plan (CNRA, 2018), may provide opportunities to enable research collaborations to address well-defined science and adaptation management knowledge gaps. The California plan is accompanied by state funding for adaptation-related research, for which additional SW CASC funding or human resources could ensure the co-production of usable and actionable science.
- SW CASC's SCENIC climate data tool could help address issues of assimilating climate data into operational practice, as could partnership with AZGFD's, to inform development or enhance operations of AGFD's new digital data management system.
- There are opportunities for SW CASC to address issues related to habitat connectivity, migration corridors, and climate impacts on species, by working with other CASCs, on multi-state and multi-region initiatives, aligned with Western Association of Fish & Wildlife Agency (WAFWA) priorities.

Synthesis and Assessment

- SW CASC can fill an important need identified by natural resource managers, through the production of synthesis and assessment products (e.g., reports, briefings, short summaries, webinars) tailored to state- or region-specific topics. One avenue for directed funding, or short-term CASC team focus, is to convene rapid response teams, or expert elicitation exercises, to provide state of knowledge assessments, briefings, and ask-an-expert panels.
- Data synthesis needs open the doors for SW CASC to collaborate with USGS Cooperative Fish & Wildlife units, on fisheries and aquatic species issues.

Outreach and Capacity Building

- The loss of Landscape Conservation Cooperatives provides an opportunity for SW CASC to pick up outreach with LCC networks and work with former LCC partners to selectively, given CASC capacities, build on capacity developed through LCC initiatives.
- Practitioners identified multiple needs that could be met through strategic outreach and process-based capacity building to use climate and weather extremes information in decision-making.
 - » For example, well-known and trusted facilitation processes could be used to build capacities to explore management strategies for addressing climate change uncertainties, prioritizing resource management strategies, exploring the intersections between societal activities, climate change and human-wildlife interactions, and other issues.
 - » This could be an opportunity to leverage SW CASC's scenario planning initiative.
- In conjunction with synthesis and assessment activities, SW CASC annual stakeholder-scientist meetings, occasional climate summits, adaptation forums and similar events could be used as platforms for convening briefings, "State of the Knowledge" panels, and expert elicitations on key topics of interest to natural resource managers in the Southwest.
 - » This would also help meet resource manager needs for more interactive and in-person means of climate science training and communication.
- Collaboration with the highly trusted dedicated state game and fish department liaisons to SW CASC institutions (e.g., Utah State University [USU], University of

4.4.4 OPPORTUNITIES CONTINUED

Arizona [UA]) provides opportunities to develop capacities to infuse climate and weather science information to fill knowledge gaps identified in this study. Such collaborations build on a strong history of institutional trust.

Communications

- Stakeholders have reported that they feel as if a wealth of research is going on, yet little to no data sharing and communication is taking place. This void may potentially be filled by SW CASC by acting as a convener and synergistic mediator for leading the coproduction process through continuous commitment to match researchers, research needs, management priorities, and natural resource management practitioner partners.
- If adequate resources are available, the SW CASC could play a moderator role in communicating climate science to land and water managers, which in turn will greatly enhance the ability to conserve terrestrial and aquatic wildlife habitats.
- Practitioners act reactively, must adhere to plans that prioritize specific management objectives, and must also respond to current demands of the general public—all of which provides an opportunity for the SW CASC to be more nimble with science communication, synthesis and assessment, and rapid response to inform reactive management.
- Opportunities to address communication needs may be met through cooperation with well-aligned federal actionable science initiatives, such as NOAA Regional Integrated Sciences and Assessment (RISA) and USDA Climate Hubs, and with Bureau of Indian Affairs (BIA) Tribal Climate Science Liaisons.



4.4.5 RECOMMENDATIONS

Based on inputs used in this assessment (interviews, listening sessions and web-survey), we recommend the following for the SW CASC to achieve its mission of providing objective scientific information, tools, and techniques that land, water, wildlife, and cultural resource managers and other interested parties can apply to anticipate, monitor, and adapt to climate change impacts in the southwestern United States:

1. Focus research efforts on the four emerging science areas identified by natural resource managers (Section 4.4.2, page 23), but augment or prioritize these, based on the match with SW CASC science priorities (Table 4, page 30).
2. Keep in mind that data synthesis issues, clear science communication, and lack of synthesis and assessment products can be barriers to state agency climate adaptation decision-making.
3. Find ways to address complex issues and questions identified by natural resource management stakeholders, such as improving understanding of impacts at the intersection of climate and non-climate drivers of on-the-ground changes, or aiding stakeholders with process facilitation to narrow decision-making alternatives, as this complexity reflects the daunting challenges faced by managers.
4. Leverage every in-person opportunity to communicate science, or to establish the foundation for partnership, as natural resource managers value in-person communication.



TABLE 4. SUMMARY OF KEY RESEARCH, ASSESSMENT, DATA SYNTHESIS AND COMMUNICATION ISSUES ALONG WITH ARTICULATION OF ASSOCIATED BARRIERS AND OPPORTUNITIES.

Emerging SW CASC Stakeholder Needs	Categories	Barriers	Opportunities
Understanding of climate change impacts on water availability and quality, especially in the context of (a) increased societal demands for water, (b) sufficient water to maintain wildlife populations at the interface with urban areas, and (c) fire-prone ecosystem challenges at the wildland urban interface	Research	Level of agreement on goals	Collaboration with NOAA-RISAs, USDA Climate Hubs. CA Adaptation Plan and recent experience with damaging fires.
Integrating data from snow pack, snow drought, snow melt to manage the health and wellness of populations in specific areas where populations are dependent on or influenced by snow and snow-fed water sources; managers especially noted big game species that are linked to funding associated with tagging and permitting practices	Research, Data Synthesis	Availability of place-specific data	SW CASC SCENIC tool development; collaboration with state water management agencies, Bureau of Reclamation; for AZ Game & Fish, integration with the ACS data warehouse system
Improving multi-scenario fire models that account for stand replacing fire, prescribed fire, tree mortality, fire intensity and frequency, and vegetation responses	Research	Sufficient state agency capacity to devote personnel to engagement throughout a co-production process	Collaboration with USGS Wildland Fire Science Group, Association of Fire Ecologists, USDA Climate Hubs
Integrating water and temperature data for fisheries and aquatic species, especially as applied to seeding practices and hatchery management	Data Synthesis	Availability of data	Collaboration with USGS Cooperative Fish and Wildlife Research Units (UA, USU)
Guidance on creating relevant climate change-related messaging for conversations with the general public	Communication	Receptivity to information	Collaboration with NOAA-RISA, USDA Climate Hubs, SPAAN
Guidance on communicating climate science to special interest groups, tribes and Indigenous communities	Communication	Access to Game and Fish Commissioners; Receptivity to information	SW CASC neutral party convening capabilities, AIHEC-BIA Tribal Climate Science Liaison; nimble, rapid response communications
Integrating climate science across existing and planned watershed and landscape conservation efforts	Research, Synthesis & Assessment Process	Leadership, authority, or mandate to proceed with integration	Work with trusted liaisons between State Agencies and universities; State Wildlife Action Plans; develop tailored synthesis products
Understanding how climate change will impact habitat connectivity and migration corridors, on various scales	Research	Availability of place-based science; mismatch between science availability and decision-making time scales	Safeguarding California Plan; WAFWA multi-state initiatives; Trusted liaisons between State Agencies and universities
Understanding how climate change will impact species: native versus non-native and invasive, obligate versus facultative, game and non-game, threatened and endangered, and spread of diseases by species	Research	Availability of species-specific science; perceived credibility of science results	Collaboration with USGS Cooperative Fish and Wildlife Research Units (UA, USU)
Increased understanding of coastal biomes, coastal impacts, ocean acidification, sea surface temperature and sea-level rise in areas such as the California coastline, where coastal marine life overlaps with terrestrial and aquatic species	Research	Availability of place-specific data	Safeguarding California Plan; Collaboration with NW CASC; National Climate Assessment; Collaboration with NOAA Marine & Fisheries Service

Limitations

The processes of coproduction are limited, and barriers to assessments which involve cooperation between academics and practitioners is well documented in the literature (Baldwin et al, 2018; Schwartz, 2018; Wall et al, 2017; Beier et al, 2017; Brugger et al, 2016; Meadow et al, 2015; Ferguson et al, 2014; Cook et al, 2013; Dilling and Lemos, 2011). Establishing relationships is time and labor intensive as is the process of identifying participants. Long lags between identifying and connecting with individuals to speak or meet in person were all significant hurdles. Similarly, given the daily demands and existing mission critical priorities that are placed on managers and their staff, it is often difficult for managers to establish and set aside time for meetings beyond the general scope of their day, and so the research team frequently experienced delays due to unavoidable scheduling conflicts. Unavoidable scheduling and logistics delays ultimately led to the research team needing to request a six-month, no-cost extension which allowed for greater flexibility in terms of cementing dates to conduct on site assessments.

The project team initially envisioned the use of additional focus groups, composed of individuals representing regional chapters of wildlife associations; however, this proved to be difficult due to scheduling and travel conflicts. Although the PI was able to take part in a number of meetings, the information we had hoped to glean from these focus groups had to be attained through a blend of formal and informal interviews with individuals as schedules permitted. Future projects should design their work flow around annual meeting dates and work in advance with professional meeting organizers to structure embedded opportunities for interactions with SW CASC. While every effort was made to be inclusive in terms of participation in listening sessions and selection of interview candidates, the researchers acknowledge that there were limitations in the degree to which individuals were able to respond to requests for participation. The degree of tribal input was similarly limited in this assessment by design and could potentially be included in future assessments.

The initial scope of work as proposed in mid-2017 included meetings with the SW CASC Stakeholder Advisory Council (SAC); however, the research team was unable to meet with the SAC, as this voluntary advisory body was dissolved at the end of 2017. The research team had also hoped to have higher levels of engagement, specifically through professional

4.4.5 RECOMMENDATIONS CONTINUED

organizations; yet events were either not well suited for the assessment process, or the researchers were not able to attend due to scheduling conflicts. Future assessments may potentially avoid such hurdles by involving event organizers in the proposal writing process so that events are aligned with research work plans.

It is important to consider that the findings of this assessment are merely a snapshot of ongoing events, including numerous action plan updates. The reality of each state and stakeholder needing to react to immediate and pressing needs led the authors away from designing an all-encompassing guidebook, and toward categorizing science needs and priorities as part of an initial step to engage stakeholders and build SW CASC capacity to address management needs. Future assessments must also retain this type of flexibility.

Potential Next Steps

Next steps for this project team, and for the SW CASC include the following:

1. Distribute the 2-page project summary to natural resource manager participants in the meetings conducted in 2018
2. Conduct and record one or more webinars to disseminate the project results to resource manager participants in the meetings conducted in 2018
3. Follow up with resource manager participants, to (a) exchange knowledge and maintain relationships, and (b) scope and implement collaborative research projects
4. Write and publish a peer-reviewed journal paper, based on this research

4.5 OUTREACH AND PRODUCTS

The purpose of this assessment was to identify and strengthen stakeholder relationships. Engagement with stakeholders also took place through the PI and Co-PI attending the University of California, San Diego UP Summit, the PI attending the WAFWA Regional Conference, and the Co-PI attending partner calls. With adequate resources, engagement with the stakeholders will continue.

Outreach products are in the development phase and are based on the insights gleaned from the interviews and listening sessions as well as the results of the brief web based survey through which preferred modes of communication and themes for training were collected. Table 5 lists the planned outreach products as outputs from this project as informed by the assessment process.

TABLE 5. OUTREACH PRODUCTS, AUDIENCE AND ACCESSIBILITY.

Proposed Outreach Product	Potential Audience	Accessibility Format for Output
2-Page Briefing (See Appendix F)	Managers	Website
Infographic to Summarize Assessment Findings (See Appendix E)	General Public and Managers	Website
1-Page Overview of PI's Research Focus and Expertise	Managers	Website
"State of the Knowledge" Webinar	Managers	Online Delivery, Archived on Website
Stakeholder Newsletter	General Public and Managers	Website and Social Media
Bulletin of Opportunities Organized as a Calendar	Managers and Researchers	Website and Social Media
Colloquium Talk	Students and Researchers	UA Students and Faculty
Peer Reviewed Publication	Managers and Researchers	Website/Journal Home

5 APPENDICES

APPENDIX A. STRUCTURED LISTENING SESSION AGENDA



THE UNIVERSITY OF ARIZONA
Institute of the ENVIRONMENT



Southwest Climate
 Adaptation Science Center

SW CASC & AGENCY STRUCTURED LISTENING SESSION AGENDA

Time	Location	Topic/Purpose	Team Members	Notes
10:00-10:50am Agency Session	Director's Conference Room	Introductions + Presentation by Director's team on agency background, organizational structure, management goals, research priorities, current needs and challenges, timelines, and decision making linked to current roles/responsibilities	Agency Team: Director's Team of Managers and Researchers	Session Lead: Director or Deputy Director
Break/Transition Time				
11:00-11:50am SW CASC Session	Director's Conference Room	Presentation by SW CASC University Director Gregg Garfin on overview of SW CASC mission, organizational structure, capacity, current partnerships, opportunities, and relationships to regional expertise + Brief introductions and overviews of current work presented by attendees from partner institutions	SW CASC Team: Gregg Garfin Arin Haverland	Session Lead: Gregg Garfin
Break/Transition Time				
12:00 - 12:50pm Roundtable Discussion	Director's Conference Room	Discussion over working lunch: a) co-identification of potential opportunities/challenges when working with SW CASC b) Agency needs for additional climate information and/or planning resources	All participants	Collaborative Session Leads: Gregg Garfin Arin Haverland Agency Director
12:50 - 1:00 pm Next Steps + Wrap Up	Director's Conference Room	Closing comments and next steps for working together Meeting adjourns by 1pm		

APPENDIX B. SEMI-STRUCTURED INTERVIEW QUESTIONS

Types of Questions Asked During Semi-Structured Interviews

- What is your current role and what are your primary responsibilities?
- Are you familiar with the SW CASC? If so, what types of interactions or opportunities to work with the SW CASC have you been involved with?
- Do you often work with the LCCs? Extension Agents? Researchers? Other agencies?
- Who do you frequently partner with? And why?
- In what ways are you currently using climate-related science products or analyses? Which of the following best describes the current use of climate science in your organization's decision making? e.g. Consulting resource materials, Considering how consulted resource materials could be integrated, Incorporating tools and resource materials in decision making, Using climate science resources/tools to promote dialogue about risk and the need/justification to take action when communicating with managers and stakeholders
- Do you have forthcoming plan updates which may benefit from applied climate science analyses to address particular issues, assess knowledge gaps, or investigate vulnerabilities and adaptation opportunities?
- Would it benefit your agency to have climate-related analyses that are coordinated with neighboring states?
- Do you use seasonal climate forecasts? If so: What are the sources of the forecasts that you use? How do you use forecasts? d) what other forecasts are needed? How would you use them? For example: drought? forecasting green-up, forage, probabilities of disease outbreaks
- How would you describe your current use of climate-related data? Science needs and priorities?
- What sources of climate data do you currently consult or refer to? Are those sources also used in decision making? In framing discussions?
- Are there particular species or habitats that you manage or are concerned about?
- Do you receive the data from particular experts or agencies?
- In what formats? Weather stations? Remotely sensed climate parameters? Indices (e.g., drought)?
- Which parameters are important for you?
- What spatial scale is most important to your work?
- What time horizon do you tend to investigate? Weeks, months, years, decades? All?

APPENDIX B. SEMI-STRUCTURED INTERVIEW QUESTIONS CONTINUED

- What data time steps do you require? Hourly, daily, monthly, annual?
- Do you have a policy for addressing uncertainty? If so, what is that policy?
- If not, would a scenario planning process be of interest?
- Which climate extremes are most important, and for which species or habitats?
- Do you use models? If so, How does climate fit into your modeling?



APPENDIX C. COMMUNICATION AND TRAINING PREFERENCES SURVEY RESULTS

The brief nine-question web-based communication and training preferences survey was disseminated and available to respondents from September to December of 2018. Of the 130 individuals invited to participate by email in the voluntary survey, 88 participants responded resulting in a 68% response rate. The overall response rate may have been impacted by various factors such as invitees not receiving an invitation due to preventative spam filters, or firewalls designed to prevent access to outside links. Most respondents self-identified as being affiliated with a state agency (76%), followed by individuals identifying as affiliated with a consortium of state agencies (17%), and those working within a consortium of state, federal and community- based organizations (7%). The web-based survey results have been summarized here.

Q1. Through which of the following partnerships are you most likely to seek assistance for climate-related activities?

Partnership Type	Preference	Total Responses
LCCs	17%	15
Academics	15%	13
Regional CASCs	15%	13
NGOs/Non-profits	14%	12
Consortium	13%	11
Other State Agencies	13%	11
Other Federal Agencies	8%	7
Extension	7%	6
	100%	88

Q2. Please rate the following assessment themes by priority.

Assessment Theme	High Priority		Medium Priority		Low Priority		Total Responses
	%	Count	%	Count	%	Count	
Habitat-based climate vulnerability assessment	94%	83	6%	5	0%	0	88
Watershed-scale assessments for adaptation planning	85%	75	15%	13	0%	0	88
Climate assessments translated for public outreach and messaging	69%	61	30%	26	1%	1	88
Landscape-scale assessments for adaptation planning	55%	48	44%	39	1%	1	88
Species-based climate vulnerability assessment	53%	47	24%	21	23%	20	88
Scenario-based assessments for planning	38%	33	32%	28	31%	27	88
Climate assessments translated for working with tribal communities	30%	26	69%	61	1%	1	88
Infrastructure based climate vulnerability assessment	13%	11	55%	48	33%	29	88

APPENDIX C. COMMUNICATION AND TRAINING PREFERENCES SURVEY RESULTS CONTINUED

Q3. How likely is your organization to use the following in decision making and mission needs?

Likelihood of Use in Decision Making and Mission Needs	Extremely Likely		Very Likely		Somewhat Likely		Not So Likely		Not At All Likely		Total Responses
	%	Count	%	Count	%	Count	%	Count	%	Count	
Habitat connectivity	77%	68	20%	18	1%	1	1%	1	0%	0	88
Successful integration within adaptation strategies	74%	65	25%	22	1%	1	0%	0	0%	0	88
Translation to useable formats	73%	64	23%	20	5%	4	0%	0	0%	0	88
Guidance: Climate Science in Agency Planning/Decision Making	61%	54	35%	31	3%	3	0%	0	0%	0	88
Synthesis reports on latest climate science	38%	33	28%	25	31%	27	3%	3	0%	0	88
Impacts on specific habitats or species	33%	29	55%	48	8%	7	5%	4	0%	0	88
Guidance: Facilitating conversations between staff and communities	28%	25	52%	46	19%	17	0%	0	0%	0	88

Q4. Which of the following would assist your organization in implementing climate science as part of your mission?

Assistance Type	Preference	Number of Survey Participants That Prefer This Type of Assistance
Professional meetings or symposia	100%	88
In-person trainings	99%	87
Workshops	81%	71
Webinars	80%	70
Access to a database of local to regional experts	24%	21
Visualization and multi-scenario tools	20%	18
Online resources e.g. fact sheets, summaries of research findings	18%	16
Electronic research journal articles/peer reviewed publications	15%	13
Other (please specify)	2%	2

Q5. Which of the following activities would you be willing to attend as a participant?

Activity Type	Preference	Number of Survey Participants That Prefer This Type of Activity
½-day in-person workshop focused on sharing strategies for integrating climate science	75%	66
½-day in-person workshop focused on current climate science knowledge and recent research findings	67%	59
1-hour web-based training focused on a specific regional issue	43%	38
1-hour web-based collaborative meeting focused on co-identifying research priorities and opportunities	34%	30
1-hour web-based collaborative meeting focused on co-identifying funding opportunities	28%	25

Q6. Please rank the importance of the following criteria for collaborating with scientists.

Criteria for Collaborating with Scientists ("1" = Highest Importance, "5" = Lowest Importance)	Highest Importance "1"		Moderate to High Importance "2"		Moderate Importance "3"		Moderate to Low Importance "4"		Lowest Importance "5"		Total Responses
	%	Count	%	Count	%	Count	%	Count	%	Count	
Funding	55%	48	14%	12	16%	14	9%	8	7%	6	88
Long-term relationships that evolve over time in response to changing needs	22%	19	14%	12	20%	18	24%	21	20%	18	88
Opportunities for co-developing and co-producing research to produce actionable science	13%	11	43%	38	20%	18	17%	15	7%	6	88
Access to local expertise	9%	8	22%	19	38%	33	26%	23	6%	5	88
Access to a larger regional knowledge network	2%	2	8%	7	6%	5	24%	21	60%	53	88
	100%	88	100%	88	100%	88	100%	88	100%	88	

APPENDIX C. COMMUNICATION AND TRAINING PREFERENCES SURVEY RESULTS CONTINUED

Q7. In your opinion: What are the top 2 management decisions that should serve as "the starting point" for research that directly supports your organization's wildlife, habitat or resource management needs? In other words, where do you need the greatest assistance from researchers?

Note: Responses to questions 7 and 8 were open ended and have been summarized in the body of the report as part of IRB protocol.

Q8. What barriers exist that may prevent your organization from working with other organizations, agencies or scientists?

Note: Responses to questions 7 and 8 were open ended and have been summarized in the body of the report as part of IRB protocol.

Q9. Demographics: What category best describes your organization?

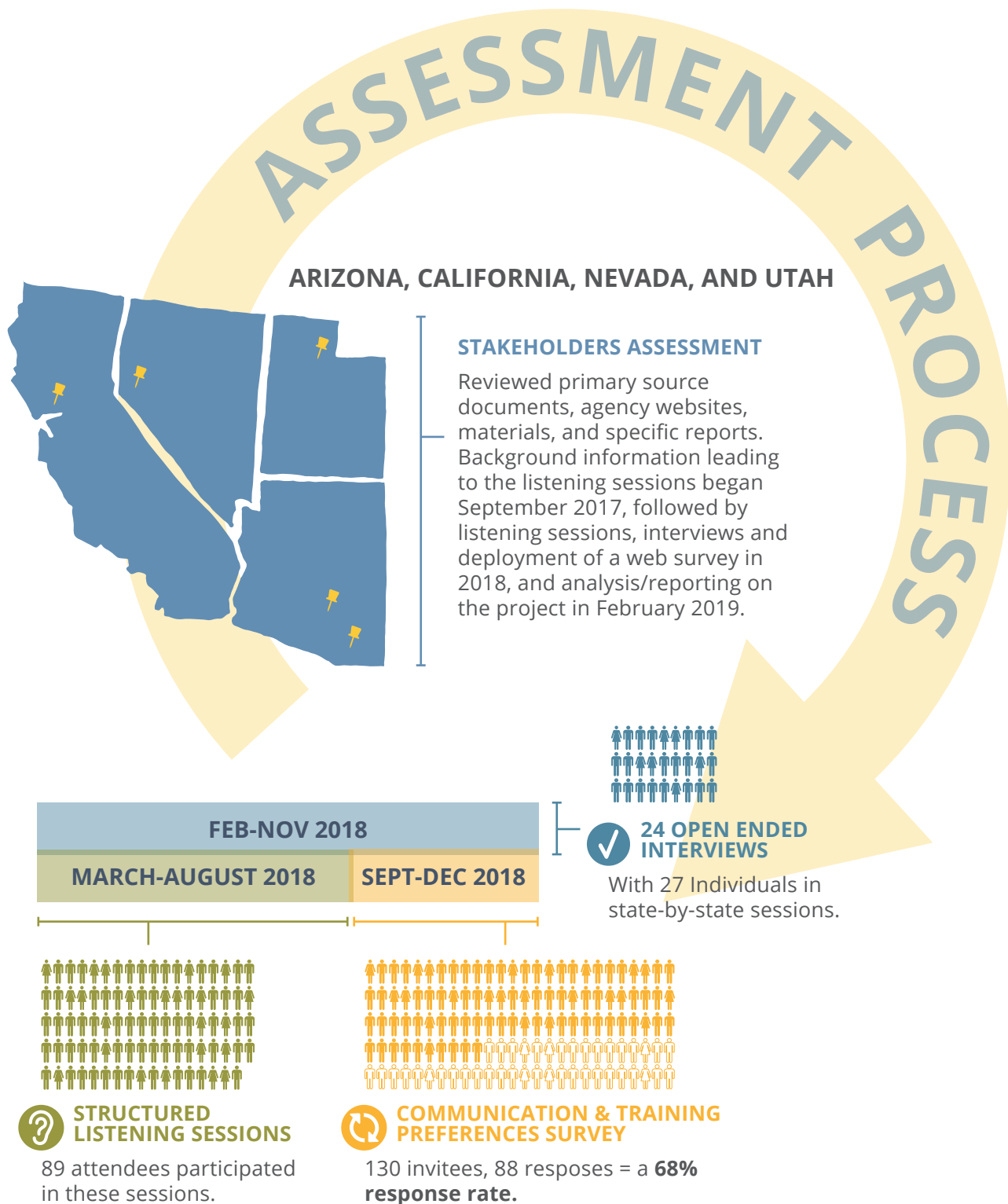
Affiliation Type	% of Respondents	Total Responses
State agency	76%	67
Consortium of state agencies	17%	15
Consortium of state, federal and community based organizations	7%	6
	100%	88



APPENDIX D. PLANS AND INITIATIVES BY STATE

State	Title of Plan or Initiative	URL
Arizona	Arizona's State Wildlife Action Plan 2012-2022	https://www.azgfd.com/Portallimages/files/wildlife/2012-2022_Arizona_State_Wildlife_Action_Plan.pdf
	Sonoran Institute: Charting-Wetland-Conditions-of-the-Lower-Santa Cruz River	https://sonoraninstitute.org/files/Living-River-Charting-Wetland-Conditions-of-the-Lower-Santa-Cruz-River-2016-Water-Year-1.pdf
California	California's Fourth Climate Assessment Summary Report	http://www.climateassessment.ca.gov/state/docs/20190116-StatewideSummary.pdf
	California's Fourth Climate Assessment Summary Report by Region	http://www.climateassessment.ca.gov/regions/
	Safeguarding California Plan: 2018 Update: California's Climate Adaptation Strategy	http://resources.ca.gov/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf
	Sea-Level Rise Guidance Document	http://www.opc.ca.gov/webmaster/ftp/pdf/docs/2013_SLR_Guidance_Update_FINAL1.pdf
	The California Adaptation Planning Guide: Planning for Adaptive Communities	http://resources.ca.gov/docs/climate/01APG_Planning_for_Adaptive_Communities.pdf
Utah	Utah Wildlife Action Plan: 2015-2025	https://wildlife.utah.gov/wap/Utah_WAP.pdf
	Utah Department of Natural Resources 2018 Annual Report	https://naturalresources.utah.gov/wp-content/uploads/Annual-Report-17_18_web-final.pdf
	Utah Department of Environmental Quality	https://deq.utah.gov/category/communication/state-of-the-environment-report
Nevada	Nevada Department of Wildlife Strategic Plan 2018-2022	<i>Link not found</i>
	The Nature Conservancy: Climate Change Revisions to Nevada's Wildlife Action Plan: Vegetation Mapping and Modeling Report to the Nevada Department of Wildlife	http://www.ndow.org/uploadedFiles/ndoworg/Content/Nevada_Wildlife/Conservation/04-TNC_Final_Report_WAP_Appendices_I-III_2012-04-16-tanyas-edits.pdf
	Nevada Department of Wildlife 2017 Biennial Report Energy Review/Cost-recovery 2011 AB 307	http://www.ndow.org/uploadedFiles/ndoworg/Content/Our_Agency/2017%20Biennial%20Report.pdf
Other Partnering Organizations	Developing a Management Model of the Effects of Future Climate Change on Species: A Tool for the Landscape Conservation Cooperatives	http://climate.audubon.org/sites/default/files/Audubon-USFWS%20LCC%20Climate%20Change%20FINAL%201.1.pdf
	Audubon's Birds and Climate Change Report: A Primer for Practitioners	http://climate.audubon.org/sites/default/files/Audubon-Birds-Climate-Report-v1.2.pdf
	Audubon's Birds and Climate Change Report	http://climate.audubon.org/sites/default/files/NAS_EXTBIRD_V1.3_9.2.15%20lb.pdf

APPENDIX E. ASSESSMENT INFOGRAPHIC



APPENDIX F. TWO PAGE PROJECT SUMMARY

Toward Effective Actionable Science: Southwest Climate Adaptation Science Center Stakeholder Needs Assessment

Background: In 2018, to help fulfill the Southwest Climate Adaptation Science Center's (SWCASC) mission of developing useful science products for natural resource managers, researchers conducted a rapid assessment of science and information needs of Southwest natural resource managers in Arizona, California, Nevada and Utah.



Lake Mead, 2002, National Drought Mitigation Center

FINDINGS: KEY RESEARCH THEMES

- Stand-replacing fire
- Overwhelming introductions of aquatic and grassland invasive species
- Climate influences on wildlife and vegetation diseases
- Impacts of snow drought and snow melt timing on species habitat

Project Goals: To assess (a) stakeholder research, data and information needs, (b) communication and engagement preferences, (c) training and extension needs, and (d) partnership and collaboration barriers and opportunities.

Methods: Researchers gathered data through 6 structured listening sessions, 24 interviews, and 88 web-based survey responses. The researchers developed a repeatable, robust process for rapidly assessing stakeholder needs (Figure 1).



Outputs: An updated resource manager contact database, a catalog of state natural resource agency management plans, and a synthesis of management science needs and priorities.

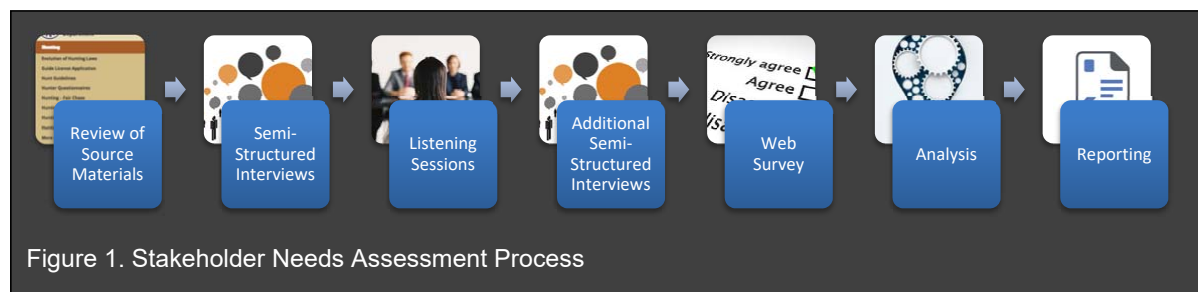


Figure 1. Stakeholder Needs Assessment Process

Emerging Needs:

- Understanding climate change impacts on water availability and quality in contexts of increased societal water demands, to maintain wildlife populations at the interface with urban areas, and challenges at the wildland urban interface
- Integrating snow drought data to manage the health and wellness of species, where populations are dependent on or influenced by snow and snow-fed water sources; managers noted big game species that are linked to funding associated with tagging and permitting practices
- Improving multi-scenario fire models for stand-replacing fire, prescribed fire, tree mortality, fire intensity and frequency, and vegetation responses
- Integrating water and temperature data for fisheries and aquatic species, especially as applied to seeding practices and hatchery management
- Guidance on climate change-related messaging for the public
- Guidance on communicating climate science to special interest groups, tribes and indigenous communities
- Integrating climate science into watershed and landscape conservation efforts
- Understanding how climate change will impact habitat connectivity and migration corridors, on various scales
- Understanding how climate change will impact species: native–non-native, obligate–facultative, game–non-game, threatened–endangered, and spread of diseases by species
- Increased understanding of coastal impacts, ocean acidification, sea surface temperature and sea level rise in areas where marine life overlaps with terrestrial and aquatic species

FINDINGS: SYNTHESIS AND COMMUNICATION THEMES

- Examples of the implementation of successful adaptation strategies
- Synthesis of the latest regionally-relevant climate science
- Guidance on facilitation of climate-related conversations between agency staff and communities of interest
- Guidance on implementing climate information in planning and decision-making

Barriers: Perceived overarching barriers to working closely to co-produce research and information to address climate-related challenges and risks include: (a) lack of funding or human resource capacity for sustained engagement; (b) lack of fit between temporal and spatial scales of research and management decisions; (c) agency requirements to work with prescribed partners or use specific data and models; (d) substantial needs for in-person engagement and communication.



Opportunities: A SWCASC focus on state policy initiatives, or multi-state and multi-region issues aligned with the Western Association of Fish & Wildlife Agencies provides opportunities for synergy with agency priorities. SWCASC can meet resource manager information needs, through rapid scientific synthesis and assessment products, and expert elicitation processes. SWCASC annual stakeholder-scientist meetings and regional adaptation forums could be used as platforms to convene in-person briefings and expert panels on subjects of interest to natural resource managers. Working with highly trusted liaisons to state agencies provides opportunities to foster two-way communication leading to tailored research requests and a better match between resource manager needs and science capabilities.

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The Southwest Climate Adaptation Science Center (SW CASC) provides objective scientific information, tools, and techniques that land, water, wildlife, and cultural resource managers and other interested parties can apply to anticipate, monitor, and adapt to climate change impacts in the southwestern United States.

www.swcasc.arizona.edu

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