

Southwest Climate Science Center

Annual Final X Project Report

(please mark which applies)

1. **USGS GRANT OR UA CO-OP AGREEMENT# G12AC20506**
2. **PROJECT TITLE:** Climate Change Vulnerability of Native Americans in the Southwest
3. **PRINCIPAL INVESTIGATOR EMAIL:** kchief@email.arizona.edu
4. **CO-PRINIPAL INVESTIGATOR EMAIL:** aleix@email.arizona.edu
5. **PERSONNEL**
 - a. Principal Investigator (Name and institution)
Dr. Karletta Chief, Assistant Professor, Department of Soil, Water, and Environmental Sciences, University of Arizona
 - b. Co-Investigators (Name(s) and institution(s))
Dr. Aleix Serrat-Capdevila, Research Associate Professor, Department of Hydrology & Water Resources, University of Arizona
Dr. William J. Smith Jr., Research Associate Professor, Department of Anthropology, University of Nevada, Las Vegas
Dr. David E. Busch, Biologist, U.S. Geological Survey Pacific Southwest Area
 - c. Undergraduate Students (Names and institutions) none
 - d. Graduate Students – MS or MA (Names and institutions) none
 - e. Graduate Students – Ph.D. (Names and institutions)
Edward Schuyler Chew, Ph.D. Student, Department of Soil, Water, and Environmental Sciences, University of Arizona
 - f. Postdoctoral Researchers (Name(s) and institution(s)) none
 - g. Other (please specify)
Kameron Morgan, Water Quality Standards Specialist, Environmental Department, Pyramid Lake Paiute Tribe (Tribal liaison for the project)
6. **PROJECT START DATE (MM/YYYY):** 09/2012
7. **EXPECTED COMPLETION DATE (MM/YYYY):** 03/2015
8. **PURPOSE AND OBJECTIVES:** Describe the project goals and objectives, with particular emphasis on any changes made to the objectives as stated in the original proposal. If the objectives have been added to, eliminated, or modified, please explain why these changes have been made.

Project Goals:

- Determine the potential of the Pyramid Lake Paiute Tribe to adapt to climate change by understanding vulnerabilities, thresholds, and resiliencies of the systems
- Propose collaborative tribal water management and adaptive strategies for the Pyramid Lake Paiute Tribe
- Produce a framework for a decision support system model of a coupled climate-biophysical-social system
- Explore the potential for effective partnerships and collaborations between tribes and scientists

The text of the second goal has been changed from “develop” to “propose” in order to emphasize the fact that our role is to “propose” management strategies for the Pyramid Lake Paiute Tribe to review.

We believe that only the Pyramid Lake Paiute Tribal government has the authority and sovereignty to “develop” management strategies that meet their needs.

The fourth goal was originally stated as: “Determine effective tribal partnerships and collaborations”. This goal has been restated in a broader manner because we intend to investigate a range of possibilities for partnerships and collaborations. We believe that it is up to the Pyramid Lake Paiute Tribe to decide which partnerships and collaborations are most effective and meet their needs. In addition, the phrase “between tribes and scientists” was added to clarify that these partnerships and collaborations are between tribes and scientists.

9. **ORGANIZATION AND APPROACH:** Explain how each research task is being conducted. Briefly list which research methods are being used to achieve results, including any new methods that were not described in the original proposal. Please also discuss any problems or delays encountered in conducting the research during the reporting period.

Task 1: Data collection of climate and non-climatic data (hydrological, climatological, and socioeconomic)

Research methods include a literature review of journal articles related to the hydrology and ecology of the Truckee River and Pyramid Lake. In addition, an overview of tribal water rights and the Truckee River Operating Agreement (TROA) was undertaken to understand the evolution of tribal water rights and water use agreements in the basin. This investigation was put on hold at the request of the tribe because the TROA is currently being challenged in court and has not been officially implemented.

An extensive literature review of socio-ecological dynamics in the Pyramid Lake system was conducted. It focused on understanding the linkages between the life cycle of two fish species – the endangered Cui-ui (*chasmistes cujus*) and the threatened Lahontan cutthroat trout (*oncorhynchus clarki henshawi*) - and the hydrologic dynamics of the Truckee River. The survival of these two fish species and the associated ecosystem dynamics are extremely important for the Pyramid Lake Paiute Tribe. For that reason, an effort has been made to develop ecological indicators that monitor conditions influencing the wellbeing and thriving of these species.

We are researching the socio-economics of the tribe through the literature review. In addition, we held the “Climate Change Planning Workshop” on September 25, and 26, 2013 with tribal members on tribal land in Nixon, NV in order to gain better insight to climate change challenges from the perspective of tribal members. This workshop also served to identify some management alternatives and solutions that address the challenges.

Historical records from a number of hydro-climatic variables have been gathered from a number of sources, ranging from the PL Paiute Tribe itself to USGS public datasets, as well as others. As an example, some of the variables are streamflow, temperature, precipitation, and lake levels. Specifically this data records have been used to develop the hydrologic model of the lake described in Task 6.

Task 2: Institutional analysis and adaptation potential (historical and present)

Some information related to this task was revealed during the workshop with tribal members. We will use recorded interviews from the previous vulnerability analysis study to identify information for this task. More work remains to be done on reviewing the tribe’s governance and water management. As part of a related effort, this project co-PI is working with a group of international donors and water institutes to develop a framework for decision-makers and water practitioners to assess adaptive capacity. Such a framework in the making can be used as a self-diagnosis tool for the Tribe to assess their adaptive capacity and guide how to cultivate it.

Task 3: Current and future water demands

We reached out to the “Truckee Basin Study” (funded by the U.S. Bureau of Reclamation’s Water SMART program) which is looking at climate change impacts of water demand in the Truckee River Basin. We attended a webinar in November 2014 which discussed some preliminary findings from this study, but a public draft has not yet been available.

Task 4: Climate change projections

We reached out to USGS SCC collaborators on their efforts to do climate modeling in the Great Basin, but were unable to collaborate with them to date. We relied on climate projections for the region as determined by the Southwest Climate Change Assessment Report. Citation:

Cayan, D., M. Tyree, K. E. Kunkel, C. Castro, A. Gershunov, J. Barsugli, A. J. Ray, J. Overpeck, M. Anderson, J. Russell, B. Rajagopalan, I. Rangwala, and P. Duffy. 2013. “Future Climate: Projected Average.” In *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 101–125. A report by the Southwest Climate Alliance. Washington, DC: Island Press.

Task 5: Collaborative development of future water management alternatives and adaptation strategies

We identified a number of management alternatives at the recent workshop with tribal members and a list of recommendations will be presented to the Tribe. We intend to continue developing this information further. We are developing this Task as a dynamic process in which Tribal members and other actors will also keep contributing and developing ideas as time goes by and the state of the system evolves.

Task 6: Conceptual Framework for a Decision Support System model for testing alternative management and adaptation strategies

First, we have made significant progress on this task through the development of a hydrologic balance model that provides hypothetical projections of Pyramid Lake elevation under various climate scenarios. This model is intended as a resource to help tribal environmental managers with decision making and outreach efforts. Much of our current work will inform the design of the conceptual framework. Secondly, the project will benefit from our involvement (Serrat-Capdevila) with the Alliance for Global Water Adaptation (AGWA) Group and their development of the Climate Risk Informed Decision Approach (CRIDA) to climate change adaptation. The AGWA approach consists of a structured and consistent way to scale climate-related decisions from the decision-makers needs, using uncertain climate information.

Task 7: Integrated vulnerability (IV) assessment of Pyramid Lake Paiute Tribe

The socio-economic vulnerability assessment of the Pyramid Lake Paiute Tribe was published in October 2013 in *Climatic Change*. The citation is:

Gautam, M., K. Chief, and W. J. Smith, Jr. 2013. Climate Change in Arid Lands and Native American Socioeconomic Vulnerability: The Case of the Pyramid Lake Paiute Tribe. In “Facing climate change: The experiences of and impacts on U.S. tribal communities, indigenous people, and native lands and resources.” *Climatic Change: Volume 120, Issue 3 (2013)*, Page 585-599. DOI # 10.1007/s10584-013-0737-0

A draft of an integrated vulnerability assessment has been drafted.

Task 8: Investigation of physical and social limits of adaption and resiliency

The socio-economic limits of adaptation and resiliency were published as cited above. Throughout our work, we have investigated the physical limits of adaptation. Some of the physical limits to adaptation that we have observed are related to hydrologic and ecological indicators that reflect the security or health of the life cycle of the Cui-üi and the Lahontan cutthroat trout, which are essential and invaluable

to the culture of the PL Paiute Tribe. Other physical limits are hydro-climatic variables that are difficult to control by the tribe, as they are a function of upstream water management and land use cover (Streamflow, timing and frequency of flow events, and water quality), and global climate (Temperature, Precipitation).

Task 9: Tribal Consultation and Presentations

We presented at multiple tribal symposiums. We presented at the American Indian Climate Change Working Group and at the University of Arizona Native Nations Water Rights Symposium. We also presented the progress of the project at the Mid-year conference of the National Conference of American Indians in Reno, NV. The presentation was part of the Tribal Leader / Scholar Forum's panel entitled "Agriculture, Timber and Water: Sustaining our Natural Resources." Edward Schuyler Chew, Olin Anderson and Shannon Mandell, a member of the tribe and director of the tribe's museum, delivered this presentation. Edward Schuyler Chew gave a similar presentation in November 2013 at the Nevada Water Resources association River Symposium in Reno, NV. We have presented the progress of the research with tribal members of the PLPT at public presentations in September 2013 and August 2014. (see complete list below).

Task 10: Effective Tribal Collaboration

The workshop we conducted with tribal members was our first opportunity to observe tribal collaboration with the researchers. Edward Schuyler Chew attended a training course on developing climate change adaptation plans for tribes. This training was hosted by the Institute for Tribal Environmental Professionals and took place in early October 2013 at the Desert Research Institute. The training was very useful to see the types of resources on climate change adaptation are relevant to tribes in the Great Basin of Nevada. This training also provided ideas for further collaboration with the Pyramid Lake Paiute Tribe and other tribes nearby. We will participate in the larger SW CSC evaluation project and we will receive an assessment of our engagement practices that will fulfill our project goal of a set of best practices for engagement with tribal stakeholders. On August 15, 2014, we met with the PLPT Environmental Department director and staff to discuss the results of our work and to get their feedback on our proposed adaptation strategies.

Task 11: Reporting results

We reported to the Pyramid Lake Paiute Tribal Environmental department and Council in August 2014 on latest results. We will be writing up results on climate change adaptation in 2015 and presenting it to the tribal council in 2015.

10. **RESULTS:** Present your preliminary project results if possible. Both quantitative and qualitative results (descriptions of how well or poorly something worked) are useful. Of particular interest are major discoveries, innovative approaches and solutions, and accomplishments made by the project team to date.

The case of the Pyramid Lake Paiute Tribe exemplifies tribal vulnerabilities as a result of climate change. Preliminary socio-economic data and analysis reveal that the tribe's vulnerability to climate change is related to cultural and economic dependence on Pyramid Lake, while external socio-economic vulnerability factors influence adaptive capacity and amplify potential impacts. Reduced water supplies as a consequence of climate change would result in a compounded reduction of inflows to Pyramid Lake, thus potentially impacting the spawning and sustenance of a cultural livelihood, the endangered cui-ui fish (*chasmistes cujus*). Meanwhile, limited economic opportunities and dwindling federal support constrain tribal adaptive capacity. Factors that contribute to tribal adaptive capacity include: sustainability-based values, technical capacity for natural resource management, legal capacity to secure additional water rights to try to ensure adequate quantity and timing of streamflows, proactive initiatives for the control of invasive-species, strong external scientific networks, and remarkable tribal awareness of climate change.

We identified ecological indicators through a literature review. The indicators, which will be monitored and assessed toward the goal of sustainability, are related primarily to the lake's hydrology and the ecology of two culturally and economically significant fish species: cui-ui (*chasmistes cujus*) and the Lahontan cutthroat trout (*oncorhynchus clarki henshawi*). We presented these findings at the September 2013 workshop and asked tribal members to identify other indicators related to problems/challenges that they identified. The results we obtained will be essential to our research. In addition, the workshop allowed tribal members to suggest management alternatives that address these problems/challenges.

We look forward to collaborating more closely with the tribe's environmental department to identify more quantitative data related to the issues that were mentioned in the workshop. One of the central questions raised at the workshop was how Pyramid Lake's elevation might be affected by climate change. The tribal members participating in this workshop were keenly aware of the ecological coupling between lake elevation and well-being of culturally and economically important species. In response to this inquiry we focused our efforts toward understanding how climatic shifts such as temperature increases and precipitation decreases might affect Pyramid Lake. Using historical hydro-climatological records, we developed a hydrologic water balance model in Microsoft Excel which simulates and predicts the elevation of Pyramid Lake over time. We obtained climatic and environmental data on Truckee River flow, temperature and precipitation of the region in order to calibrate this model. We also developed hypothetical projections of Lake Elevation up to the year 2100 by applying climate change scenarios, e.g., gradual increases in temperature by 2 Degrees F and gradual decreases in precipitation by 1 inch. This component of the model is intended as an informational resource for tribal managers to aid them in adaptation planning and educational outreach.

We discussed nineteen adaptation recommendations at a public meeting in Wadsworth, NV on August 15, 2014. These recommendations were grouped into the following five categories:

- Water management upstream and litigation
- Water & environmental management in spawning corridor upstream from Lake
- Rangeland, land cover and water management
- Fish and wildlife management
- Monitoring, scientific research and outreach

In our presentation to the Pyramid Lake Paiute Tribal Council on August 15, 2014, we summarized this list down to ten bullet point recommendations for the Tribe to consider.

1. Manage Stampede Reservoir releases at convenient times for cui-ui spawning
2. Increase irrigation efficiency which will reduce water demand and follow soil conservation practices which will improve water quality.
3. Revisit Operations of Marble Bluff Dam to adapt to changes the hydrologic regime of the river
4. Revisit hatchery operations to adapt to changes in fish populations.
5. Maintain and enhance efforts to restore the natural riparian habitat of the Truckee River
6. Adapted urban planning and residential outdoor landscaping to promote water harvesting of storm runoff, reduce erosion, enhance water quality, water for community gardens.
7. Integrated comprehensive Emergency Response Plan (for mitigation of chemical pollution and sediment pollution upstream)
8. Monitoring environmental indicators is important.
9. Outreach: Engage schools and the community. Teach the value of environmental and cultural resources,, and the opportunities to face today's challenges, as well as the role of the youth.
10. Establish tribal led reservation-wide initiatives to increase education of global change and protecting the environment. Involve high schools and senior centers.

11. **NEXT STEPS:** State and describe the next steps in the research, including an updated project timeline and anticipated completion date.

We have been working on distilling the results of the workshop into manuscript. This will entail transcribing audio recordings and transferring information written down on poster boards into word documents. We intended to identify tribal members during the workshop to do one-on-one follow-up interviews, but were unable to make these connections. Our next task will require working closely with the tribe to identify individuals that would be ideal to interview. The tribe has identified additional areas of collaborate work including building on the climate scenarios and adaptation. We are seeking additional funding opportunities to explore self-diagnosing adaptive-capacity framework. We are in the process of assimilating all project results into a climate change report for the Tribe. Below is an updated timeline.

Activity	O-D '12	J-M '13	A-J '13	J-S '13	O-D '13	J-M '14	A-J '14	J-S '14
Kick-off and Quarterly Meetings								
Pyramid Lake Field visit								
Task 1: Data collection								
Task 2: Institutional analysis								
Task 3: Current & future water demand								
Task 4: Climate change projections								
Task 5: Water mgt & adaptive strategies								
Task 6: Framework for DSS								
Task 7: Vulnerability assessment								
Task 8: Adaptation and resiliency								
Task 9: Tribal consultation			Reno					
Task 10: Effective tribal collaboration								
Task 11: Reporting								

12. **OUTPUTS**

- a. Please list any **peer-reviewed publications** that have resulted from this project (full citations). Please include articles in preparation, in review, accepted, or published.

Gautam, M., **K. Chief**, and W. J. Smith, Jr. 2013. Climate Change in Arid Lands and Native American Socioeconomic Vulnerability: The Case of the Pyramid Lake Paiute Tribe. In "Facing climate change: The experiences of and impacts on U.S. tribal communities, indigenous people, and native lands and resources." Climatic Change: Volume 120, Issue 3 (2013), Page 585-599. DOI # 10.1007/s10584-013-0737-0

Cozzetto K., K. Chief, K. Dittmer, M. Brubaker, R. Gough, K. Souza, F. Ettawageshik, S. Wotkyns, S. Opitz-Stapleton, S. Duren, and P. Chavan. 2013. Climate change impacts on the water resources of American Indians and Alaska Natives in the U.S. Climatic Change. DOI# 10.1007/s10584-013-0852-y.

Smith, Jr., W. J., Z. Liu, A. S. Safi and K. Chief. (2014) Climate change perception, observation and policy support in rural Nevada: A comparative analysis of Native Americans, non-native ranchers and farmers and mainstream America. Environmental Science & Policy 42: 101-122.

Chief, K., J.J. Daigle, K. Lynn, and K.P. Whyte. Indigenous Experiences in the U.S. with Climate Change and Environmental Stewardship in the Anthropocene in Sample, V. Alaric and Bixler, R. Patrick (eds.). 2014. Forest Conservation and Management in the Anthropocene: Conference Proceedings. Proceedings. RMRS-P-71. Fort Collins, CO: US Department of Agriculture, Forest Service. Rocky Mountain Research Station. 494 p.

Chew, E.S., A.S. Serrat-Capdevila, and K. Chief. Climate change resiliency in a Native American community. (in preparation).

b. **Non-peer-reviewed publications** (full citations).

Chew, E.S. and K. Chief. 2013. Year-round Migrations of the Cui-ui and Lahontan Cutthroat Trout in Pyramid Lake. <https://www.youtube.com/watch?v=1sBAYBMeRFs> Video

Stolte, D. 2013. How climate change impacts indigenous communities. University of Arizona (UA) News, October 28, 2013, <http://uanews.org/story/how-climate-change-impacts-indigenous-communities>

Magrane, E. 2014. Collaborating with tribes on climate change. University of Arizona Institute of the Environment, Environment and Sustainability Portal, April 16, 2014, <http://www.portal.environment.arizona.edu/content/collaborating-tribes-climate-adaptation>

Fisher, M. 2014. Native American tribe prepares for climate change with the help of a soil scientist. Soils Horizons, pages 1-4, Soil Science Society of America, Published July 9, 2014. doi:10.2136/sh2014-55-4-f

Chew, E.S., K. Chief, A. Serrat-Capdevila, W.J. Smith Jr. and D.E. Busch, 2014. Project Update: Climate Change Vulnerability of Native Americans in the Southwest: Pyramid Lake Paiute Tribe Resilience and Adaptive Management Strategies, Spring 2014 Newsletter.

Guidelines for Considering Traditional Knowledges in Climate Change Initiatives <http://climatetkw.wordpress.com/> *Webmaster: Kathy Lynn*

Climate Change Vulnerability of Native Americans in the Southwest Program Website. <http://nativeadaptation.arizona.edu/> *Webmaster: E.S. Chew*

Chew, E.S. and K. Chief. 2013. Climate Change Vulnerability of Native Americans in the Southwest. <https://www.facebook.com/nativeadaptation> Facebook. *Moderator: E.S. Chew*

c. Please list any **conference talks** you have given based on this project (conference title, date, and location).

Chief, K., M. Gautam, and W. Smith Jr. 2012. An Integrated Assessment of Climate Change in Arid Lands and Native American Vulnerability: The Case of the Pyramid Lake Paiute Tribe. American Society of Agronomy–Crop Science Society of America– Soil Science Society of America International Annual Meeting. October 22, 2012. Cincinnati, OH.

Chief, K., M. Gautam, and W. Smith Jr. 2012. Integrative and Collaborative Framework for Tribal Climate Change Vulnerability and Adaptation: Pyramid Lake Paiute Tribe. April 23, 2012. American Indian and Alaskan Native Climate Change Working Group Spring 2012 Meeting, Tohono O'odham Community College, Sells, AZ

Chief, K., M. Gautam, and W. Smith Jr. 2012. Climate Change Vulnerability Assessment for Pyramid Lake Paiute Tribe: an integrated approach and collaborative modeling framework *In* Tribes and Climate Change: Vulnerability Assessments and Adaptation. Abstract No. 44. May 29-

31. 2012. Climate Adaptation Futures: Second International Climate Change Adaptation Conference 2012, University of Arizona, Tucson, AZ.

Garfin, G.M., M. Wilder, B. Udall, E. Fleishman, G. Frisvold, S. Moser, and K. Chief. 2012. Perspectives from Ground Zero: Adapting to Climate Change in the Southwest: Key Themes from the U.S. National Climate Assessment Southwest Region Technical Report May 29-31. Climate Adaptation Futures: Second International Climate Change Adaptation Conference 2012, University of Arizona, Tucson, AZ.

Chief, K., A. Serrat-Capdevila, W.J. Smith Jr., and M. Gautam. 2012. The vulnerability and resiliency of Pyramid Lake Paiute Tribe under climatic and non-climatic stressors: Coupling social and hydrologic systems. Southwest Climate Science Center Webinar, August 2, 2012.

Anderson, O., E.S. Chew, K. Chief, A. Serrat-Capdevila, W.J. Smith Jr., and D.E. Busch. 2013. Resilience to Climate Change: Collaborating on Adaptive Management Strategies for the Pyramid Lake Paiute Tribe. Nevada Water Resources Association River Symposium, November 2, 2013, Reno, NV.

Busch, D.E., K. Chief, E.S. Chew, A. Serrat-Capdevila, and W.J. Smith Jr. 2013. Climate Change Vulnerability of Native Americans in the Southwest: Pyramid Lake Paiute Tribe Resilience and Adaptive Management Strategies. Great Basin Consortium Conference, The Great Basin: A Landscape Under Fire, December 9-10, 2013, University of Nevada, Reno, NV.

Chief, K., E.S. Chew, A. Serrat-Capdevila, W. Smith Jr., and D.E. Busch. 2013. Climate Change Vulnerability of Native Americans in the Southwest: Pyramid Lake Paiute Tribe Resilience and Adaptive Management Strategies. Great Basin Consortium, December 9, 2013, University of Nevada Reno, NV.

Chief, K., E.S. Chew, A. Serrat-Capdevila, W. Smith Jr., and D.E. Busch. 2013. Resilience to Climate Change: Collaborating on Adaptive Management Strategies for the Pyramid Lake Paiute Tribe. Nevada Water Resources Association River Symposium, November 7, 2013, Reno, NV.

Chief, K., Cozzetto K., K. Dittmer, M. Brubaker, R. Gough, K. Souza, F. Ettawageshik, S. Wotkyns, S. Opitz-Stapleton, S. Duren, and P. Chavan. 2013. Climate Change Impacts on the Water Resources of American Indians and Alaska Natives in the U.S. Climatic Change. Biennial Conference of Science and Management on the Colorado Plateau, September 18, 2013, Northern Arizona University, Flagstaff, AZ.

Mandell, S., O. Anderson, E.S. Chew, K. Chief, A. Serrat-Capdevila, W. Smith Jr., and D.E. Busch. 2013. Resilience to Climate Change: Collaborating on Adaptive Management Strategies for the Pyramid Lake Paiute Tribe. National Congress of American Indians Tribal Leader/Scholar Forum: "Agriculture, Timber, & Water: Sustaining our Natural Resources", June 26, 2013, Reno, NV.

Chief, K., W.J. Smith Jr., A. Serrat-Capdevila, E.S. Chew, D.E. Bush, and A. Bryson. 2014. Tribal climate change resiliency and collaborative water management and adaptive strategies: Pyramid Lake Paiute Tribe. 9th Biennial Association of Natural Resources Extension Professionals Conference, May 18-22, 2014, Sacramento, CA.

Chief, K., E.S. Chew, A. Serrat-Capdevila, C. N. Joseph. 2014. Collaborative and resilient water management planning under climatic and non-climatic stressors for southwestern tribes. University Council on Water Resources Conference, June 19, 2014, Tufts, University in Medford, MA.

Chief, K., E. S. Chew, and A. Serrat-Capdevilla. 2014. Resilience to Climate Change: Collaborating on Adaptive management strategies for the Pyramid Lake Paiute Tribe. Association of Natural Resource Extension Professionals (ANREP) Climate Science Initiative Webinar, March 6, 2014.

- d. Please list any **data outputs, maps, decision-support or other informational tools** developed as part of this project and provide: 1) a very brief description of the product 2) Internet links if applicable.

Educational tool: We developed a video of cui-ui spawning life cycle and Lahontan Cutthroat Trout habitat in Pyramid Lake that is available online.
<https://www.youtube.com/watch?v=1sBAYBMeRFs>

We developed a hydrologic model of Pyramid Lake elevation to serve as a decision-making tool for tribal environmental managers. The model was developed in Microsoft Excel and a copy of the file was delivered to the Tribe in August 2014.

Online information about the project and publications is available at a website we developed at: <http://nativeadaptation.arizona.edu/> and a Facebook page at <https://www.facebook.com/nativeadaptation>

13. **OUTREACH AND ENGAGEMENT:** Describe all project-related outreach opportunities to date.

- a. Please list any **presentations, seminars, webinars, or workshops** made to stakeholders, the public at large, or any other group outside the research community.

We coordinated the “Climate Change Planning Workshop” on September 25, and 26, 2013 with tribal members on tribal land in Nixon, NV in order to gain better insight to climate change challenges from the perspective of tribal members. This workshop also served to identify some management alternatives and solutions that address the challenges.

We have presented twelve times on the project to tribal and non-tribal audiences.

On Friday, August 15, 2014, project PI’s met with the director and staff members of the PLPT Environmental Department to discuss project outcomes and get feedback on the project’s progress.

On Friday, August 15, 2014, project PI’s gave a two-hour long public presentation on project outcomes to PLPT tribal members, agency representatives, and university representatives at the Wadsworth Community Center at Wadsworth, NV.

On Friday, August 15, 2014, project PI’s gave a brief summary presentation to the Pyramid Lake Paiute Tribal Council on project outcomes and recommendations for moving forward.

Chief, K. Climate change impacts on tribal water resources. Native Nations Water Rights Symposium 2012. March 24, 2012. University of Arizona, Tucson, AZ.

Chief, K. 2012, A. Serrat-Capdevila, W.J. Smith Jr. D.E. Busch. 2012. Pyramid Lake Tribal Climate Change Impacts, Vulnerability, and Planning. Pyramid Lake Paiute Tribe, November 19, 2012, Nixon, NV.

Chief, K., A. Serrat-Capdevila, E.S. Chew. 2013. Identifying and prioritizing climate change challenges and potential management alternatives, Pyramid Lake Paiute Tribe Climate Change Planning Workshop, September 25-26, 2013, Nixon, NV.

Chief, K., A. Serrat-Capdevila, E.S. Chew, W.J. Smith Jr., and D.E. Busch. 2014. Collaborative & Resilient Water Management and Planning under climatic and non climatic stressors. Pyramid Lake Paiute Tribal Climate Change Workshop August 19, 2014, Wadsworth, NV.

Chief, K. 2014. Collaborative and resilient water management and planning under climatic and non-climatic stressors: Pyramid Lake Paiute Tribe. Navajo Climate Change Workshop, August 19, 2014, Twin Arrows, AZ.

Chief, K. and K. Cozzetto. 2014. Climate Change Impacts on Tribal Water Resources. Webinar Presentation for the Tribal Climate Change Webinar Series, Institute for Tribal Environmental Professionals, June 9, 2014.

Chief, K., E.S. Chew, A. Serrat-Capdevila, W. Smith Jr., and D.E. Busch. 2014. "Climate Change Vulnerability of Native Americans in the Southwest: A Case Study of Tribal Climate Adaptation Among the Pyramid Lake Paiute Tribe" Webinar Presentation for the National Climate Change and Wildlife Science Center (NCCWSC), October 14, 2014.

Chew, E.S. and K.Chief. 2013. Climate change vulnerability of Native Americans in the Southwest. GEOG696O Adaptation and Resilience in Water Resources Systems (Instructor: Christopher A. Scott), Guest Lecture, October 7, 2013, University of Arizona, Tucson, AZ.

- b. **Communications with decision-makers**, including their name and agency and the date(s) and frequency of your communications. Information on whether the decision-makers were involved in the design of the project plan or if the research has been tailored to address a specifically stated management need is also helpful.

Several tribal environment program managers participated in monthly to quarterly conference calls. Over the course of the project the primary liaison between the PI's and the tribe has changed three times. Olin Anderson, Water Quality Standards Specialist, served in this position from September 2012 to November 2013. Autumn Bryson, Environmental Department Director, served in this capacity from November 2013 to July 2014. Currently Kameron Morgan, Water Quality Standards Specialist, has been the main point of contact. We have also been coordinating with Brian Wadsworth, Water Quality Manager, in order to have our research agreement submitted for approval by the Tribal Council. The communication and exchange with Tribal officers has been frequent, constructive and has created a good collaborative research environment between scientists and the Tribe. Both sides seem satisfied with the nature of the research process and we all look forward to the prospect of its continuation.

- c. Are you aware of any **resource management decisions** that have come out of this project? If so, please provide a brief description.

Not yet.

14. **OTHER** project impacts, outcomes, or communications not discussed above.

Dr. Alison Meadow and Milton Bluehouse, Jr. are no longer collaborating on the project.

15. **BUDGET:** Briefly describe the budget, with particular emphasis on changes to the budget that was submitted in the original proposal. Please discuss reasons for substantial budget modifications or why funds have not been spent as expected.

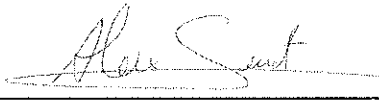
There are no significant changes in the budget and budget expenditures are as expected. However, Alison Meadow left the project and the amount budgeted for her work (\$7,641.30) is re-allocated to fund Edward Schuyler Chew in 2014 for 2 additional months of funding.

Submitted by:

(Project PI name)

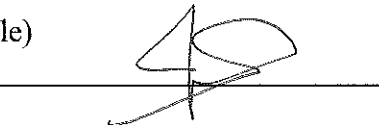
 1 / 26 / 15

(Project Co-Principal name(s))

 1 / 30 / 15

Reviewed by:

Jonathan T. Overpeck, Award PI (if applicable)
University of Arizona

 2 / 6 / 15

Stephen T. Jackson, SWCSC Director, USGS

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Forwarded to USGS: (USGS POC) 1 / 1 / 15