



QUICK RESPONSE REPORT

Analyzing Tribal Drought Management: A Case Study of the Hualapai Tribe

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The views expressed in the report are those of the authors and not necessarily those of the Natural Hazards Center or the University of Colorado.



Introduction

Despite significant improvements in weather forecasting and warning systems, government programs, public education, and the development of new tools and technologies, the costs resulting from disasters around the world and in the United States are still high and rising, indicating growing societal vulnerability to natural hazards (Changnon et al. 2000; Wilhite 2000; Bender 2002). A similar trend of increasing vulnerability exists with droughts (Changnon 1993; Changnon 2000), illustrated by recent (since 1998) droughts across the United States. Parts of Florida, Georgia, South Carolina, Texas, and Hawaii experienced four consecutive years of drought from 1998 through 2001, the East Coast experienced a crippling drought in 1999, and the

Northwest and northern Rockies faced a severe drought in 2001. During 2002, severe and extreme drought existed along parts of the East Coast and in most of the Rockies and High Plains from Montana to Arizona and Texas. Drought persisted across much of the West during 2003 and 2004, with improvements in 2005. Meanwhile, severe drought developed in parts of the Midwest and southern Mississippi Valley in 2005.

Native American reservations are as susceptible to drought as nontribal regions, if not more so (National Drought Policy Commission 2000). Tribes are often faced with unique cultural, political, and technical issues that must be taken into account when planning for and dealing with drought conditions. Therefore, this research project focuses on better understanding tribal drought management

issues. The Hualapai Tribe in northwestern Arizona was selected for investigation. Not only is the tribe emerging from a multiyear drought, but it has also recently completed one of the first tribal drought mitigation and response plans in the southwestern United States (i.e., the Hualapai Tribe Cooperative Drought Contingency Plan [Christensen 2003], hereafter referred to as the Hualapai Drought Plan).

Background on the Hualapai Tribe

The Hualapai Tribe consists of approximately 2,000 tribal members that are governed by an elected nine-member tribal council (Christensen 2003). According to the Center for American Indian Economic Development (CAIED 2003), the primary portion of the reservation consists of 993,083 acres along 108 miles of the Colorado River and the Grand Canyon in Arizona. The tribal headquarters are located in Peach Springs, Arizona, at the southernmost boundary of the reservation. The tribe also has three satellite reservation parcels, consisting of approximately 1,063 acres near Peach Springs and Wickiup, Arizona.

Occupying part of three northern Arizona counties, Coconino, Yavapai, and Mohave, the reservation's topography varies from rolling grassland to forest to the rugged canyons of the Colorado River (ITCA 2003). Elevations range from approximately 1,175 feet at the Colorado River to more than 8,500 feet on the eastern portion of the reservation, and the climate is generally mild and arid with annual rainfall of approximately 11 inches per year (Christensen 2003).

According to the 2000 U.S. Census, of the 1,353 tribal residents identified in the census, the median age on the reservation is 23.9 years and average per capita income is \$8,147 per year (as compared to an average of \$21,587 for the United States). Roughly 18 percent of the eligible civilian labor force over 16 years old is unemployed and 36 percent of families live in poverty status. Governmental-based public administration and education, health, and social service jobs provide the largest share of employment opportunities on the reservation. However, the tourism/recreation industry is a close third. In general, the principal economic activities on the reservation revolve around tourism, cattle ranching, timber sales, and arts and crafts.

In terms of tourism, several tribal enterprises offer recreational activities: Grand Canyon West provides tourists with bus tours along the west rim of the Grand Canyon; the Hualapai Lodge of-

fers lodging and meals to tourists; Hualapai River Runners offers one- and two-day rafting trips on the Colorado River; the Hualapai Wildlife Conservation Department sells big game hunting permits for desert bighorn sheep, trophy elk, antelope, mountain lion, and other animals; and the Hualapai Arts and Crafts Enterprise produces local craft goods (ITCA 2003; CAIED 2003).

Selection of the Hualapai Tribe

The Hualapai Reservation has experienced drought conditions for several years. As recently as February 2005, portions of the reservation were depicted as being in "severe drought" by the U.S. Drought Monitor (<http://drought.unl.edu/dm/>). Even though the spring and summer of 2005 brought much needed rainfall, the region was still depicted as being "abnormally dry" as of January 1, 2006. During the time of our field research, the region was in the drought recovery stage, which was a good time to conduct drought-related research, while the issue was still on the minds of tribal officials.

The U.S. Department of the Interior Bureau of Reclamation (BOR) also recommended the Hualapai Tribe for inclusion in the study because they recently completed the first tribal drought plan to be fully processed to Congress through BOR's Lower Colorado Region (Mullis 2005). The BOR felt that this was a drought planning process that should be studied and documented. Complementing our study, the National Drought Mitigation Center (NDMC) had previously been approached by the BOR about participating in a test of the Hualapai Drought Plan. Combining research on the effects of drought on the Hualapai Reservation and their drought planning efforts, along with a test of their drought plan, seemed an efficient research approach. Ultimately, the research yielded a deeper understanding of tribal drought impacts and planning.

Research Objectives and Methodology

The objectives of this research were to conduct interviews on the drought-affected Hualapai Reservation to 1) gather perspectives on drought impacts; 2) assess the range of drought planning measures implemented, including the development of their drought plan; 3) assess cultural, political, and technical barriers to drought planning and response; and 4) identify lessons learned that could be used to improve drought management in the future. The intention of this research is to provide a specific

case study of drought impacts and management on a reservation, highlight concerns that are unique to reservations, and stimulate additional research and drought planning among Native American tribes.

In order to initiate the project, the Hualapai tribal chairman was contacted to ask about their willingness to participate. He granted permission to conduct research on the Hualapai Reservation from October 3-6, 2005. During the field study, drought perceptions were obtained through key informant interviews in compliance with research guidelines outlined by the University of Nebraska Institutional Review Board (IRB # 2004-02-157 EX). An informed consent document, describing the purpose of the research and the rights of a research subject, was reviewed by the interview participants and signed before the start of each interview. The interviewing process followed a face-to-face, semistructured format based on a list of open-ended questions.

Interview subjects were chosen based on their knowledge of drought management issues on the Hualapai Reservation. Study participants included federal and tribal officials familiar with the effects and management of drought on the reservation. They were identified with assistance from the Hualapai Department of Natural Resources. In total, 11 participants were interviewed as part of this project. The information obtained from these interviews was evaluated to summarize and highlight tribal drought management issues.

In addition to the interviews, the research team also participated in a test of the Hualapai Drought Plan, which had recently been submitted to Congress. The test involved a roundtable discussion with tribal representatives on the development and implementation of the drought plan.

Selected Research Findings

Drought Monitoring

According to the Hualapai Drought Plan, the tribe receives precipitation data from several nearby sources, including weather stations at the Thornton Tower and Kingman airport, Peach Springs and Grand Canyon West meteorological stations, and the Seligman weather station. The tribe also periodically monitors surface water springs, streams, and catchments; has begun to monitor municipal groundwater well levels; and assesses trends in range conditions. Despite the available monitoring data, the tribe has some difficulty measuring drought, especially meteorological drought.

When interview participants were asked the duration of the recent drought, answers ranged from 5 to 15 years. There were also many different perspectives about whether or not the region was out of drought. There was a good deal of confusion about how to calculate and interpret drought indices, such as the Standardized Precipitation Index and the Palmer Drought Severity Index, which are necessary for activation of the Hualapai Drought Plan. Admittedly, interview participants felt that more expertise was needed in this area, and that additional monitoring stations may be necessary to fully document drought conditions on the reservation. Currently, drought conditions are assessed by consensus in weekly meetings instead of strictly following the protocol outlined in the Hualapai Drought Plan.

In order for the tribe to better understand and monitor drought occurrence on the reservation, the research team recommended that the tribe investigate the acquisition of additional weather monitoring stations, conduct research to better understand drought indices, develop their own drought indicators from their own local observation network, and conduct research on the historical occurrence of drought on the reservation to help them assess drought conditions. In addition, it may be beneficial to develop a periodic drought monitoring report to keep a broader group of tribal officials and members updated on current drought conditions. Establishing links with the Monitoring Subcommittee of the Arizona Governor's Drought Task Force may also help to advance the tribe's drought monitoring capabilities and ensure that local drought conditions are appropriately reflected in state and national monitoring products, such as the U.S. Drought Monitor.

Recent Drought Impacts

Although the exact length of the drought was difficult to identify, tribal officials cited a broad range of drought impacts experienced during the recent event. The primary impacts reported include increased number of wildfires, road closures due to fire threat, forage reduction and problems with invasive species, heavy culling of cattle, supplemental hay and water hauling, wildlife and cattle deaths, increase in wildlife disease, loss in quality of trophy bighorn sheep and elk, reduction in hunting permits issued, loss of wetlands and riparian habitat, wind erosion and visibility problems, and increased operating expenses for a local river rafting business (i.e., raft motor and pontoon replacements).

In terms of the monetary effects associated with these impacts, cattle district members on the reservation reduced their herds by 30 percent in 2001-2002 as a result of drought, which resulted in nearly \$500,000 in economic losses by 2003 (Christensen 2003). The Hualapai Drought Plan states that the tribe lost more than 40 head of elk and 30 cattle in 2002 alone (Figure 1). According to interview participants, the entire tribal herd of approximately 500 cattle was sold in 2003 because of the increasing costs associated with supplemental water and feed.¹

Figure 1. Cattle deaths in 2002 on the eastern portion of the Hualapai Reservation



Source: Hualapai Department of Natural Resources.

Another example of the drought's monetary effects involves big game hunting. The Hualapai Reservation is a popular destination for hunters seeking desert bighorn sheep, Rocky Mountain elk, pronghorn antelope, mountain lions, and turkeys. According to interview participants, the number of permits issued has been decreased as a result of recent drought. For example, in 2004-2005, the number of bighorn sheep permits was reduced from 6 to 4, and the number of turkey permits was reduced from 60 to 30. The permits are expected to be reduced again in 2006. Any fluctuation in hunting permits represents a substantial economic loss when the cost of a bighorn sheep permit is \$27,820 (plus a \$5,000 minimum guide fee), a bull elk permit is \$14,500 (plus a \$2,000 minimum guide fee), and a turkey permit costs \$327.

Finally, as shown in Figure 2, around 10,000 tourists per year enjoy Colorado River rafting trips operated by Hualapai River Runners (a part of the Grand Canyon Resort Corporation), which is the only Indian-owned and operated river rafting company on the Colorado River (Arizona Department of Commerce 2005). The company provides a portion of their earnings to the Hualapai Tribe. According to

interview participants, although the number of tourists has not been substantially reduced because of drought conditions, operating costs have increased. Because of low river levels on the Colorado River, the company was forced to relocate their rafting extraction point to a less desirable and more expensive site because of increased transportation costs (from Pearce Ferry to South Cove).

In addition, heavier sediment loads in the river and sandbar collisions damaged 40-50 motors in 2004 at a cost of \$4,000-\$5,000 each. Several pontoons were also damaged at a cost of \$10,000 each. An interview participant reported that the drought had caused an estimated five percent increase in total operating costs. Of course, not all losses during drought are economic. Interview participants also stated a number of anecdotal negative effects on wetlands, springs, riparian habitat, wildlife, and individuals, which can never be truly calculated.

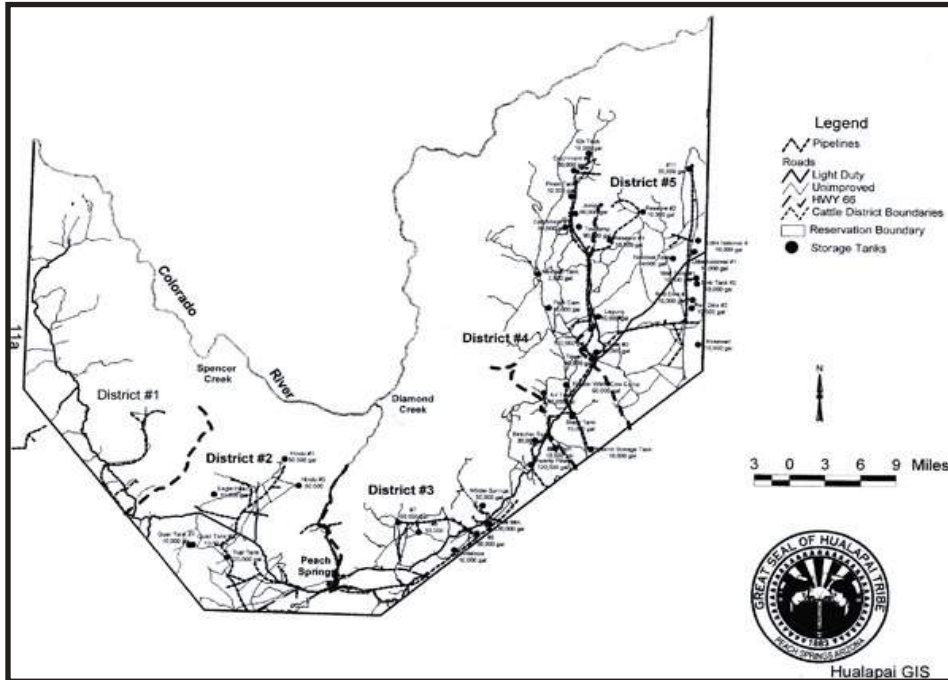
Figure 2. Hualapai River Runners rafting service on the Colorado River



Hualapai Drought Mitigation and Response

In recent years, the Hualapai Tribe has undertaken several efforts to mitigate and respond to drought on the reservation. According to the Hualapai Drought Plan, the tribe has developed multiple sources of water across the reservation over the last 10 years through a system of wells, pipelines, and storage tanks (Figure 3). According to participant interviews, they are also restoring the old Peach Springs pump house and pipeline for use as a secondary water supply source for the community of Peach Springs (Figure 4) and have used NRCS funding to enhance natural springs in the area (Figure 5). During times of drought, water is also hauled throughout the reservation to meet the needs of livestock. According to the drought plan, water is typically delivered from Peach Springs to four sites within each cattle district every other day during

Figure 3. Storage tanks and water pipelines on the Hualapai Reservation



Source: Christensen 2003.

Figure 4. Original Peach Springs cistern that could serve as a supplemental water source for the city of Peach Springs



Figure 5. A natural spring that has been renovated and pooled



severe drought. Although these activities help to reduce the impacts of drought, the tribe stresses that more effort is needed to more fully prepare for drought. For example, the drought plan cites a need for a new hydroelectric dam, the repair and purchase of above ground storage tanks and wells, the purchase of two used water trucks, and the cleaning and repair of earthen dams.

In addition to securing their water resources, the Hualapai Tribe has also been working to reduce water demand and enhance their range and habitat conditions. According to interview participants, the tribe has used Bureau of Indian Affairs Woodland Improvement

Program funds to remove water-hungry tamarisk (salt cedar) and other exotic species and to enhance native species. They also utilize a range monitoring program to help document changes in range conditions and make informed management decisions. The monitoring methods include trend plot analysis, photo site plots, and vegetation utilization studies (Querta 2003). Based on this information, the tribe recommended destocking rates to cattle districts during the last drought period. However, according to interview participants, ranchers within each of the five cattle districts ultimately make their own stocking decisions, and management methods vary by district (i.e., some ranchers are more proactive in dealing with drought than others). To further assist ranchers during the recent drought, the Hualapai Department of Natural Resources also helped locate supplemental hay sources off the reservation, and the tribal government provided financial assistance for the hay purchases.

As mentioned previously, the tribe has also taken measures to protect tourism revenue and wildlife, which are interconnected because big game hunting is an important revenue source for the tribe. To protect wildlife, the tribe has had to closely monitor trends in the number of game species and adjust the number of hunting permits issued each year. According to survey participants, wildlife “drinkers” have also been installed in more remote portions of the reservation to enhance available water

supplies (Figure 6). Some ranchers are also attempting to seek compensation for damage done to fences by wildlife and for cattle feed that is consumed by big game animals.

Figure 6. Installing remote wildlife “drinkers” by helicopter in 2005



Source: Hualapai Department of Natural Resources

Similarly, the Grand Canyon Resort has had to modify their operations to deal with the ongoing drought. As mentioned previously, they were forced to relocate their rafting extraction point, and they have had to retrain rafting guides on how to navigate the Colorado River when flows are low. They also increased their marketing and outreach during the drought years and are trying to diversify their operations to bring in additional revenue sources and reduce their risk of being affected by phenomena such as drought and wildfire.

Although the Hualapai Tribe and their associates have undertaken a number of drought mitigation and response actions in the past, until recently, they have not had a coordinated plan detailing specifically how they would prepare for and respond to drought.

Hualapai Tribe's Cooperative Drought Contingency Plan

In order to reduce the effects of future drought, the Hualapai Tribe completed a drought contingency plan in 2003, funded by a cooperative agreement with the BOR. The Hualapai Tribe's Department of Natural Resources provided local leadership in developing the plan.

According to interview participants, a lead planner first undertook the process of developing the plan but soon realized that a collaborative effort

was necessary to gain a broader understanding of potential drought mitigation and response measures appropriate for the reservation. Therefore, community meetings were held along with an iterative process of review among relevant tribal officials to inform tribal members of the process, gain feedback on the document, and foster “buy-in” to the project. Although there were some initial communication issues and negotiations to work through with tribal elders and between groups responsible for implementing the plan, all interview participants commented that the end result was a good collaborative planning process that met most of the participants' needs. Although some participants felt that there was more work to do on the plan (e.g., omit some unnecessary actions and address gaps), all thought that it was a good starting point for addressing drought on the reservation.

Specifically, the drought plan provides information on the physical and social characteristics of the reservation, highlighting sectors that are most vulnerable to the effects of drought (i.e., municipal water, tourism, cattle, wildlife, wildfire, and forestry). The plan then outlines a drought monitoring protocol that is to be used in assessing drought and activating drought response stages (i.e., normal, alert, warning, and emergency levels). Depending on the stage, the plan outlines mitigation and response actions that are to be carried out by the responsible tribal agency. In addition, the plan lists external local, state, and federal agencies that could also assist in drought mitigation and response. Finally, the drought plan identifies a number of short- and long-term capital improvement projects that are needed to reduce the tribe's vulnerability to future drought (e.g., Diamond Creek Hydroelectric Dam, the repair and purchase of above-ground storage tanks and wells, the purchase of water trucks, and the cleaning and repair of earthen dams). The plan is to be reviewed and amended as needed every two years.

Test of the Hualapai Nation Drought Contingency Plan

To assist in the review of the Hualapai Drought Plan, a drought exercise was held on October 5, 2005. The NDMC facilitated the exercise with several tribal and federal authorities taking part. All tribal agencies responsible for carrying out actions outlined in the drought plan were invited to the exercise, along with the BOR, who helped fund and review the plan. Tribal agencies represented at the meeting included the Department of Natural Resources; Water

Resources Program; Department of Public Works; Tribal Forestry; Range Water Program; Wildlife, Fisheries and Parks Program; Agriculture Program; Air Quality Program; and Grand Canyon Resort Corporation.

During the drought exercise, tribal and federal representatives were asked to discuss recent drought impacts on the reservation, review their respective mitigation and response obligations outlined in the plan and comment on their usefulness and relevancy for reducing impacts, and go through a range of potential drought scenarios to ensure that everyone understands the proper response protocol. The exercise helped to educate new tribal representatives on their role and responsibilities before and during times of drought, yielded information on barriers that need to be addressed to fully implement the plan, and provided suggestions to help the Hualapai Tribe improve their drought plan.

Barriers to Fully Implementing the Hualapai Drought Plan

The drought exercise identified a number of specific barriers that may affect the implementation of the Hualapai Drought Plan:

- The Hualapai Tribe's drought monitoring capabilities are limited, and the plan's strategy for determining when to initiate actions may not be appropriate in all circumstances. The plan also does not provide a strategy for declaring when a drought is over and specific actions can cease.
- There is a lack of funds and/or personnel to carry out activities and construct improvement projects outlined in the plan. For example, tribal officials felt that additional funds were needed to restore private wells; expand and maintain water delivery and storage systems; implement programs, such as one aimed at removing feral livestock; and charter helicopters for surveying and installing equipment in remote areas.
- The drought plan states that water could be hauled to Peach Springs during times of drought if necessary. To carry this out, the City of Peach Springs would need to determine a backup source of water and acquire a water truck to haul water to the city during a shortage.
- The drought plan states that the City of Peach Springs will implement a water conservation plan during times of shortage, but the water conservation plan has not yet been finalized.
- Tribal council authority is needed to carry out some management decisions outlined in the plan

during drought, such as closing portions of the reservation during wildfires and modifying animal harvest schedules, which can take time and involve political conflict.

- There is a lack of readily available personnel and materials to maintain wildlife troughs and other water sources and construct adequate storage for wildlife feed.
- There is a need for additional training among cattle owners on how to prepare for and deal with drought, and among tribal managers on how to control animal disease on the reservation.
- The region lacks a timber market, which would be helpful when thinning and removing unhealthy timber stands.
- Some activities and sectors identified as vulnerable to drought, such as tourism, could be more adequately addressed. There are cases when mitigation and response actions have not been identified for potential vulnerabilities.
- It may be difficult to get all tribal, federal, and state drought representatives together on short notice to hold management meetings during times of drought.

Generally, the identified barriers revolve around a need for funding and personnel to carry out identified mitigation and response activities; a lack of training and education to understand and implement concepts outlined in the plan; not having the infrastructure or plans fully in place to carry out designated activities; the need to identify additional mitigation and response actions; and the political and organizational difficulties involved in getting people together and forming a consensus on action items.

Recommendations for Improving Drought Management on the Hualapai Reservation

In addition to recommending that the previous barriers be addressed, some specific suggestions were identified during the test for improving the Hualapai Drought Plan and for general drought management on the reservation:

- Enhance tribal drought monitoring capabilities by developing additional weather monitoring and fuel moisture stations along with a more detailed historical climatology for determining appropriate drought triggers.
- Address air quality issues in the drought plan by enhancing air quality monitoring (i.e., measuring particulate concentrations and utilizing photos/

webcams of visibility at Grand Canyon West) and reporting through community articles and news sources, such as *Gamyu*, the local newspaper.

- Shift some management authority during drought from the Tribal Council to other relevant tribal agencies.
- Add the monitoring of static well levels to the drought plan as one of the responsibilities of the Department of Public Works to ensure that monitoring is done in the future and the effects of drought on city water supply supplies are documented.
- Hold additional workshops and classes on the reservation to help educate the public and tribal managers on select topics outlined in the drought plan.
- Publish a periodic reservation drought/water supply report in the *Gamyu* newspaper.
- Develop a strategy for downgrading drought levels in the drought plan.
- Continue to seek funding for water supply improvement projects and the implementation of other drought-related programs.

It should be made clear that the Hualapai Tribe has made great strides in developing a drought contingency plan. These recommendations are offered as constructive criticisms to make a good planning process even better. Drought planning is an ongoing process that must be revisited on a regular basis. A drought plan is meant to be a living document that is relevant for the current needs of a place or entity. According to the Hualapai Drought Plan, the plan is to be updated every two years. These reviews will provide an avenue for continually addressing concerns and suggestions, such as those posed during the recent drought exercise.

Recommendations and Lessons Learned for Other Drought Planners

During interviews, tribal officials were also asked to provide general recommendations and lessons learned that may benefit other drought planners:

- Develop a drought plan to better understand drought, coordinate efforts to prepare for and deal with drought, and become more autonomous in declaring drought conditions. It was felt that the general process undertaken by the Hualapai Tribe worked well and that others should follow a similar approach.
- Ensure a collaborative planning effort from the

start. Drought planning is too complex a topic for one person to do it all. Bring all of the different players to the table early in the planning process.

- Initiate a public education/discussion component early in the process to inform the public and other officials about the need for a planning process, address contentious issues, and increase project buy-in. Foster a clear, open, and transparent process. Community meetings and articles in the local newspaper were seen as beneficial during this process.
- Focus the drought plan around three components: monitoring, vulnerability assessment, and risk management. This means developing a system to understand the physical nature of drought (frequency, duration, and extent), understanding how and why a place or sector is vulnerable to drought, and implementing a range of actions to mitigate and respond to drought.
- View drought mitigation from a long-term, holistic perspective. For example, the focus should be on long-term, sustainable development that takes into account factors such as economic and community development, water resources development, and land management issues. Do not focus only on drought response.
- Consider the location in respect to the rest of the region and state. The entire region is affected by drought, and there are lessons to be learned from others. Establishing a “network of collaboration” is necessary to effectively plan for and deal with drought.
- Make sure the drought plan does not end up on a shelf. Ensure that the relevant agencies are aware of their roles as outlined in the plan, and that the plan is periodically tested and updated.

Conclusion and Acknowledgments

The goal of the NDMC is to assist in reducing society’s vulnerability to drought. In these efforts, the NDMC frequently consults with states, tribes, and other water planners on drought planning issues, publishes information about drought planning, and conducts drought planning workshops across the United States and overseas. Information gained from this quick response project will enable the NDMC to provide tribal and other interested drought planners with more specific information to use in their drought planning activities.

The NDMC would like to thank the Natural Hazards Center at the University of Colorado at Boulder and the U.S. Bureau of Reclamation’s Lower

Colorado Region for providing funding and insight on this project. The NDMC also owes a debt of gratitude to the Hualapai Tribe for their willingness to openly share their knowledge. The tribe should be commended for being a leader in developing drought plans. Their efforts not only benefit their local people and environment but also provide an important example for others to follow. By continually striving to improve and implement their plan, they are making an investment that will help protect their way of life and the land upon which we all depend.

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Notes

¹Previously, the tribal government had owned a herd of cattle, which was managed by Grand Canyon Resort Corporation. Individual tribal members also own cattle on land leased from the tribe, which are managed through five cattle associations across the reservation.



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