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Climate change perception, observation and policy support in rural Nevada: A comparative analysis of Native Americans, non-native ranchers and farmers and mainstream America

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ABSTRACT

As climate change research burgeons at a remarkable pace, it is intersecting with research regarding indigenous and rural people in fascinating ways. Yet, there remains a significant gap in integrated quantitative and qualitative methods for studying rural climate change perception and policy support, especially with regard to Native Americans. The objectives of this paper are to utilize our multi-method approach of integrating surveys, interviews, video, literature and fieldwork in innovative ways to: (1) address the aforementioned gap in rural studies, while advancing knowledge regarding effective methodologies for investigation of linkages between socio-political variables and climate change perceptions; and (2) perform comparative primary research regarding the climate change assumptions, risk perceptions, policy preferences, observations and knowledge among rural Nevada's tribes and tribal environmental leaders, non-native ranchers and farmers, and America's general public. The results of this study have ramifications for similar populations in arid and semi-arid lands, particularly in the U.S. Southwest.

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1. Introduction

Major climate change perception surveys have been conducted in the U.S. within the last 20 years (Bord et al., 1998; O'Connor et al., 1999; Krosnick et al., 2000; Leiserowitz, 2005, 2006; Kellstedt et al., 2008; Brody et al., 2008; Leiserowitz et al., 2009; Malka et al., 2009; McCright, 2010; McCright and

Dunlap, 2011a,b). Pew Research Center (2010) polls found that 57% (2009) and 59% (2010) of Americans believed that global warming was occurring. From 2006 to 2008 Pew reported 70–79%. Meanwhile, survey data from Borick and Rabe (2010) varied from 69% to 75%. Related surveys have also been conducted on a state-scale, for example, concerning Michigan and Virginia (Dietz et al., 2007; Shwom et al., 2008, 2010), New Hampshire (Hamilton, 2010), and

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Virginia, California, Mississippi, and Pennsylvania (Borick and Rabe, 2010).

Fewer studies have focused on rural American climate change perceptions. Hamilton and Keim (2009) surveyed nineteen rural counties in nine states and noted a significant perception-temperature influence. Coles and Scott (2009) conducted seventeen interviews in Arizona, and found that the major perceived climatic risks were drought, floods, and frosts, and that farmers and ranchers continued to rely on past experiences and short-range forecasts as adaptive strategies. While Arbuckle et al. (2013) studied farmers' beliefs in climate change in the Midwest.

2. Methods

In this paper we explore perceptions, knowledge and preferences regarding climate change with less-powerful actors who have an intimate connection to their local, and sometimes extreme, Nevada environment. Supporting their voices is important, as Sachs (1993) and others have indicated that the way potential “multifaceted dangers to mankind” are often wrapped-up in high level discourse may bring the major players at the table (i.e. UN mega-conferences), but the result can be a merging of views that can mute the smaller actor and calls for necessary radical change. A mixed-method approach can capture the views of these actors (Supplemental detailed discussion of our study communities and regional climate change predictions are located in Appendix A).

2.1. Video

Through “Community Based Participatory Methods” (CBPR) we engaged in fieldwork with the Summit Lake Paiute Tribe (SL) and Pyramid Lake Paiute Tribe (PL), including a rare opportunity to film the spawning of the Lahontan Cutthroat Trout. Found only in Nevada's mountainous northwest corner, its viability under future climate change scenarios spurs deep tribal concern (Figs. 1–5, and video by Smith and Fruth, 2012). The tribes were interviewed on camera and had editorial input, raising salient climate justice issues that attracted the interest of academic, governmental, tribal, NGO, and other actors in areas such as professional training, research, and education (Figs. 6 and 7) (2013 *Environmental Politics*). This research output provided information used throughout this paper, helped us to scope which research questions would be important to address through our survey construction, highlighted important questions to pursue regarding climate observations, and culturally and geographically contextualized the scenarios examined. While our linkages to broader literature helped ensure ‘broader impacts,’ the CBPR approach ensured local relevance with regard to the outputs produced. Buy-in to this process was partially fueled by groups' desires to understand what their own ‘public’ perceived and would also support in relation to climate change impacts, policies, and adaptation, and also to give voice to vital observations that they believed were being made by local persons, but were not being considered by outsiders.

2.2. Surveys

To study tribal climate and risk perceptions, assumptions, knowledge and policy preferences in relation to climate change we primarily researched three NA groups and ranchers/farmers (RF) (the RF were non-Native American). Tribal groups included the SL, PL, and environmental managers (EM) of tribes across Nevada (ITCN, 2014). Surveys were tied to the literature at the time of creation, utilized Likert scale, open-ended and other formats, with outputs transformed into Access and spatial databases. Our survey analysis integrates, but is not limited to, t-tests, unstructured and semi-structured interview analysis, geostatistics (most of which do not appear in this paper) and basic statistics. Information from our interviews, video and field observations facilitated survey interpretation.

The EM survey response rate was 54% ($N = 24$). The EM represent statewide tribal governmental perspectives, knowledge, and action plans. Respondents were from various Native American tribes. Their views are crucial, powerfully influencing tribal perception, policies, and planning. We also conducted PL tribal-wide surveys on its general public, with a response rate of 20% ($N = 549$). We targeted tribal households through mail and house-to-house surveys distributed by a tribal member undergraduate researcher (Headwaters Economics, 2012). SL research focused on interviews with a core group of six tribal leaders and fieldwork. The RF survey achieved a 26% response rate ($N = 481$), solid for a survey-resistant group and lengthy survey (Fig. 8).

3. Results and discussion

3.1. Profiles

Table 1 shows that EM have much in common with the RF community in terms of education, and both groups have major land and water management responsibilities. The relative similarities in formal education between the EM and RF groups may reduce the difference in this one important variable for comparative analysis across subgroups, but not necessarily across major differences in informal education. We crystallize the demographic and political profiles of our study groups in Table 2, and also note their fundamental perceptions regarding the existence and origin of climate change and its associated priority level.

RF were 73% Republican, 14% Democrat, 10% independent and 2% other and no party ($N = 436$). Underscoring the contrast, they are 43% very conservative, 33% conservative, 16% middle of the road, 7% liberal, and 1% very liberal. PL is 52% Democrat and only 5% Republican ($N = 103$); whereas, 7.8% are independent with 9.7% “other party.” Interestingly, 24% indicate no interest in politics.

Differences in RF and PL perspectives do not reflect major income disparities. Sixty-two percent of all RF who responded to our surveys earn between \$0 and \$25,000, with virtually no one making greater than between \$100,000 and \$150,000 annually ($N = 425$). And with the PL having 46% between \$0 and \$25,000 and virtually no one making greater than \$120,000 ($N = 99$).

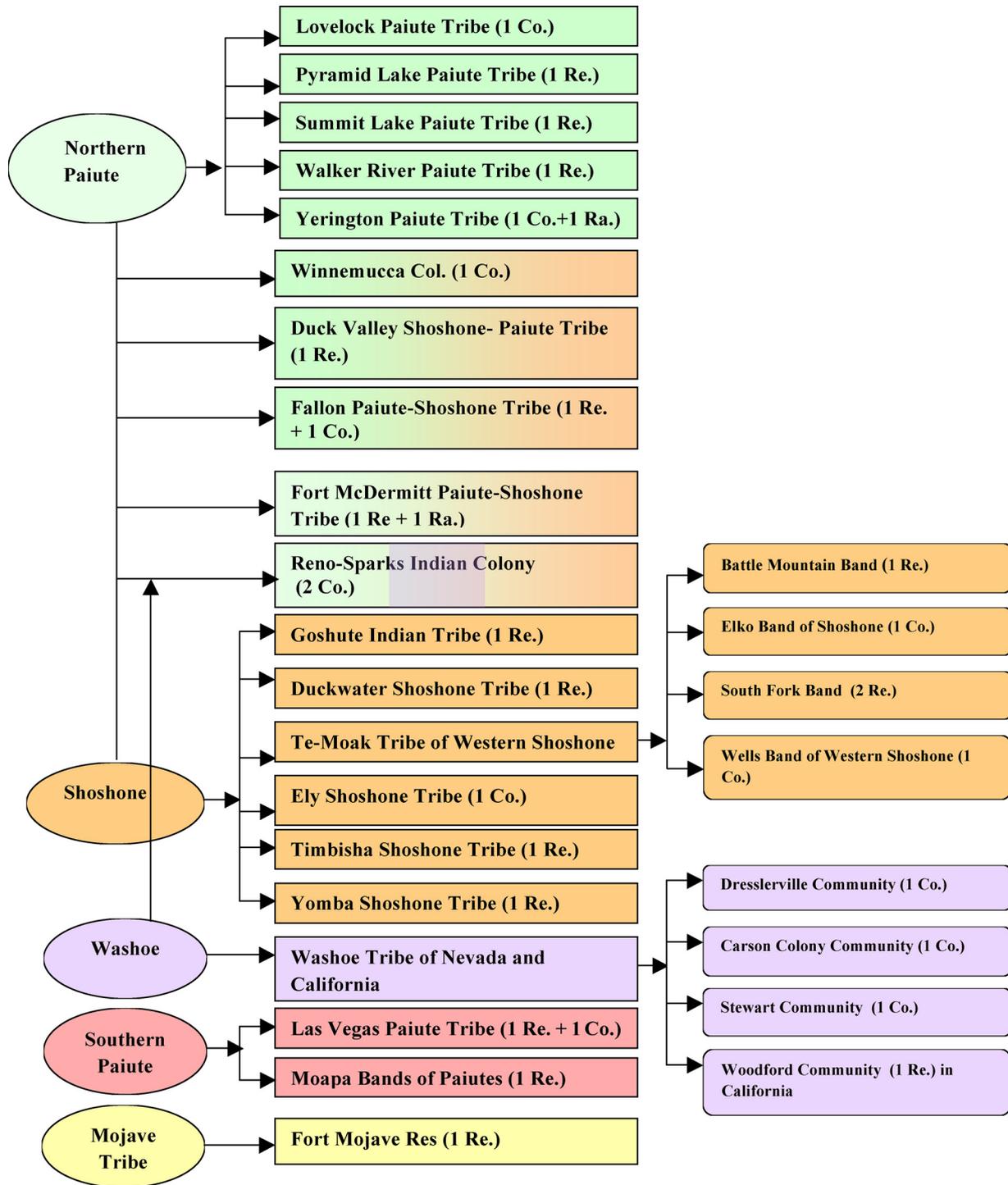


Fig. 1 – Nevada’s tribes and bands. Re., Reservation. Ra., Ranch; Co., Colony.

Public opinion and risk perception regarding climate change are increasingly important in environmental policy and management modifications (Brody et al., 2008; Leiserowitz, 2005). Selected outputs of our research regarding opinion, risk perception, knowledge and policy support are highlighted below (see also Safi et al., 2012 for a more specific focus on risk). Quotes leading subsections are important, as they give relatively unfiltered voice to the character of qualitative responses to questions. The sections below explore

timing, impacts, drought, sector analysis, space and time, observations, policy and voluntary action, and trust in government with regard to climate change.

3.2. Belief in climate change

PL
It impacts my life and my family’s life in ways that we cannot measure, there are changes happening faster than expected.

Nevada's Native American Reservations

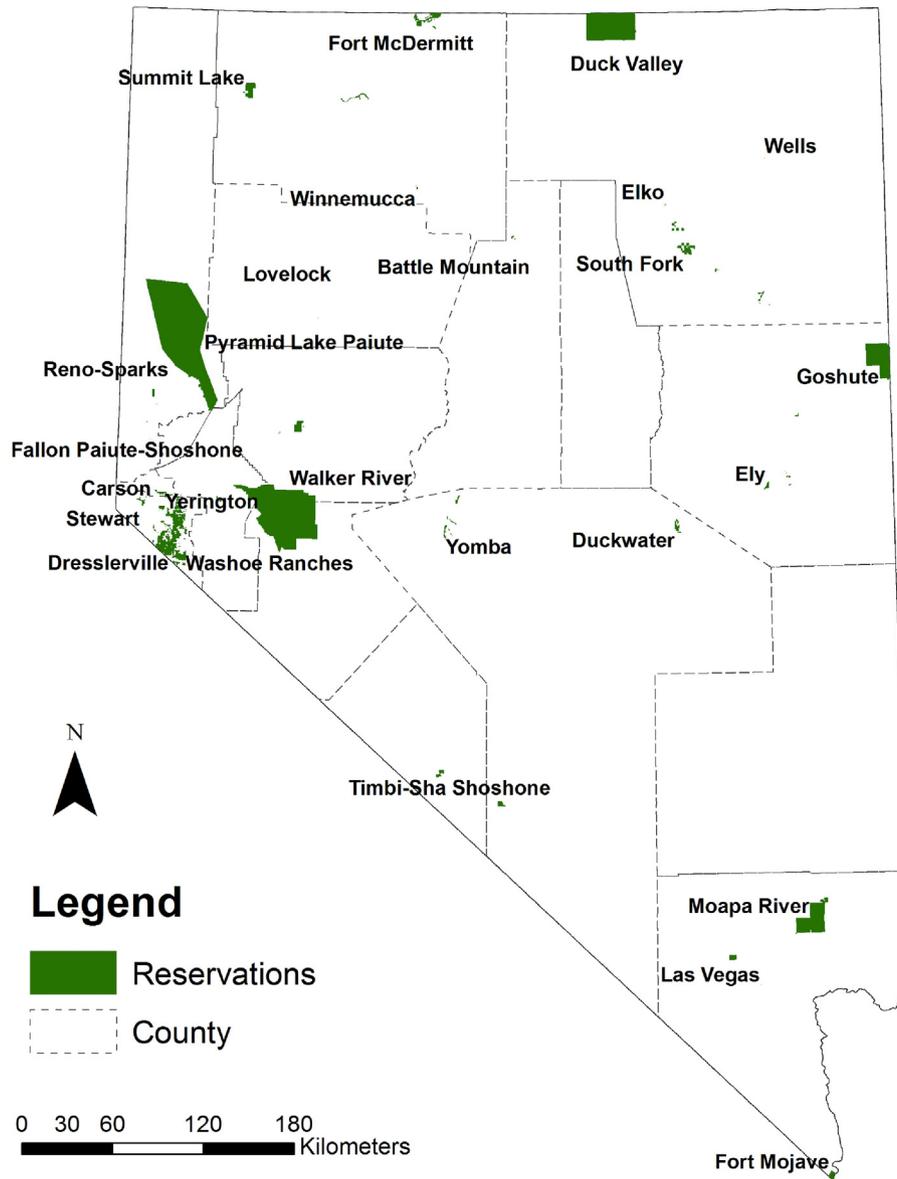


Fig. 2 – Nevada's Native American Reservations.

RF

There are many local changes due to land use changes. At larger scale there are effects from sunspots, magnetic field strengthens seafloor and terrestrial volcanism; changes in h/t of earth axis among the factors that occurring cycles that sometimes overlap and strengthen their respective effects. No one yet explained very well the difference between variation and change across a suite of scales.

... there is a major debate in the scientific world about climate change. Not enough info to support either sides claim... We know it's hot.

It is caused by elections, policy makers/scientists looking to redistribute wealth.

...even cooler in the summer than 30 years ago. The morons in Washington DC...

How many people and manufacturing plants were here when the dinosaurs disappeared?

The only absolute authority on the future assures me that "seed time and harvest will continue as long as the world remains" Genesis 8:22 (God).

PL sources of climate change information are dominated by television. About 48% of respondents receive information from television, 10% from Internet sources, 8% from radio (N = 106). References to newspaper-based consumption are only 5%, with scant reference to tribal-based news or tribal climate change literature. RF also mostly receive information from television (61%), though more tap the Internet (22%) and radio, which is often conservative in rural Nevada (29%) (N = 481). The percentage of RF consuming information through newspapers is over double that of PL at 11%, with several mentions specifically of the Wall Street Journal, and it is interesting to



Fig. 3 – SL indigenous fishing methods.



Fig. 4 – Threatened Lahontan Cutthroat trout running tiny Mahogany Creek during spawning. An event the tribe is concerned could be impacted by climate change.



Fig. 5 – Mr. William Cowan, Summit Lake Paiute Tribe, lent through a USFW program allowing tribal members work on tribal land.

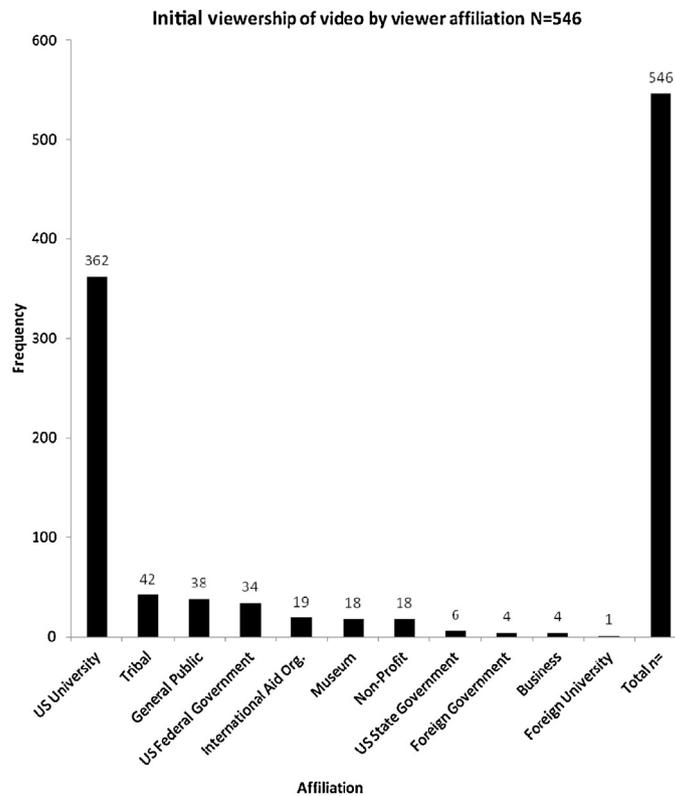


Fig. 6 – Initial video viewership by affiliation.

note several mentions of “reading, reports, magazines” and “all.” Both groups report only minimal consumption of government or NGO pieces and technical reports.

Beliefs regarding the status of climate change and the role of human activity in creating it are found in Figs. 9 and 10. The fundamental questions regarding the existence of climate change, and if human activity is playing a significant role, are answered in the affirmative by about 3/4 of PL respondents (N = 99). Only a small percentage of PL respondents lie at the extremes of perceiving human activity as either playing the only, or zero, role in climate change (7% each). While 100% (N = 14) of EM believe that climate change is happening and greenhouse gases are a cause. Only 60% of Nevada’s farmers and ranchers agree that we are in a period of climate change,

and a mere 29% believe that human activity is playing a significant role, whereas, [Arbuckle et al. \(2013\)](#) reported 66% and 41% for Midwest farmers.

Along the same lines, [Biello \(2013\)](#) notes a corn farmer and an economist for the Iowa Farm Bureau arguing that climate change always happens, but rejecting human causality. At least some U.S. ranching and farming leaders share this view. The author quotes American Farm Bureau Federation spokesman Mace Thornton as stating, “We’re not convinced that the climate change we’re seeing is anthropogenic in origin. We don’t think the science is there to show that in a convincing way” (Internet).

A t-test reveals clear differences between PL and RF in terms of whether they believe that we are in a period of climate change. Answers ranged from 1 Strongly disagree, 2 Disagree, 3 Not decided, 4 Agree, to 5 Strongly agree.

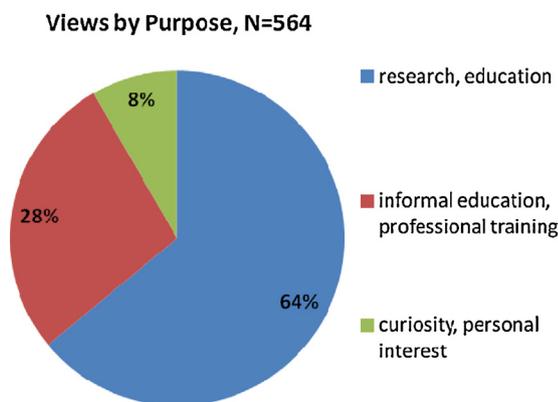


Fig. 7 – Video views by purpose.

Group	N	Mean	Std. dev.	DF	t-Value	P-value
RF	470	3.47	1.20			
NA	98	3.87	1.02	158	-3.39	0.0009

Another t-test shows a significant difference between the views of PL and RF regarding whether human activity has been playing a significant role in recent climate change. Answers ranged from 1 Strongly disagree, 2 Disagree, 3 Not decided, 4 Agree, to 5 Strongly agree.

Group	N	Mean	Std. dev.	DF	t-Value	P-value
RF	467	2.55	1.37			
NA	99	3.99	1.04	179	-11.85	<0.0001

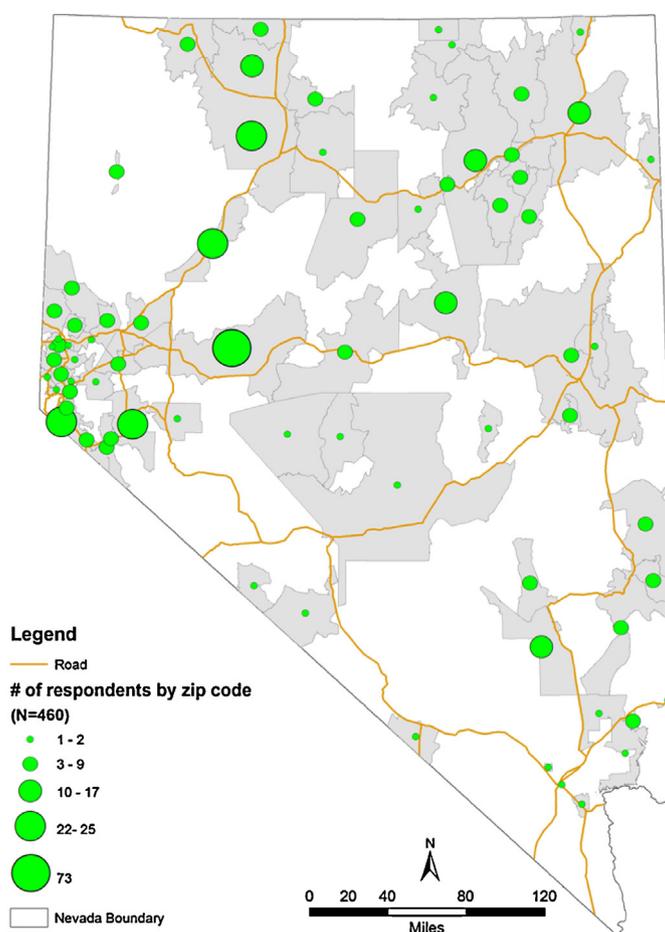


Fig. 8 – RF survey responses.

Table 1 – Formal Western education.

Study group	N	Middle school (%)	High school (%)	Some college (%)	2-year college (%)	4-year college (%)	Master degree (%)	Advanced degree (%)	Ph.D. degree (%)
Environmental managers	11		9	9	9	46	9	18	
Ranchers and farmers	476	1	18	23	9	33	9	5	2
Pyramid Lake Paiute Tribe	99		39	28	15	10	7	1	

Because our data is more robust for the RF community, we performed additional analysis on this fundamental issue. We studied responses to two statements: (1) “I believe that we are in a period of climate change;” and (2) “I believe that human activity has been playing a significant role in recent climate change.” The scale ranged from (1) Disagree, (2) Not decided, to (3) Agree.

Such factors as gender, marital status, and education had moderate effects on an individual’s scientific knowledge of climate change. *The strongest factors influencing one’s acceptance and knowledge of climate change were partisan affiliation and political ideology.* Spearman’s rank correlation test showed that party and political ideology were significantly correlated ($r = 0.47$, $P < 0.0001$, $N = 421$). Both Democrat and independent RF were more likely than Republicans to believe that we are in a period of climate change. Democrats were over four times as likely to perceive that human activity has been playing a significant role in recent climate change.

Such strong associations were not observed for any other categories except political ideology, wherein political ideol-

ogy was significantly correlated with political party affiliation. This is consistent with previous research on the partisan gap in climate change opinion nationwide (Dietz et al., 2007; Pew Research Center, 2007; Borick and Rabe, 2010; McCright and Dunlap, 2011a,b). Further, Spearman’s rank correlation analyses between party affiliation and these two climate change knowledge variables statistically validated the polarization ($r = 0.21$, $P < 0.0001$, $N = 414$ for party and #1; and $r = 0.42$, $P < 0.0001$, $N = 412$ for party and #2). Very similar significant Spearman’s rank correlation coefficients were identified between party and Statement #1 ($r = 0.30$). The correlation coefficient between party and cause of climate change from this research was nearly the same as that from a Gallup survey in 2008 (Pearson correlation coefficient of 0.344) (Dunlap and McCright, 2008).

A greater percentage of women than men believed that climate change is happening (69–58%), and that it is mainly caused by human activities (45–24%). The overall relationship between gender and scientific knowledge of climate change

Table 2 – Population and climate statistics.

Variable	Coding	Pyramid Lake PT			Farmer/rancher		
		N	Mean	Std. dev.	N	Mean	Std. dev.
Age	Number in years	100	47.4	15.06	474	61.8	13.27
Gender	1 (female) to 2 (male)	104	1.39	0.49	478	1.74	0.44
Marital status	1 (single/divorced/widowed) to 2 (married)	101	1.41	0.49	475	1.84	0.37
Education	1 (less than high school) to 4 (Bachelor's degree or higher)	99	2.8	0.73	476	3.3	0.78
Party affiliation	1 (Republican), 2 (Democrat), 3 (independent), 4 (other), 5 (no party)	101	2.96	1.36	436	1.44	0.85
Political ideology	1 (very liberal) to 5 (very conservative)	83	2.86	0.83	456	4.11	0.96
Annual household income	1 (less than \$25,000) to 4 (more than 1 million \$)	97	1.78	0.9	425	1.72	1.06
In a period of climate change	1 (disagree) to 3 (agree)	98	2.64	0.63	470	2.4	0.82
Cause of climate change: role of human activity	1 (disagree) to 3 (agree)	99	2.65	0.64	467	1.75	0.88
Climate change as a national priority ^a	1 (high priority) to 3 (low priority)	99	1.37	0.63	474	2.42	0.76
Personal importance of climate change	1 (not important) to 2 (important)	95	1.87	0.33	454	1.69	0.46
Perceived climate change impact index ^b	Index (0–4) = average of the eight variables	92	2.84	1.17	433	2.25	0.92

^a Climate change as a national priority for EM was N = 11, mean = 1.07, and std. dev. = 0.27.

^b Coding for eight variables of perceived climate change impacts: 0 (don't know), 1 (not at all) to 4 (a great deal).

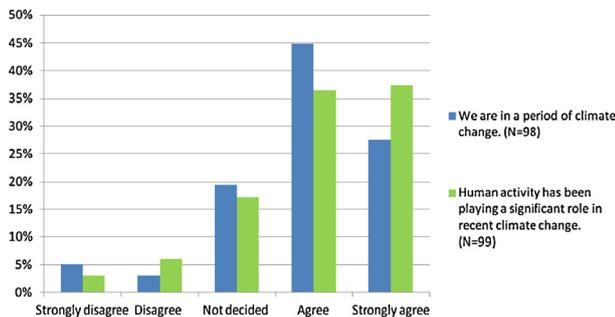


Fig. 9 – PL: Occurrence and origins of climate change.

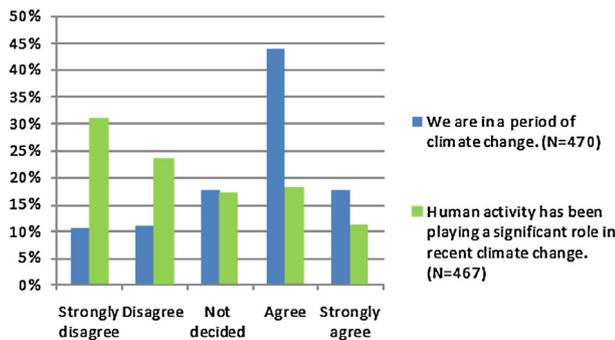


Fig. 10 – RF: Occurrence and origins of climate change.

(Statement #1) was significant with gamma $G = 0.18$ (Goodman–Kruskal Gamma; $N = 468$; $P = 0.03$). The gamma G was 0.23 ($N = 313$; $P = 0.03$) and -0.09 ($N = 155$, $P = 0.29$, non-significant). For Statement #2 and gender, Nevada female ranchers and farmers hold more scientifically accurate

knowledge about climate change than do their male counterparts (Goodman–Kruskal Gamma; $N = 464$; $G = 0.30$; $P \leq 0.001$). Moreover, G was 0.30 ($N = 464$; $P = 0.004$), respectively. This is consistent with the findings on climate change for national surveys from McCright (2010), (Goodman–Kruskal Gamma, both $P \leq 0.001$), but is diametrically opposed to what has been found with other measures of environmental knowledge (i.e. Arcury et al., 1987; Hayes, 2001).

Gender was correlated with political ideology ($r = 0.20$, $P < 0.0001$, $N = 455$) and party ($r = 0.15$, $P = 0.002$, $N = 421$). To assess the relative importance of political variables (political ideology and party) vs. gender, we calculated the gamma G between climate change knowledge variables and political ideology and party. The G was 0.46 ($N = 414$, $P < 0.001$) and 0.67 ($N = 412$, $P < 0.001$) between party and Statements #1 and #2, respectively. For political ideology and Statements #1 and #2, the associations were much more profound, G being 0.48 ($N = 448$, $P < 0.001$) and 0.73 ($N = 445$, $P < 0.001$), compared to the paragraph above. Thus, the gender divide in climate change knowledge was not overwhelming, although statistically significant, compared to differences based regarding such demographic variables as political ideology and party (Dunlap and McCright, 2008; McCright, 2010).

3.3. Prioritization

Americans' awareness of "global warming" or "climate change" has generally risen since the 1980s (although they perceive risk as limited and distant temporally and spatially). However, the rise has been uneven (Leiserowitz et al., 2009, 2010; Leiserowitz, 2005, 2006; O'Connor et al., 1999; Bord et al., 1998). Leiserowitz (2003) notes that in 1989 70% of Americans viewed climate change seriously, and by 2003 that percentage rose to 92%. However, in recent years belief in

Table 3 – Prioritization of climate change.

	Environmental managers (%)	Pyramid Lake Paiute Tribe (%)	Ranchers and farmers (%)
<i>Personal scale</i>			
Extremely important		18	8
Very important		27	17
Somewhat important		43	44
Not important at all		12	31
Total		100 (N = 96)	100 (N = 454)
<i>US scale</i>			
Top priority	36	18	3
High priority	57	53	13
Medium priority	7	21	25
Low priority	0	1	30
Not a priority	0	7	29
Total	100 (N = 14)	100 (N = 99)	100 (N = 474)

the anthropocentric link and risk has dipped. In 2010, 57% of American adults felt climate change was happening, compared to 71% in 2008. Only 53% believed in an anthropogenic trigger (complete or partial) in 2010, compared to 62% in 2008.

Comprehending the priority assigned to climate change by stakeholders increases the understanding of potential policy support. We explore the priority attached to climate change at personal, tribal and national scales.

Our survey shows that climate change ranks third in the list of key environmental problems identified by EM. A strong 93% find it to be a high to top priority at the national scale, 7% a medium priority (Table 3). At a personal scale, PL responses were that 45% felt that climate change is very to extremely important. Nationally, 71% found it a high to top priority, 21% a medium priority.

RF responses at a personal scale were a mere 25% very to extremely important, and 44% somewhat important, which is similar to national data (N = 454). Also, 31% said that the issue was not important at all, whereas, Leiserowitz et al. (2009) showed a much lower percentage nationally at 11%. Significant relationships were found between the perceived importance (regrouped at two levels) and party affiliation, political orientation and gender (Goodman–Kruskal Gamma; $G = 0.64, 0.84, \text{ and } 0.45$, respectively; all $P < 0.0001$). Republican, conservative and male ranchers and farmers indicated climate change as unimportant to themselves.

RF responses at the national scale were 16% for a high to top priority, 25% a medium priority, and nearly a third (29%) not a priority – more than four times the PL response. To provide context, top and high priority responses in national surveys by Leiserowitz et al. (2009) and WorldPublicOpinion.org (2009)

were 21% and 33%. The low priority responses also compare to 17% from the same Leiserowitz survey.

The relationships between perceived priority level and the demographic variables of party, political ideology, and gender were all strongly significant (Goodman–Kruskal Gamma; $G = 0.66, 0.78, \text{ and } 0.41$, respectively; all $P < 0.0001$). The Gamma test shows significant relationships. While perceived priority level is not significantly related with age, education, or income. Republican, conservative and male ranchers and farmers tended to view climate change as a low national priority – which is discouraging in terms of potential policy support.

Another t-test at the personal scale also reveals significant differences between PL and RF groups. Answers ranged from 1 Not at all important, 2 Somewhat important, 3 Very important, to 4 Extremely important.

Group	N	Mean	Std. dev.	DF	t-Value	P-value
RF	454	2.01	0.89			
NA	96	2.51	0.95	133	−4.7	<0.0001

Meanwhile, a t-test at the U.S. scale manifests a significant difference between the PL and RF. Answers ranged from 1 Top priority, 2 High priority, 3 Medium priority, 4 Low priority, to 5 Not a priority.

Group	N	Mean	Std. dev.	DF	t-Value	P-value
RF	474	3.68	1.13			
NA	99	2.26	1.01	154	12.46	<0.0001

3.4. Timing

From 2008 to 2010 the percentage of Americans who thought that the people in the U.S. were being harmed now by climate change decreased from 34% to 25%, while the percentage of Americans who thought that the U.S. will never be harmed increased from 15% to 23% (Leiserowitz et al., 2010).

However, a majority of tribal members that we surveyed were aware of climate change and agree that human activity plays a significant role in it, and many were concerned about impacts in the short-term and beyond. PL tribal members mostly (51%) perceive that climate change is impacting them now, with 32% unsure of the timing, which is close to RF 36% (Table 4), while 100% of EM believe that impacts are occurring now.

The percentage of RF respondents believing that they are being harmed now is about half that of PL (27%), which is close to the national percentage reported above, with around 1/3 being unsure, and 1/4 anticipating never experiencing impacts. Also, 1/3 anticipate harm either now or within the next ten years (27% and 5%). RF findings are lower than Leiserowitz et al. (2009) in their national study (34% present

Table 4 – Time frame of climate change impacts.

Group and time frame	Now (%)	10 years (%)	25 years (%)	50 years (%)	100 years (%)	Never (%)	Unsure (%)
Pyramid Lake Paiute Tribe (N = 96)	51	7.3	5.2	1	2.1	1	32.4
Ranchers and farmers (N = 444)	27	5	4	1	3	24	36

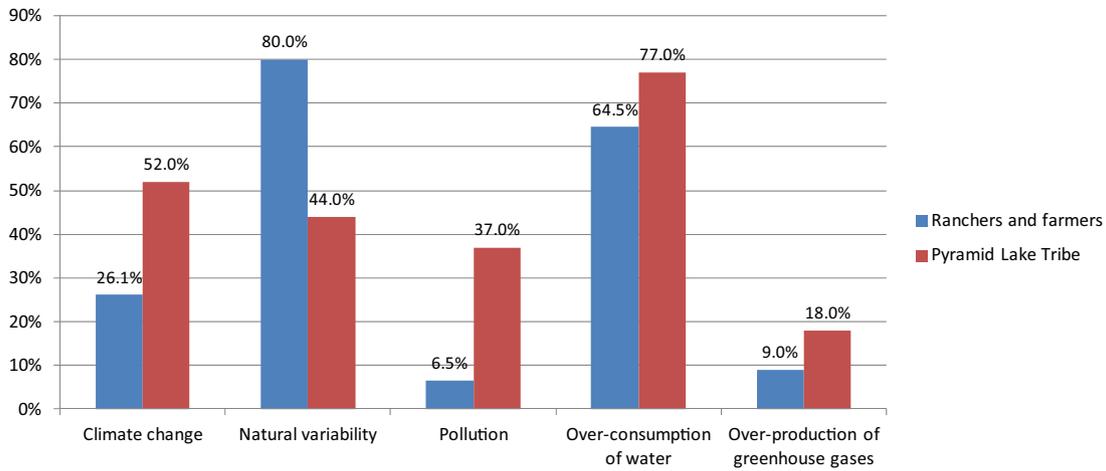


Fig. 11 – PL (N = 100) and RF (N = 479) beliefs regarding the causes of Nevada’s drought.

tense, 13% future tense), and significantly lower than PL at 58%. Within the larger RF dataset we did not identify any significant statistical relationships between the perceived timing variable and age, gender, party affiliation, or political orientation (Goodman-Kruskal Gamma tests). We found that 65% of self-identified liberal farmers and ranchers (N = 34) said that climate change is harming people now, while those percentages for conservatives, Democrats, and Republicans were 21% (N = 327), 51% (N = 59), and 22% (N = 296). Sixty-eight percent of conservatives (N = 327) and Republicans (N = 296) selected “Never” or “Not sure.”

We highlight that 3/4 of RF stated that impacts will “never happen” or are “not sure” (VS. PL at about 1/3). Thus, approaching this subgroup for support of policies based on future-tense arguments is not likely to be effective.

3.5. Perceptions of impacts

EM

I think climate change has impacted the tribe because we do not have enough water for our plants and animals. If we don't have these resources we don't have anything.

It reverses the progress that has been already made especially litigiously by law and mandate and through many management changes.

PL

Less water for our lake, vegetation in areas of the reservation have dried up, aquifers have dried up. I remember waist deep snow (adult) years ago. We are lucky to get ankle deep snow these days. Springs are no longer there on the reservation, less game available and less native medicines to gather.

I think that the earlier melt off and runoff of snow packs are happening because of warmer weather in winter season. Increased wildfires because of drier, hotter summers.

RF

Who is to say that it would not be beneficial? Longer growing season. Maybe it would snow more...and the water table would rise. Being taxed to death to pay to correct it and give money to developing countries... is what's going to harm my family and business.

Late 1800s ice was harvested from rivers and lakes for summer – not done since 1910s.

Less snow pack in the mountains, more water rainfall with resulting lower summer water runoff and insufficient storage to hold the winter moisture.

Less irrigation water due to reduced snowpack. Increase in insect populations due to milder winters. Changes in pollination due to timing of bloom & effects of heat on the bloom – setting of fruits and vegetables. ...mandatory irrigation pump interruption.

I don't know if the continued domestic use increase is the cause or less snow pack.

We had to let 2 fields sit idle in 2009 because we didn't have water in Rye Patch Dam.

Loss of plants species is already hurting the honey bee populations and changing weather patterns and moisture patterns are already affecting crop production. ...wells 90% dry.

I believe climate change is coming to the point we are planning to move, change lifestyle.

3.5.1. Drought

As some of the quotes above underscore, the powerful drought that has struck Nevada and the surrounding region of the U.S. is the easiest mental link to make from climate change to concrete local phenomena, and thus, the impacts of drought may strongly influence climate change policy support. Fig. 11 reveals that 52% of PL respondents find climate change directly responsible for drought, which is double the RF percentage, with demand-side abuse of water a major contributor (77%). And, 93% of EM (N = 14) believe that Nevada is suffering severe drought linked to climate change.

Only 26% of the RF community blame climate change for drought. Natural variability dominates thinking at 80%. Demand-side mismanagement of water is also a major issue (65%).

3.6. Sector analysis

Figs. 12 and 13 represent sector analysis data regarding sectors that may be impacted by climate change. Concerns regarding

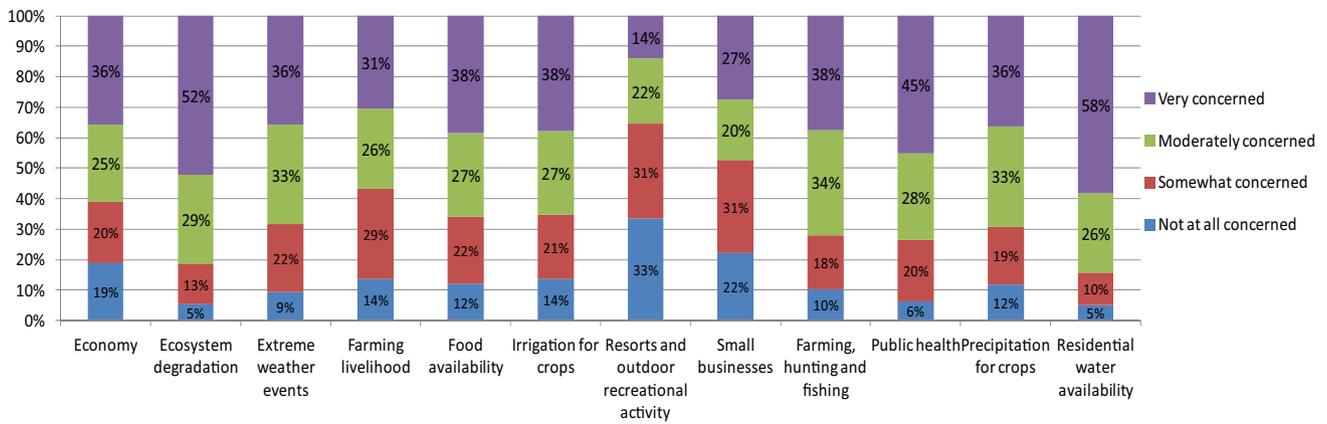


Fig. 12 – PL perceptions of potential impacts by sector (N = 96).

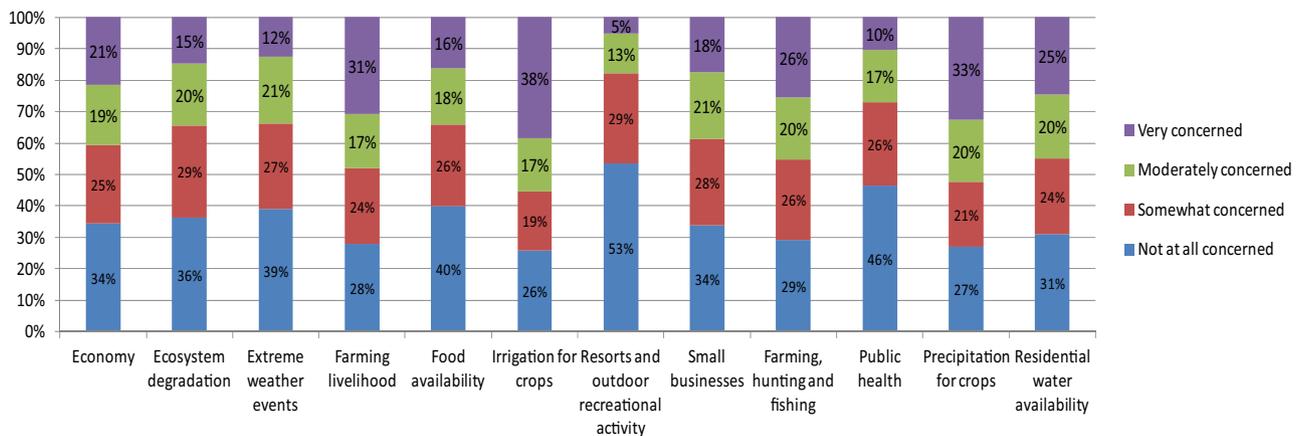


Fig. 13 – RF perceptions of potential impacts by sector (N = 439–444).

sustainable water supplies for residents, ecosystems and public health lead for PL. And, concerns regarding food exist for over 1/3. Business concerns hover just below 1/2.

Our figures regarding RF community responses manifest 35% “Not at all concerned” and 21% “Very concerned” responses on average across the board. This makes for a stark comparison to the 13% “Not at all concerned” and 37% “Very concerned” PL responses. Responses for all categories in the “Very, Moderately, Somewhat,” and “Not at all concerned” ranges are often more symmetrical for RF than PL. Though, rather interestingly, responses are identical regarding the linked themes of farming livelihood and irrigation of crops in the “Very concerned” category. Nevertheless, there is approximately a 10% spread between the study groups in terms of “moderate concern” in both cases (RF communities representing the smaller percentage). Especially large gaps exist between the RF and PL in terms of being “Very concerned” in the areas of “Ecosystem degradation” (15% and 52%), “Extreme weather events” (12% and 36%), “Food availability” (16% and 38%), “Public health” (10% and 45%), and “Residential water availability” (25% and 58%).

We conducted t-tests, including an index, analyzing the difference between the PL and RF views regarding, “To what extent you are concerned about the following areas being impacted by climate change in Nevada.” We discovered

‘significant’ results. Answers ranged from 1 Not concerned at all, 2 Somewhat concerned, 3 Moderately concerned, to 4 Very concerned:

Group	N	Mean	Std. dev.	DF	t-Value	P-value
<i>(A) Economy</i>						
RF	444	2.27	1.15			
NA	95	2.78	1.13	139	-3.93	<0.0001
<i>(B) Ecosystem degradation (i.e. forests, fisheries, wetlands)</i>						
RF	441	2.13	1.07			
NA	92	3.28	0.89	150	-10.87	<0.0001
<i>(C) Extreme weather events</i>						
RF	442	2.07	1.05			
NA	95	2.95	0.98	144	-7.78	<0.0001
<i>(D) Farming livelihood</i>						
RF	443	2.51	1.19			
NA	95	2.74	1.04	152	-1.89	0.06
<i>(E) Food availability</i>						
RF	440	2.10	1.11			
NA	91	2.92	1.05	135	-6.73	<0.0001
<i>(F) Irrigation for crops</i>						
RF	444	2.68	1.23			
NA	95	2.89	1.07	152	-1.75	0.08

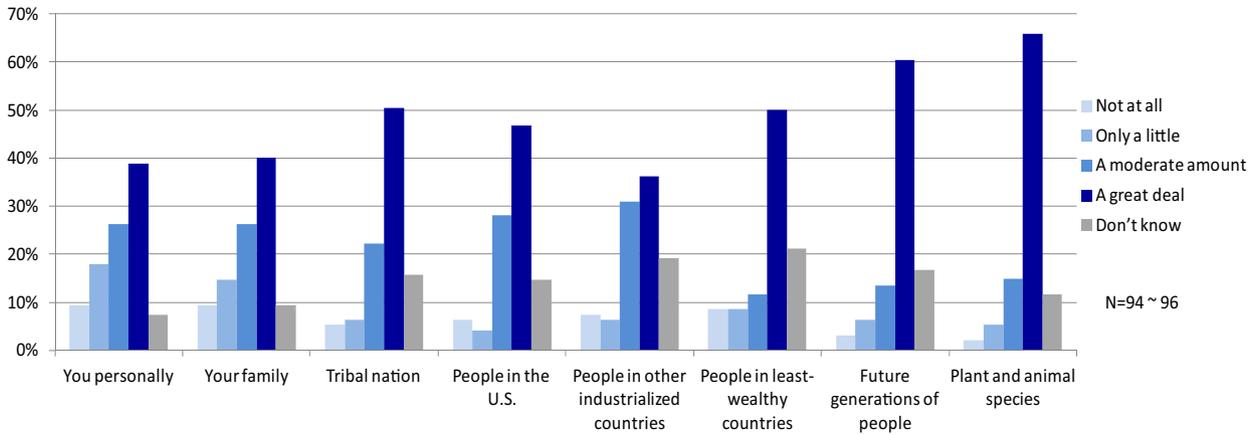


Fig. 14 – PL perceptions of potential impacts by entity (N = 94–96).

(G) Resorts and other businesses related to outdoor leisure activities

RF	440	1.70	0.88			
NA	93	2.16	1.05	121	-4.01	<0.0001

(H) Small businesses

RF	439	2.23	1.10			
NA	95	2.53	1.12	136	-2.38	0.02

(I) Farming, hunting and fishing

RF	442	2.42	1.16			
NA	96	2.99	0.99	157	-4.98	<0.0001

(J) Public health

RF	439	1.91	1.02			
NA	95	3.13	0.95	145	-11.2	<0.0001

(K) Precipitation for crops

RF	440	2.58	1.20			
NA	94	2.94	1.01	154	-2.99	0.0032

(L) Residential water supply availability

RF	440	2.38	1.16			
NA	96	3.38	0.87	177	-9.44	<0.0001

Index (sum of all questions divided by 12)

RF	433	2.25	0.92			
NA	89	2.86	0.71	156	-7.02	<0.0001

3.7. Space and time

Leiserowitz et al. (2009) reported that the majority of respondents from their national survey perceived that global warming or climate change would harm other animal and plant species (62%) or future generations (61%) a great deal or moderate amount, while fewer respondents said global warming would harm them or their families a great deal or moderate amount (32% and 35%). For Americans, global warming or climate change, was a greater threat to other species, people and places far away spatially and temporally, but not to themselves, their families, or communities.

Fig. 14 illustrates that PL tribal members, unlike RF, perceive local impacts of climate change as robust, and there is less uncertainty (“don’t know”) the closer the subject is to the respondent. Although the perception that climate change is going to impact “A great deal” leads all other categories across the board; and as with RF, the more distant and less related groups are even more dominated by a relatively high percentage of such responses.

In Fig. 15 the RF “You personally” and “Your family” responses are proportionately nearly inverse to those of tribal members in terms of expected magnitude of change. In contrast to groups closest to the respondents, people in least-wealthy countries, in the future, and plants and animals are

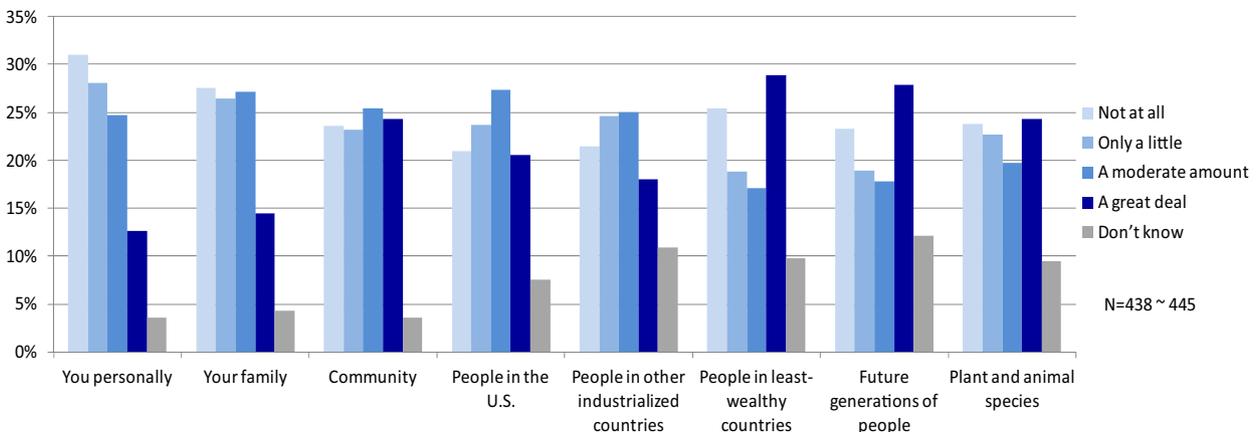


Fig. 15 – RF perceptions of potential impacts by entity (N = 438–445).

far more likely to feel impacts according to the RF community, and there is more uncertainty indicated. Notable are the “moderate” amounts of harmful impacts on people in the U.S., but away from home.

Once again, we conducted t-tests for comparative analysis, including an index. Answers ranged from 1 Not at all, 2 Only a little, 3 A moderate amount, 4 A great deal, to 5 Don't know. When analyzing the difference between the PL and RF views regarding “how much you think climate change will negatively impact the following,” we discovered ‘significant’ results found below:

Group	N	Mean	Std. dev.	DF	t-Value	P-value
<i>(A) You personally</i>						
RF	445	2.12	1.09			
NA	95	2.80	1.26	126	−4.91	<0.0001
<i>(B) Your family</i>						
RF	442	2.20	1.12			
NA	95	2.78	1.32	125	−3.98	<0.0001
<i>(C) Your surrounding community</i>						
RF	445	2.43	1.19			
NA	95	2.86	1.48	121	−2.66	0.009
<i>(D) People in the United States</i>						
RF	439	2.32	1.23			
NA	96	2.86	1.44	127	−3.42	0.0008
<i>(E) People in other modern industrialized countries</i>						
RF	439	2.18	1.26			
NA	94	2.57	1.51	122	−2.37	0.02
<i>(F) People in least-wealthy countries</i>						
RF	440	2.30	1.37			
NA	94	2.61	1.65	122	−1.69	0.093
<i>(G) Future generations of people</i>						
RF	438	2.26	1.39			
NA	96	2.98	1.52	132	−4.25	<0.0001
<i>(H) Plant and animal species</i>						
RF	441	2.25	1.31			
NA	94	3.21	1.35	133	−6.28	<0.0001
<i>Index (all questions added together and divided by 8)</i>						
RF	434	2.26	1.05			
NA	92	2.84	1.17	124	−4.37	<0.0001

Finally, in interviews with EM, these tribal leaders identified specific impacts presently occurring due to climate change. Impacts include: changes in animal and plant composition and species loss; challenges to traditional lifestyle; water shortage; and temperature extremes. Yet, our surveys revealed that climate change planning is undeveloped or not developed at all.

3.8. Knowledge, politics, gender

Select findings help disaggregate the more voluminous RF responses with respect to knowledge, politics and gender. Goodman–Kruskal Gamma tests revealed that each of the eight impact categories was significantly related with party (G ranging from 0.35 to 0.45, all $P < 0.0001$), political orientation (G ranging from 0.46 to 0.59, all $P < 0.0001$), gender (G ranging from 0.31 to 0.42, all $P < 0.0001$), and marital status (except for impacts on Americans, G ranging from -0.19 to -0.29 , all P

ranging from 0.001 to 0.03). This indicated that a significantly large percentage of conservative, Republican, male, and married ranchers and farmers perceive that climate change would bring only little or no harmful impacts.

Gender had a statistically significant negative effect. Female RF were relatively more concerned regarding adverse impacts. With the presence of basic demographic (model 1) and agricultural (model 2) variables, only gender was statistically significant. Those two models accounted for 6–7% of the variations in the dependent impact variable (adjusted R^2). When the political variables were introduced (model 3), the gender effect was mediated, although also significant. *Political ideology had the strongest significant negative effect on perceived climate change impact*, indicating that conservatives tended to view climate change as non-harmful. Party affiliation and marital status became significant, reflecting that unmarried and Democratic rural residents were relatively more worried about climate change impacts. The explanatory power of the model was increased to 23% (conversely, it is interesting to note that while only 5 tribal members considered themselves Republican, their lack of support for national policies and initiatives aimed at mitigating climate change was similar to Republican RF, while their observations of climate change impacts remained similar to fellow tribal members).

After the knowledge variable (cause) was added, our model displayed a much stronger effect ($P < 0.001$). The adjusted R^2 increased from 0.23 to 0.47, meaning that the regression model significantly predicted perceived climate change impacts and explained 47% of variations. Climate change knowledge had a strong, positive effect on climate change impact, thus, respondents with greater knowledge about climate change perceived greater negative impacts from climate change. Political ideology and gender remained significant, while their effects dropped to the significance levels of 0.01 and 0.05. Party affiliation and marital status were no longer significant.

The finding regarding the climate change knowledge variable supports the results of two recent climate change studies (Wood and Vedlitz, 2007; McCright, 2010). Also, this was consistent with Hayes (2001), as greater environmental knowledge does not lessen environmental concern. The impact of political ideology was consistent with the findings of from national climate change surveys (Leiserowitz, 2006; Dunlap and McCright, 2008; McCright, 2010; McCright and Dunlap, 2011a,b). Moreover, our research reveals that political orientation is the most important variable. We discovered results for the effect of gender on perceived climate change impacts that were similar to other national climate change public opinion research (i.e. O'Connor et al., 1999; Brody et al., 2008; McCright, 2010).

While we found that only a small percentage of Nevada's RF attribute local changes to climate change, it is noteworthy to those interested in outreach that women show greater concern about climate change and more scientifically accurate knowledge, even after controlling for assessed climate change knowledge, party identification and political orientation. In recent research McCright (2010) presented that women demonstrate more scientifically accurate climate change knowledge. Women show more concern regarding environmental issues, especially those posing local health/safety risks (Brody, 1984; Mohai and Bryant, 1998; Davidson and Freudenburg, 1996; Bord and O'Connor, 1997; Hayes, 2001).

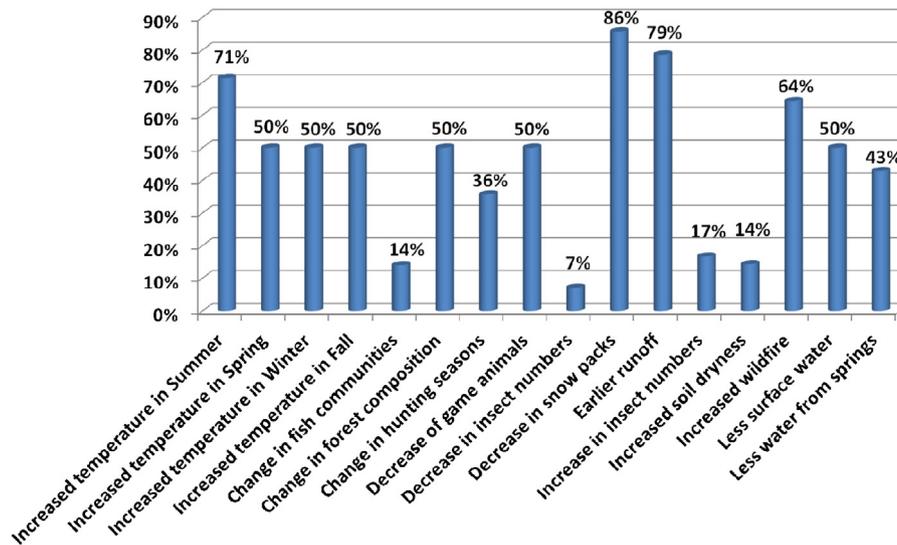


Fig. 16 – EM observations (N = 14).

While an important finding to come out of this paper is that RF women hold a different perception and have greater knowledge of climate change than RF men, the root causes of this gender divide beg further investigation. Another fact is that, generally speaking, PL places a greater value on future generations than RF. We were able to examine potential links between these findings by studying if RF women were more likely to place a value on future generations than RF men, which might partially explain the aforementioned gender gap in the RF communities. And, in fact, further analysis on RF men and women showed that 62.2% (N = 66) RF women and 40.3% (N = 133) RF men were likely to place value on “future generations.” A two-sample t test revealed that in contrast with RF man, RF women were more likely value “future generations” (P < 0.001, t = 4.01, DF = 434).

3.9. Observations

EM

Variability of weather and extremes seem to be more extreme.

...flight patterns of birds and lower water tables that dry up, springs that are frequented by native animals as well as native vegetation that are dying...

There is a creek by my house that flowed after snow every snow runoff. It hasn't had water for the past five years.

Many Native Americans, like RF, spend much of their time on the land and water, possess historical knowledge, and can make important observations. This data, integrated within collaborative research methodologies, may facilitate exchange of information if all parties desire this. Such observations (Figs. 16–18) and priorities may bolster policy support and voluntary actions such as those discussed later in this paper.

Tribal observations match the biophysical modeling (see Appendix A electronic supplementary content). In terms of EM

climate impacts, observations are about 86% for decrease in snow packs and 79% earlier runoff. Increased summer temperatures (71%), are also relevant to regional models. PL records three high marks in the same categories (about 56%, 47% and 56%), and there are also noteworthy percentages for observing less surface water and less spring water (about 72% and 57%). Strong comments were made regarding the movement of plants and animals in the intensifying climate (reflecting modeling in Nevada by Guida et al., 2014).

RF have lower percentages across the board. Close to half note snow pack decrease (48%), and a quarter (24%) note early melting and runoff, with the same for increasing summer temperatures (29%). However, more find less surface water and less water from springs (45% and 37%).

3.10. Policy and voluntary action

RF

The world has been cooling & warming since its existence. There are tree stumps in the bottom of Lake Tahoe proving this. Yes population has added some heating, but man is not going to change what will happen. One large volcano can cause instant global cooling for years. You are not going to change global warming because developing countries who are just getting out of poverty are not going to go backwards in lifestyle and the rich (so called) countries are not going to have enough money to pay for it all. Man will adjust to climate change. I believe we should develop electric cars, solar, wind, and nuclear power plants. This will take many years so we should learn how to burn coal cleanly and use it.

I would do them all to save money – I can't save the planet.

If you can't adapt, you don't deserve to survive, change is inevitable.

O'Connor et al. (1999) reported that by the close of the 20th century most Americans were willing take the voluntary actions to choose more fuel efficient cars (63%), and replace inefficient energy appliances (75%), but only a slight majority support governmental legislation placing taxes on extremely inefficient automobiles (55%). Only a small minority would

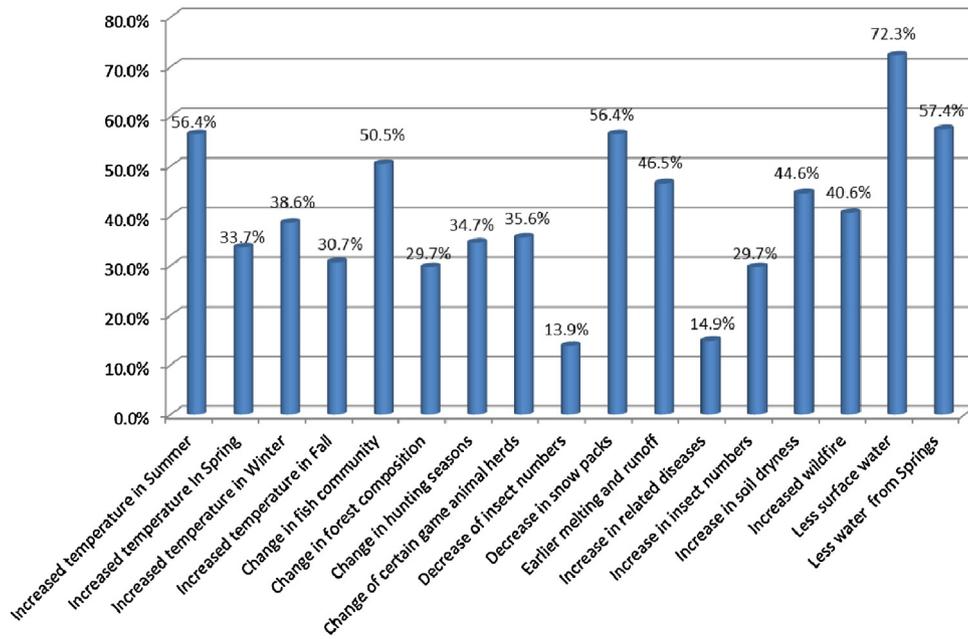


Fig. 17 – PL observations (N = 103).

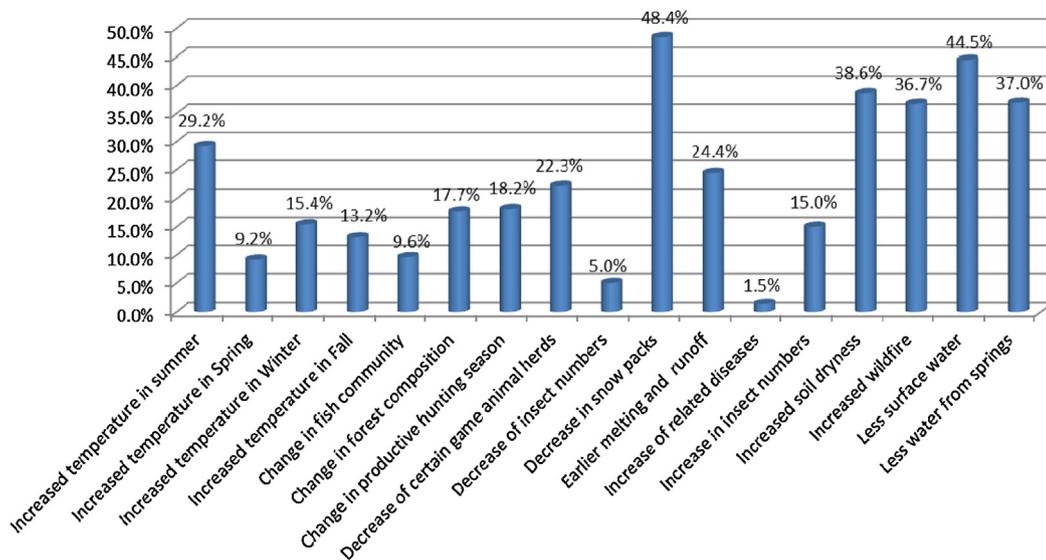


Fig. 18 – RF observations (N = 479).

support taxing gasoline (18%) or businesses (38%). [Leiserowitz et al. \(2009\)](#) reported similar results; as merely 33% of Americans reported they would support taxing gasoline, however, most supported policies such as increasing vehicle fuel efficiency to 45 mpg (79%), subsidizing energy efficient appliances (72%) and increasing utility utilization of renewable energy (72%).

Figs. 19–21 assist in contrasting willingness to engage in voluntary actions to mitigate climate change. PL and RF are somewhat similar regarding the percentage willing to increase the amount of insulation they use (57% and 59%), with EM at

79%. With regard to the installation of light bulbs, the percentages for all were relatively high at 86%, 71%, and 60%. For planting trees, RF, at 53%, once again lags behind EM and PL at about 79% and 64%. Differences were dramatic regarding being willing to use more fuel efficient vehicles at about 93%, 47% and 54% for EM, PL and RF, this being a rare case where percentages for RF are clearly greater than PL. It is also telling regarding the relative ‘hardness’ of their positions, to note that zero EM, about 8% of PL, and 13% RF would do “nothing.” For RF, only actions that saved money as a byproduct earned over 50% support.

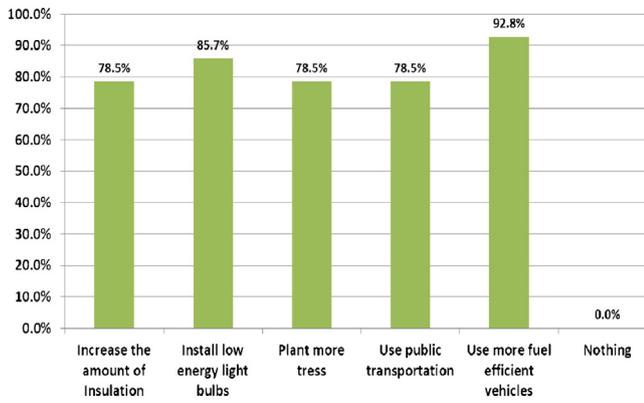


Fig. 19 – EM voluntarily action support (N = 14).

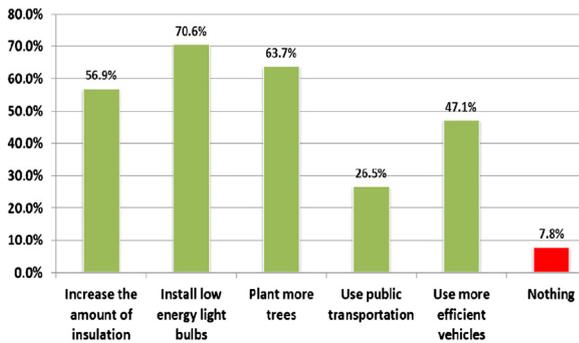


Fig. 20 – PL voluntary action support (N = 102).

Data on climate policy support is found in Figs. 22–24. Renewable energy enjoys nearly 93%, 67% and 69% support by EM, PL, and RF respectively. Education of the public enjoyed support at approximately 86%, 63% and a meager 33% for EM, PL and RF. It is interesting that education, which is essentially free and helps direct future generation’s willingness and capacity to partner with government, is soundly rejected.

Taxation of corporations was supported by over half of EM at about 57%, 41% of PL, and only 15% of RF. Taxing fossil fuel enjoyed support of over 1/2 of EM at around 57%, nearly 1/3 of PL at around 29%, but less than 10% support is attributed to RF. Taxing citizens was supported by about 29% of EM and 10% of PL, and a scant 2.5% of RF.

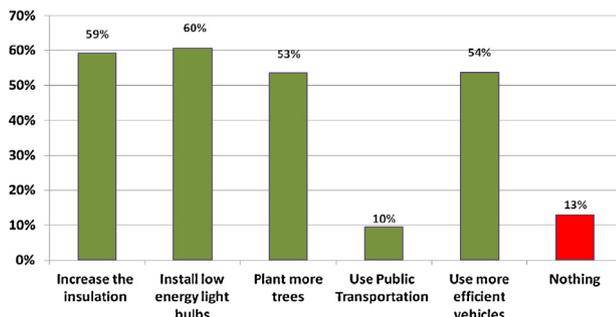


Fig. 21 – RF voluntary action support (N = 479).

Table 5 – O.L.S. regression: willingness to engage in mitigation.

Variable	Correlation coefficient	Standard error	Significance
Intercept	-0.066	0.228	0.772
Voting in tribal elections	0.108	0.082	0.189
Party affiliation	-0.151	0.136	0.271
Beliefs regarding the anthropogenic causes of climate change	0.042	0.034	0.218
Beliefs regarding the connection between Nevada drought and climate change	0.183	0.075	0.017
Age	0.004	0.002	0.115
Gender	0.054	0.071	0.450
Education	0.044	0.029	0.130
Household income	-0.013	0.013	0.309
Adjusted R ²	0.172		
N	81		

Pressuring car companies earned around 79% support from EM, 45% from PL and 40% from RF. Pressuring the U.S. government to ratify international protocols, recorded about 71% support from EM, perhaps surprisingly, only 30% support from PL, and a meager 17% of support from RF. Market incentives were approximately 79% for EM, 37% for PL, and 28% for RF. When offered “Nothing” as an option, no EM supported this, 13% of PL residents supported doing nothing regarding climate change, and 17% of RF supported this option.

We were curious where PL’s relatively strong support of voluntary actions originated, and so we performed additional tests. PL member support of voluntary actions were mostly determined by their beliefs regarding the connection between locally experienced drought and climate change (Table 5). Other factors such as age, gender, education, income, voting in the tribal elections, and beliefs regarding the anthropocentric causes of climate change were not keys. Willingness to engage in the aforementioned five voluntary actions were averaged to formulate the willingness to voluntarily mitigate climate

Table 6 – O.L.S. regression: support of mitigation policies.

Variable	Correlation coefficient	Standard error	Significance
Intercept	-0.140	0.203	0.491
Voting in tribal elections	0.170	0.073	0.022
Party affiliation	-0.310	0.121	0.012
Beliefs regarding the anthropogenic causes of climate change	0.003	0.030	0.912
Beliefs regarding the connection between Nevada drought and climate change	0.287	0.066	0.000
Age	4.5 E-5	0.002	0.983
Gender	-0.064	0.063	0.313
Education	0.058	0.026	0.027
Household income	-0.010	0.011	0.364
Adjusted R ²	0.331		
N	81		

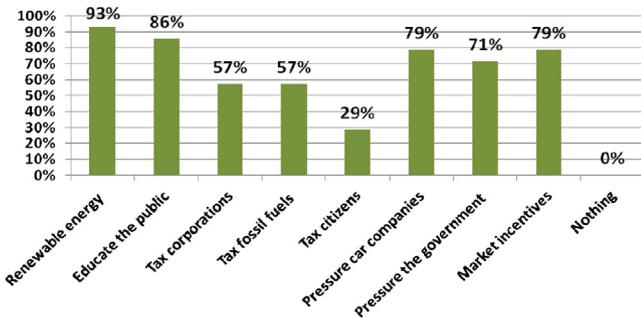


Fig. 22 – EM policy preferences (N = 14).

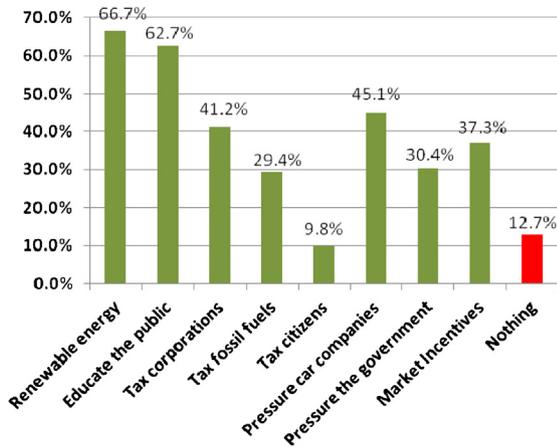


Fig. 23 – PL policy preferences (N = 102).

change indicator (Cronbach’s alpha = 0.78, which indicates accepted construct reliability).

When it comes to supporting climate change mitigation policy, more factors shape PL members’ attitudes. In addition to beliefs regarding the connection between Nevada’s drought and climate change, voting in the local elections appears to enhance mitigation policy support, while, being Republican suppresses such support. Among the demographic factors, education also enhances support of climate change mitigation policies. Beliefs regarding the anthropogenic causes of climate change, age, gender and income are all tested to be insignificant determinants. Support of the eight were averaged to formulate the climate change mitigation policy support indicator (Cronbach’s alpha = 0.86, which indicates high construct reliability in Table 6).

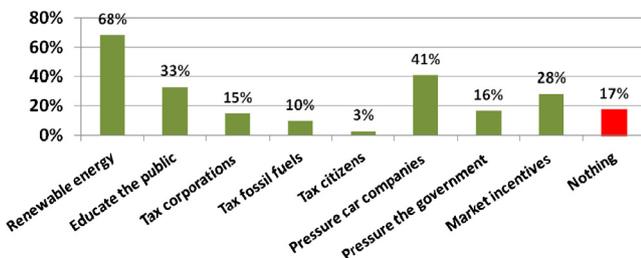


Fig. 24 – RF policy preferences (N = 479).

3.11. Trust in science and government

I’m not against scientific research. I just want it to be done right. They used our blood for all these studies, people got degrees and grants, and they never asked our permission (Carletta Tilousi, a member of the Havasupai Tribal Council, Harmon, 2010).

RF

In early 1950’s Boy’s Scouts were sent out to plant willows on tributaries of Klamath Lake in Oregon, under the pretense of stopping erosion. The only thing stopped was the water flow. ... The lake had provided water downstream for agriculture, industry, wildlife, and recreation. Lake water helped replenish the aquifers downstream. Anonymous respondent who formerly held a high position in a farming organization.

Press in 1970’s predicted new ice age. A slag of the earth’s oldest living thing a bristlecone pine from Mt. Wheeler in WP Co (cut down by a “scientist”) shows through tree rings back to the time of Abraham, that climate change is cyclical.

Climate change has become an industry, self-perpetuating with very little true science and a lot of money spent and collected to control lots of people’s lives.

I think D.R.I. [Desert Research Institute], via cloud seeding, has made my weather drier!

When they tell me what the weather will be next week, I may believe a 50 year forecast.

I worry government or congress will enact rules and regulations using climate change as an excuse to change water & natural resources laws, expand trade laws & taxes.

Donate money to politicians that fight this hoax.

What is harming us is the ripoff of our tax dollars to fund dubious “research” which is pre-ordained to come up with a liberal liar & environmental burdens.

Maibach and Hornig-Priest (2009) and others have made the case for more “constructive engagement” when addressing climate change. And in parallel, authors such as Moser (2010) have called for “more societally relevant” forms of research regarding vulnerability and adaptation to climate change. For either of these to happen a certain baseline level of trust must be reached.

We found that EM, who serve as tribal environmental leaders, “trust” scientists, water purveyors, and environmental groups the most, each aggregated to around 80% (Fig. 25). Energy purveyors were polarizing at 50%. Their distrust of state and city government was clear, at only about 1/3 trusting, surpassed only by dismal showings for local industry and the media. Also, the percentages for all scales of government were the same for “somewhat trust” and “strongly distrust” – bleak, at over 60%.

3.12. God, fraud and Gore

RF

I think it is very presumptuous of man to think he can control the earth & weather. God made the earth & controls the weather. All the control man can come up with would be wasted in one single volcano eruption. The idiots profiting off of the ruse of global warming, Al Gore, etc.

PL

Our people treated our land with respect, and we continue to hold our land as a sacred place and continue to fight for water and fight to protect our environment. Respectful of all life, included Mother Earth.

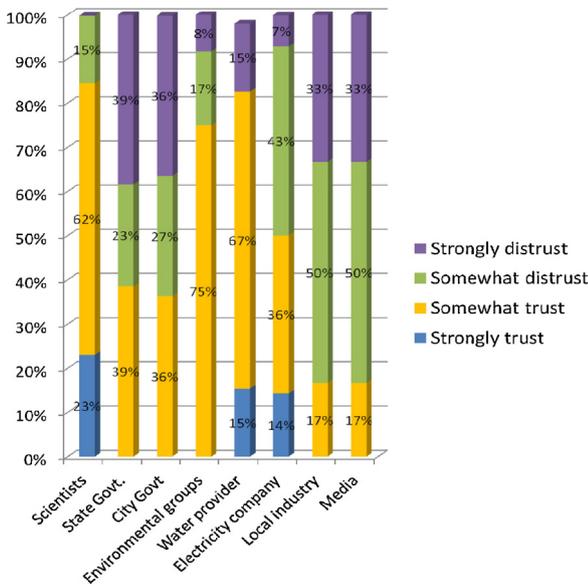


Fig. 25 – EM trust in sources of information (N = 13).

Many scientists believe that their life’s work is a neutral craft. However, as Lorenzoni et al. (2007) points out, and is underscored by the quotes above, interpretations of science are mediated by societal values, personal experience, and other factors. ‘Hard’ data, such as the average carbon dioxide reading surpassing 400 parts per million for the first time in Hawaii on May 9th 2013, may grab the scientific community’s attention. However, many of our respondents, without being cued, tended to focus on personalities and associations, i.e. Al Gore. Not all science is distrusted, as Biello (2013) notes, and the head of the National Farmers Union underscores, science that results in higher yields, less dust storms, tools for reducing tilling passes and fuel use, and genetics that mitigate drought and pests enjoy support. However, some RF may be sensitive to people pointing to the science-based injection of fossil fuel-based machines and fertilizer, methane, and deforestation that makes agriculture the second largest source of greenhouse gas emissions.

Table 7 – Counts of references to fraud, God, and Gore.

	EM	PL	RF
Fraud – corruption	0	3	0
Fraud – control	0	6	16
Fraud – corporations	0	1	5
Fraud – government	0	5	17
Fraud – scientists	0	0	17
God	2	9	31
Al Gore	0	0	23
Intervention will do more harm than good	0	1	35
Request for more info	0	5	9
Request for more data	1	1	0
Request for tech assistance	1	0	1

Note: every reference to Al Gore was also a reference to government fraud, but was not counted as such to avoid double counting.

Table 7 transforms qualitative responses to open-ended questions into quantitative counts that reveal religious belief, cynicism and political relations. Notably, tribes often invoked God’s name in terms of honoring what God made by taking action to pray for and protect nature, whereas, for many ranchers and farmers, God was the reason not to take action, as it was “arrogant” to believe one could interfere with his plan.

This same dichotomy is reflected in Congress. For example, in May 2013 U.S. Senator Sheldon Whitehouse (D) (his wife is a marine biologist) spoke regarding God and climate change, fighting the notion that, ‘God will not allow us to ruin our planet.’ In contrast, the remarks by John Shimkus, Republican representative from Illinois, are representative of the opposing point of view (Wing, 2010). For more, Barker and Bearce (2013) discuss empirical findings of a strong independent effect of a belief in biblical “end times.” See also a special volume of the American Behavioral Scientist (2013) by Dunlap, an introduction to climate change and religion by Veldman et al. (2012), and a piece on evangelical Christians and religions foundations of climate perception by Carr et al. (2012).

3.13. A conservation ethic

You non-Indians can move if you pollute the land on which you live, but we were created for this place, so we must face whatever happens here. We cannot move and continue to be Paiute people – this is our land – we are this land (Calvin Meyers, Southern Paiute, former Moapa Paiute Tribe Chairman as cited in Stoffle and Richard, 2003, p. 1).

When asked how PL members treat the land: “Non-materialistic, reverence for the land.”

Following up on the data above, we asked the PL community whether or not earning money from land today is a priority over protecting it for “future generations.” This sustainability question provides a window into tribal member views regarding management of a commons across generations, as well as the importance of economics their decision making. Only 15% favor immediate economic interests, while 43% do not, 37% felt that it depends on the situation, while 5% were unsure (N = 103). This ethic manifests important characteristics in a potential partner for climate change research collaboration, mitigation, adaptation, and capacity building.

4. Conclusion

Our findings complement literature regarding how climate change can be researched as a “relational phenomenon” and comprehended on a local level (Brace and Geoghegan, 2010), making it more meaningful to the public, even to those arguably at the “boundaries,” such as our study groups (Slocum, 2004; Palutikof et al., 2004; Bailey, 2008; Hulme, 2007, 2008, 2009).

Our research revealed that a mere 29% of RF believe that human activity is playing a significant role in climate change. Statistically, both Democrat and independent RF were far more likely than Republicans to believe that we are experiencing climate change. Importance of climate change to RF was

related to party affiliation, political orientation and gender. t-Tests regarding whether climate change should be a low to high priority for the United States government manifest a significant difference between the PL and RF in terms of concerns about ecosystem degradation, extreme weather, food security, health, and water supply – with RF far less concerned. RF perceptions of the greatest climate change impacts tend to increase to plants, animals and other people as they are more distant temporally and spatially. Goodman-Kruskal Gamma tests revealed that each of our categories of expected impacts was significantly related with party, political orientation, gender, and marital status (except at the U.S. scale). Non-married and Democratic rural residents were relatively more worried about climate change impacts. Respondents with greater knowledge about climate change perceived greater negative impacts from climate change.

Since nearly 3/4 of RF perceived that impacts will “never happen” or are “not sure,” approaching this subgroup for support of policies based on future-tense arguments is unlikely to be effective. *Policy makers and agencies would gain little traction using sustainability terminology regarding “future generations” in outreach.* Only renewable energy enjoys 67% or greater support by EM, PL, and RF respectively (only money saving actions enjoyed RF support), with very large differences between tribal and non-tribal persons for other subcategories. Even climate change education registers merely 33% support from RF. Thus, there must be an alternative entry point to the discussion about ‘future scenarios,’ and the validity of those scenarios cannot be assumed. *The best place to start is to build bridges to groups viewed as legitimate by RF, especially working with women, while simultaneously mitigating homophily (associating only with those who are similar to you) – rather than simply increasing the volume or complexity/authority of educational content directed at these rural stakeholders as a response to resistance.* Women RF show greater concern about climate change and more scientifically accurate knowledge than men, even after controlling for other variables, and so this may be another place to build bridges (National Public Radio, 2014, <http://www.knpr.org/son/archive/detail2.cfm?SegmentID=11094>).

Close to half of RF note snow pack decrease, but only a quarter note early melting and runoff, and the same is true for increasing summer temperatures, but almost 1/2 observe less surface water and just above 1/3 observe less water from springs. The significance of the political variable demonstrated in this paper makes the authors wonder if RF observations of climate change might be muted by this variable? Testing what is potentially a tension between personal observations and personal political affiliation, and which may dominate the other, represents a potential next stage of our research.

The great majority of tribal members believe in anthropocentric links to climate change, perceive local impacts of climate change to be relatively robust, and possess relatively less uncertainty. Over double the percentage of tribal respondents believe that they are presently being harmed by climate change than do RF. Climate change impacts that tribal environmental managers report include around 86% observing a decrease in snow packs and 79% earlier runoff. Increased temperatures were noted by approximately 3/4 of those surveyed. PL also records three high scores in the same

observation categories, all around or above 50%, but about 3/4 noted less surface water and a little over 1/2 noted less water from the springs. Qualitative responses also noted the movement of plants and animals depriving tribes of traditional resources. *These observations match scientific models.*

PL member support of voluntary actions was mostly determined by their beliefs regarding the connection between locally experienced drought and climate change. Religion matters, as, generally speaking, *tribes’ religious perspective leads them to feel a powerful obligation to protect God’s creation – whereas RF found God a reason for inaction, as it represented arrogance and a lack of faith to question his plan for earth and its inhabitants.* Notably, only 15% of PL favor immediate economic interests over protecting land for “future generations.”

Our research manifests that, despite lower levels of Western formal education and a horrendous history of mistreatment by U.S. government, and at times, academia, *it is time to focus on capacity building and collaborative research with tribes.* Their decision making is not always dominated by short-term economic gain, and they assume major climate change impacts well into the future, while supporting diverse policy options and voluntary actions – which is often not true of their rural counterparts. Whereas, with regard to ranchers and farmers in what is often termed the ‘New West’ in the arid region of America, the aforementioned bridge-building and reaching out to both genders should be prioritized.

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Appendix A. Supplementary data

Supplementary data about climate change model predictions for the study area, water rights, land use and demographics can be found in the online version, at <http://dx.doi.org/10.1016/j.envsci.2014.03.007>.

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