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The role of citizen science in science perception, meaning, and environmental values:

An evaluation of the Living Snow Project

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Abstract

Citizen science programs provide a means for outdoor enthusiasts to combine their recreational pursuits with engagement in science. This research evaluated the role of citizen science in peoples' perceptions of science, meaningfulness of their outdoor experiences, and environmental attitudes, identity, and connection. The Living Snow Project (LSP), a community-enabled (citizen science) program, engages the outdoor recreation community in research characterizing alpine snow microbiomes through volunteer sample collections in alpine environments. Citizen scientists ($N=41$) volunteering with LSP participated in this study at two time points before and after the 2019 snow sampling season. At both time points, participants completed five well-established measures to assess environmental attitudes, values, identity, and connection to nature. In addition, we collected demographic and LSP participation information (Time 1), as well as their citizen science experience and perceptions of science (Time 2). The results indicated that citizen scientists (1) reported their recreational experiences were more meaningful as a result of their engagement in citizen science; (2) had more positive perceptions of science and interest in participating in science; and (3) displayed high levels of environmental concern, connectedness to nature, and pro-environmental values and identity as evidenced by near ceiling levels across the five measures.

The role of citizen science in science perception, meaning, and environmental values:**An evaluation of the Living Snow Project**

The purpose of this research was to evaluate participation in a citizen science program, The Living Snow Project, in terms of individuals' environmental attitudes and values, environmental identity, connection to nature. The Living Snow Project is a community enabled (citizen science) program run out of Western Washington University (Director: Dr. Robin Kodner) that engages the local outdoor recreation community in research characterizing alpine snow microbiomes through volunteer sample collecting.

The Living Snow Projects' approach to engaging citizen scientists is built on knowledge of how people understand nature, learn about scientific complexity, and become motivated to make a change based on research that integrates conservation psychology, neurobiology, and STEM education. Previous research indicates that understanding large scale changes in ecological systems and climate are challenging because the human brain is not naturally equipped to make meaning out of complex and variable systems and data (Loftus, 2004; Moore, Obradovich, Lehner, & Baylis, 2019). However, research also suggests when people know more about a place, they are more inclined toward conservation of that place (Saunders, Brook, & Myers, 2006). Thus, as people learn and comprehend the complexities of natural systems in flux, they should be more motivated to support large-scale conservation. In particular, participation in citizen science can increase participants' further engagement in conservation and facilitates conservation attitudes and behavior changes (Brewer, 2006; Jordan et al., 2011; Toomey & Domroese, 2013).

The outdoor recreation community is under-engaged in conservation efforts despite their reliance on healthy ecosystems for recreational opportunities. The Living Snow Project targets

this group to assess how place-based education about complex ecological principles in combination with community building can create a desire for conservation and motivate people to take action, which is effective in related contexts (Larson, Whiting, & Green, 2011; McKay, Brownlee, & Hallo, 2012).

Thus, the primary goals of the Living Snow Project are to (1) educate the outdoor recreation community on complex ecological concepts, (2) promote pro-environmental conservation behaviors, and (3) to address scientific questions that can only be addressed collectively using a citizen science approach. In order to address the second goal, the current research project evaluated the impact of the Living Snow Project approach on participants' environmental attitudes, values, identity, and connection using pre- and post-Living Snow Project participation surveys. Previous research suggests that connectedness to nature increases as a result of engagement in various nature-related activities (e.g., observing animals, hiking, creative arts, and special events) (Bruni et al., 2015). In turn, connectedness to nature promotes greater environmental concern (Schultz, 2001; Schultz & Tabanico, 2007) and more pro-environmental behaviors (Gosling & Williams, 2009). Importantly, positive experiences related to conservation have a 'spillover effect' to increase the likelihood of future pro-environmental behaviors (Nillson et al., 2017). However, to date researchers have not evaluated the effectiveness of citizen-science programs on environmental attitudes, connectedness to nature, or perceptions of nature. The current evaluation focuses on LSP citizen scientists' perceptions of nature in terms of their environmental attitudes and concerns, connection to nature (identity and affect), and ecological worldview. In particular, we were interested in the potential impact of LSP participation on people's perceptions of the environment, thus this study included a pre-LSP participation (Time 1) and post-LSP participation (Time 2) surveys.

Method

Participants. This study included 41 adults ($M_{\text{age}}=37.24$ years, $SD=12.84$ (range 19-74 years); 46% female, 54% male) who participated as LSP citizen scientists during the 2019 snow sampling season. Of these, 21 further participated in the follow-up (post-snow sampling season) survey. Participants reported their ethnic origins as European (83%), Middle Eastern (10%), Asian (5%), and African (2%). Participant-reported education level included some college (16%), Associates or Trade degree (3%), Bachelor's degree (46%), Master's degree (16%), Professional degree (8%), and Doctoral degree (11%). Participants currently resided in Washington state (65%), British Columbia, Canada (11%), California (5%), Oregon (5%), Montana (5%), and Nevada (3%), Utah (3%), and another unspecified location (3%). There were no demographic differences between those who participated in the Time 1 survey and those who participated in both Time 1 and 2 surveys.

In addition to demographic information, participants were also asked about their childhood environments and experiences outdoors. Participants ($N=41$) reported having primarily grown up in urban (22%), suburban (57%), and rural (22%) areas. In the follow-up survey, participants ($N=21$) reported they began to consider themselves 'outdoor recreationists' on average by age 14 years ($SD = 7.1$ years; range 2-30 years). When asked to rate how much of their childhood they spent in nature, where 1='all of the time' and 5='never', participants ($N=21$) reported a mean of 2.75 ($SD=1.07$) during the school year and a mean of 2.15 ($SD=.99$) during the summer.

Procedure. This study examined potential within-individual changes in environmental attitudes, feelings, and behaviors at two time points. The two-part survey was administered during the 2019 snow sampling season. The Time I survey was administered late-May through

early-June 2019 prior to the snow sampling season and the Time II survey was administered mid-October through early-November 2019 after the conclusion of the snow sampling season. LSP volunteers were invited via email to participate in the Time I survey and those who completed the Time I survey were invited to participate in the Time II survey.

Measures. The evaluation used five well-validated and established measures to assess participants' environmental attitudes, values, identity, and connection at Time 1 and 2.

Nature Relatedness Scale (NRS; Nisbet, Zelenski, & Murphy, 2009) is a 21-item measure of individuals' connections with nature, environmental concerns, and behaviors. Participants respond on a 5-point scale (1=strongly disagree and 5=strongly agree) and higher scores indicate greater nature relatedness.

Extended Inclusion of Self in Nature (EISN; Martin & Czellar, 2016; Schultz, 2001): 4-item measure of individuals' environmental identity; that is, "the extent to which an individual includes nature within his/her cognitive representation of self" (Schultz, 2002, p. 67). Participants view seven pictorial depictions of the self in relation to nature with item 1 representing the self as furthest from nature and item 7 representing the self as centered in nature. Thus, higher scores represent greater inclusion of self in nature.

New Ecological Paradigm (NEP; Dunlap, Van Liere, Mertig, & Jones, 2000; Gkargkavouzi et al., 2018): 15-item measure of individuals' endorsement of an ecological worldview (i.e., humans as part of nature rather than as consumers or protectors of nature). Participants respond on a 5-point scale (1=strongly agree and 5=strongly disagree). Lower scores indicate greater endorsement of a pro-environmental worldview.

Connectedness to Nature Scale (CNS; Mayer & Frantz, 2004): 14-item measure of individuals' trait levels of feeling emotionally connected to the natural world. Participants

respond on a 5-point scale (1=strongly disagree and 5=strongly agree) with higher scores representing greater connectedness to nature.

Environmental Motives Scale (EMS; Schultz, 2001): 12-item measure of individual's concerns about environmental issues caused by human behavior in terms of relative importance of the self (egoistic), other people (altruistic), or nature (biospheric).

In addition, at Time 1 we collected demographic and LSP participation information and at Time 2 we asked participants about their experience with LSP and perceptions of science.

Results

LSP Citizen Science Experience

Most participants (66%) were first-time LSP citizen scientists during the 2019 snow sampling season, whereas others had been LSP citizen scientists for one (29%) or two (5%) previous seasons. The majority of LSP citizen scientists (77%) planned to collect snow algae samples along with submitting observations (e.g., photographs), whereas 23% planned to only collect snow algae samples. At the time of completing the Time 1 survey, 8% of participants had already begun collecting snow algae or making observations for the 2019 snow sampling season.

Following the snow sampling season, a subset of Time 1 participants ($n=21$) completed the Time 2 follow-up survey. They reported on their participation as LSP citizen scientist. Interestingly, 55% did not collect any snow samples or submit observations during the 2019 snow sampling season despite their initial intentions to do so. Other LSP citizen scientists reported having collected snow algae samples or submit observations 1-2 times (30%), 3-4 times (5%), 5-6 times (5%), or 7 or more times (5%). Moreover, LSP citizen scientist often included others during their snow sampling expeditions with 67% reporting they typically included 1 or 2 others and 11% including 3-4 other people, whereas 22% completed solo snow sampling

expeditions. These expeditions took place in Washington state (77%), British Columbia (12%), California (6%), and Montana (6%), including one participant who collected samples in both Washington and Montana. In addition to their participation as LSP citizen scientists, 20% of participants reported having previously been involved in other citizen science projects, such as the Cascade Pika Watch, Urban Pollination Project (Seattle), Adventure Scientist (timber, pikas, diatoms), Wildlife connectivity projects.

Table 1. LSP participants view of science and likelihood of future LSP participation

	Time 2 Participants who collected Snow Samples ($n=9$)	All Time 2 Participants ($n=21$)
	$M (SD)$	$M (SD)$
In what way, if any, has your participation in the Living Snow Project changed your view of science? ^a	2.33 (.71)	2.30 (.80)
How likely are you to participate in the Living Snow Project in the future? ^b	1.22 (.44)	1.45 (.61)

^a 1=much more positive, 2=somewhat more positive, 3=same view, 4=somewhat more negative, 5=much more negative

^b 1=extremely likely, 2=somewhat likely, 3=neither likely or unlikely, 4=somewhat unlikely, 5=extremely unlikely

When asked whether their experience in the Living Snow Project changed their view of science, on average participants' view was more positive ($M=2.30$, $SD=.80$), $t(19)=-3.91$, $p=.001$ (Table 1). Specifically, 20% said they had a “much more positive” view, 30% reported a “somewhat more positive” view, and the remaining 50% experienced no change in their view of

science. In addition, participants reported they were likely to participate in LSP in the future ($M=1.45$, $SD=.61$), $t(19)=-11.46$, $p<.001$), with 60% indicating they were “extremely likely”, 35% indicating they were “somewhat likely”, and 5% reporting they were neither likely or unlikely to participate in LSP in the future. As reported in Table 1, this pattern of results was nearly identical when limited to those who actually collected snow samples during the 2019 season (*NS*).

Perhaps more telling are participants’ reflections from participating in the Living Snow Project. Some found having a goal to focus on in addition to their outdoor recreation was particularly rewarding:

Having a 'project' to participate in, and a goal to achieve, during outdoor recreation, was a delight.

In 2018 I collected samples on Silver Star during a climb and it was fun to multitask while out on a trip!

Still others delighted in the search and discovery of pink snow:

I went on many hikes this summer hoping to find watermelon snow, but only found it on one of my later hikes. It was exciting to finally find a patch of snow I could sample!

It was fun to be on the lookout for pink snow.

It was really cool to see pink snow and know what it was as well as where else living snow has been found.

Finding the pink snow just randomly when I was heading back to the trail in May. We took a different route and behold there was pink snow.

The first time I tried to sample was on a climb up the South Spur of Mount Adams. I didn't see any sign of snow algae on the way up and for the majority of the way down, but we finally came down a hill and saw a big pink/red streak. It was just a really rewarding day for both a summit and successfully finding some algae!

Whereas some participants specified the reward of engaging in a scientific endeavor:

It broadened my thinking as to how environmental studies can be design and the data collected.

Advancing science while doing something I love.

Finding a good patch of pink snow and feeling accomplished that I'm contributing to something bigger.

Or how engaging in citizen science contributes to engaging kids and creating a broader environmental awareness:

No single collection stands out, but the way citizen science engages my kids while we're out adventuring makes it worth every ounce of additional weight in my pack, the miles on my boots and in the car, and the effort to follow the protocols and submit data.

Makes me more aware of the situation when I am out in the mountains.

Participants' responses also provide insight as to why some did not engage in snow algae collection during the 2019 season:

I never received my sample collection kit, but I really value this project and wish to try again next spring.

My sample containers arrived in a torn package. The sample containers also appeared to have leaked leaving the tubes covered in a dried salty solution mess.

Citizen Scientists' Environmental Attitudes, Values, Identity, and Connection to Nature

Preliminary analyses were conducted to test for differences on the five dependent measures (NRS, EINS, NEP, CNS, EMS) based on age, gender, previous LSP participation, and current participation in the Time 1 and Time 2 surveys. There were no significant relations between participant age and the five dependent measures ($p > .18$), thus age was not included in subsequent analyses. Gender differences were found and are reported where detected. There were no differences on the five dependent measures between first-time and previous LSP citizen scientists ($p > .33$). Finally, there were no significant differences on the five dependent measures

between participants who only completed the initial (Time 1) and those who completed both the initial (Time 1) and the follow-up (Time 2) surveys ($ps > .66$). In order to assess change in individuals' environmental attitudes, values, identity, and connection to nature over the course of their involvement as citizen scientist, we assessed whether participants' scores on our five measures changed between Time 1 and 2.

Nature Relatedness Scale. Overall NRS scores were calculated by averaging the 21-items (with appropriate items reverse scored) with good reliability (Cronbach's $\alpha = .79$) (Nisbet, Zelenski, & Murphy, 2009). Table 2 reports Time 1 mean scores and standard deviations. Time 1 scores ranged from 3.43 to 4.86 with higher scores indicating greater nature relatedness on a scale of 1 to 5. Women at Time 1 scored significantly higher than men ($t(29.3) = 3.59, p = .001$ [.95CI = .15 to .60], Cohen's $d = 1.17$). There were no significant differences in NRS scores between participants who grew up in rural, suburban, or urban environments ($p = .75$). At Time 2, participants' NRS scores ($M = 4.33, SD = .44$) did not differ significantly from their Time 1 scores ($p = .32$).

Extended Inclusion of Nature in Self. Participant scores on the EINS were based on the mean of the 4 items comprising the measure with higher scores indicating greater self-nature connection (see Table 2; Martin & Czellar, 2016). Time 1 scores ranged from 3 to 7 with good reliability (Cronbach's $\alpha = .81$). Although descriptively women had higher scores than men, this difference did not reach significance ($p = .13$). Time 2 scores ($M = 5.55, SD = 1.01$) did not differ significantly from their Time 1 scores ($p = .32$).

New Ecological Paradigm. NEP scores were based on the mean of the 15 items with appropriate items reverse-coded (Table 2; Dunlap, Van Liere, Mertig, & Jones, 2000). Lower scores indicating greater endorsement of a pro-environmental worldview. The scale had good

internal reliability (Cronbach's $\alpha=.88$) with Time 1 scores ranging from 1.07 to 3.33. Women had significantly lower NEP scores at Time 1 than men ($t(32.3)=-2.65, p=.01$ [.95CI=-.82 to -.11], Cohen's $d=.85$), indicating that women more strongly endorsed an ecological worldview. At Time 2, participants' NEP scores ($M=2.18, SD=.46$) were significantly higher their Time 1 scores ($t(18)=-4.97, p<.001$) indicating a lower endorsements of an ecological worldview at Time 2. Subsequent analyses revealed that those who had not collected snow samples during the 2019 season had significantly greater changes in NEP scores between Time 1 and 2 ($M_{\text{Difference}}=.50 (SD=.22)$ vs. $M_{\text{Difference}}=.16 (SD=.28)$, $t(17)=2.94, p=.009$ [.95CI=-.10 to .58], Cohen's $d=1.35$). Thus, the reduction in an ecological worldview between Time 1 and 2 was driven by those who had intended to engage in the LSP as citizen scientists, but had not actually done so.

Connectedness to Nature Scale. CNS scores were based on the mean of the 14-items with appropriate items reverse-coded (Table 2; Mayer & Frantz, 2004). Higher scores indicated greater connectedness to nature. Time 1 scores ranged from 1.64 to 4.71 with good reliability (Cronbach's $\alpha=.87$). Women had significantly higher CNS scores at Time 1 than men ($t(35)=3.25, p=.003$ [.95CI=.22 to .96], Cohen's $d=1.11$), indicating women reported greater connectedness to nature. CNS scores at Time 2 ($M=3.92, SD=.36$) did not differ significantly from Time 1 ($p=.93$).

Environmental Motives Scale. EMS scores were based on the mean of the 12-items (Table 1; Schultz, 2001). Higher scores indicated more concern for environmental harms. Time 1 scores ranged from 2.67 to 6.92 with good reliability (Cronbach's $\alpha=.90$). EMS scores at Time 2 scores ($M=5.50, SD=.67$) did not differ from Time 1 ($p=.97$).

Table 2. Descriptive statistics on measures of environmental attitudes, values, identity, and connection at Time 1.

	Mean (SD)	Gender		Childhood Environment		
		Female	Male	Rural	Suburban	Urban
		(n=17)	(n=20)	(n=8)	(n=21)	(n=8)
NRS	4.34 (.35)	4.53 (.19)	4.17 (.39)[‡]	4.32 (.41)	4.37 (.30)	4.26 (.45)
EINS	5.45 (.94)	5.69 (.73)	5.21 (1.07)	5.75 (1.07)	5.43 (.78)	5.13 (1.22)
NEP	1.90 (.58)	1.65 (.40)	2.11 (.65)[†]	1.91 (.61)	1.87 (.53)	1.96 (.77)
CNS	3.71 (.62)	4.03 (.37)	3.43 (.67)[†]	3.69 (.58)	3.75 (.52)	3.62 (.93)
EMS	5.35 (1.07)	5.42 (1.32)	5.30 (.85)	5.11 (1.12)	5.56 (.98)	5.05 (1.29)

Note: bolded items are significantly different; [†] $p < .01$, [‡] $p = .001$

Discussion

This study evaluated participation as citizen scientist in the Living Snow Project – a program that engages the outdoor recreation community in sampling of pink snow. Three key findings emerged from this study of LSP citizen scientists.

First, participants recreational experiences were enhanced through their engagement as citizen scientists. They expressed enjoyment in the search and discovery of pink snow (*It was exciting to finally find a patch of snow I could sample!*) and having a goal in addition to their recreational pursuits (*Having a 'project' to participate in, and a goal to achieve, during outdoor recreation, was a delight*). Participants expressed the deeper meaning they experienced by engaging children as citizen scientists (*...the way citizen science engages my kids while we're out adventuring makes it worth every ounce of additional weight in my pack, the miles on my boots*

and in the car, and the effort to follow the protocols and submit data) and developing a broader environmental awareness (*Makes me more aware of the situation when I am out in the mountains*). They also expressed the importance they experienced by contributing to science (*Advancing science while doing something I love*).

Second, the LSP citizen science programs increased positive perceptions of science and interest in participating in citizen science. Interestingly, participants' view of science was uniformly positive regardless of whether they collected any data during the sampling season. Moreover, those who had not collected data during the sampling season remained enthusiastic about future participation. Thus, it may be that being associated with a citizen science project, whether or not one actually collects data, yields benefit in terms of perceptions of science and likelihood of future participation in citizen science projects.

Finally, LSP citizen scientists displayed high levels of environmental concern, connectedness to nature, and pro-environmental values and identity as evidenced by near ceiling levels across the five measures. Although this study did not directly assess differences between citizen scientists and the general population, previous studies provide evidence of typical scores amongst the general population. For example, nature relatedness scores for LSP citizen scientists ($M=4.34$ on a 5-point scale) were higher than found amongst Canadian executives in federal government and the private sector ($M= 3.71$; Nisbet et al., 2009), as well as university students ($M=3.35$), including those enrolled in an environmental studies course ($M=3.90$) (Nisbet, Zelenski, & Murphy, 2011). It is not surprising that LSP citizen scientists scored high given that nature relatedness positively predicts belonging to environmental organizations, self-identification as an environmentalist, and frequency of time outdoors in nature (Nisbet et al., 2009).

The results of this study bear on the question of whether the outdoor recreation community is under-engaged in environmental issues. Although the literature illustrates mixed results regarding the relation between outdoor experiences and environmental concern (see Berns & Simpson for a review), the current study provides evidence of a robust association between engagement in citizen science and environmental values, concern, and connectedness. Not only did LSP citizen scientists score at near ceiling-levels across measures, but this study provided evidence that participation in citizen science sustained a pro-environmental worldview. In fact, those who intended to participate as LSP citizen scientists but did not do so showed a significant reduction in their ecological worldview (as measured by the NEP). However, it is important to note that, although significant, these results were based on a small sample of LSP citizen scientists. Taken together, these results suggest that citizen science programs may have an influential role in individuals' broader environmental perceptions, values, and relatedness.

This study provided important insights into the potential effects of participation in citizen science; namely, a more positive view of science and likelihood of continued citizen science participation, greater enjoyment and meaning in outdoor recreation pursuits, and evidence of high-levels of environmental concern, values, and connectedness amongst citizen scientists. Future research could address limitations in the current study in three important ways. First, this research should be replicated and with a larger sample size particularly for the follow-up after engagement in citizen science. Second, it would be important to test for differences between LSP citizen scientists and the general population in environmental concern, values, and connectedness. If citizen scientists were found to have greater environmental concern, values, and connectedness, subsequent research could examine the underlying causes of this association and whether engagement in citizen science is a unique contributor or an associated outcome of

environmental values, concern, and connectedness. Finally, the current study suggests that individuals find value in their engagement in citizen science, and important insights would be gained through qualitative investigations into individuals' experience with citizen science.

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Appendix A: Measures

Living Snow Project Participation (Time 1)

1. Is 2019 your first season collecting samples for the Living Snow Project?
 - a. Yes
 - b. No
2. [If no on question 2], How many seasons have you previously collected samples for the Living Snow Project (NOT including this season)?
 - a. 1 season
 - b. 2 seasons
 - c. 3 seasons
3. During the 2019 season, do you plan to collect snow algae samples, submit snow algae observations (e.g., photographs), or both?
 - a) Collect snow algae samples only
 - b) Submit snow algae observations (photographs) only
 - c) Both collect samples and submit observations
4. Have you already begun collecting samples and/or making observations for the Living Snow Project for the 2019 season?
 - a. Yes
 - b. No

Nature Relatedness Scale (Time 1 and 2) (Nisbet, Zelenski, & Murphy, 2009)

Instructions: For each of the following, please rate the extent to which you agree with each statement, using the scale from 1 to 5 as shown below. Please responds as you really feel, rather than how you think “most people” feel.








1= Strongly Disagree	2=Somewhat Disagree	3= Neither Agree or Disagree	4= Somewhat Agree	5=Strongly Agree
1. I enjoy being outdoors, even in unpleasant weather.	_____		12. I am not separate from nature, but a part of nature.	_____
2. Some species are just meant to die out or become extinct.	_____		13. The thought of being deep in the woods, away from civilization, is frightening.	_____
3. Humans have the right to use natural resources any way we want.	_____		14. My feelings about nature do not affect how I live my life.	_____
4. My ideal vacation spot would be a remote, wilderness area.	_____		15. Animals, birds and plants should have fewer rights than humans.	_____
5. I always think about how my actions affect the environment.	_____		16. Even in the middle of the city, I notice nature around me.	_____
6. I enjoy digging in the earth and getting dirt on my hands.	_____		17. My relationship to nature is an important part of who I am.	_____
7. My connection to nature and the environment is a part of my spirituality.	_____		18. Conservation is unnecessary because nature is strong enough to recover from any human impact.	_____
8. I am very aware of environmental issues.	_____		19. The state of non-human species is an indicator of the future for humans.	_____
9. I take notice of wildlife wherever I am.	_____		20. I think a lot about the suffering of animals.	_____
10. I don't often go out in nature.	_____		21. I feel very connected to all living things and the earth.	_____
11. Nothing I do will change problems in other places on the planet.	_____			

Reverse scored items: 2, 3, 10, 11, 13, 14, 15, 18; NR-self items: 5, 7, 8, 12, 14, 16, 17, 21; NR-perspective items: 2, 3, 11, 15, 18, 19, 20; NR-experience items: 1, 4, 6, 9, 10, 13

Overall NR score is calculated by averaging all 21 items (after reverse scoring appropriate items). Scores on the 3 NR dimensions are also calculated by averaging appropriate items after reverse scoring.

Extended Inclusion of Nature in Self (Time 1 and 2) (Martin & Czellar, 2016)

Instructions: Below, please choose the pictures which best describe your relationship with the natural environment. Please answer spontaneously with what comes to your mind first.

Answer options						
1	2	3	4	5	6	7
Self Nature	Self Nature	Self Nature	Self Nature	Self Nature	Self Nature	Self Nature
						

1. Please choose the picture below which best describes nature when you think of your relationship with the natural environment.



2. Please choose the picture below that best describes your relationship with the natural environment.



3. Please choose the picture below that best describes your relationship with the natural environment.



New Ecological Paradigm Scale (Time 1 and 2) (Dunlap, Van Liere, Mertig, & Jones, 2000).

Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you **STRONGLY AGREE** (1), **MILDLY AGREE** (2), are **UNSURE** (3), **MILDLY DISAGREE** (4), or **STRONGLY DISAGREE** (5) with it.

1. We are approaching the limit of the number of people the earth can support
2. Humans have the right to modify the natural environment to suit their needs (Reverse)
3. When humans interfere with nature it often produces disastrous consequences
4. Human ingenuity will insure that we do NOT make the earth unlivable (Reverse)
5. Humans are severely abusing the environment
6. The earth has plenty of natural resources if we just learn how to develop them (Reverse)
7. Plants and animals have as much right as humans to exist
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations
(Reverse)
9. Despite our special abilities humans are still subject to the laws of nature
10. The so-called “ecological crisis” facing humankind has been greatly exaggerated (Reverse)
11. The earth is like a spaceship with very limited room and resources
12. Humans were meant to rule over the rest of nature (Reverse)
13. The balance of nature is very delicate and easily upset
14. Humans will eventually learn enough about how nature works to be able to control it
(Reverse)
15. If things continue on their present course, we will soon experience a major ecological
catastrophe

Connectedness to Nature Scale (Time 1 and 2) (Mayer & Frantz, 2004)

Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

1	2	3	4	5
Strongly Disagree		Neutral		Strongly agree

1. I often feel a sense of oneness with the natural world around me.
2. I think of the natural world as a community to which I belong.
3. I recognize and appreciate the intelligence of other living organisms.
4. I often feel disconnected from nature. (Reverse)
5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.
6. I often feel a kinship with animals and plants.
7. I feel as though I belong to the Earth as equally as it belongs to me.
8. I have a deep understanding of how my actions affect the natural world.
9. I often feel part of the web of life.
10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.
11. Like a tree can be part of a forest, I feel embedded within the broader natural world.
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature. (Reverse)
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.
14. My personal welfare is independent of the welfare of the natural world. (Reverse)

Environmental Motives Scale (Time 1 and 2)

People around the world are generally concerned about environmental problems because of the consequences that result from harming nature. However, people differ in the consequences that concern them the most.

Please rate the following items from 1 (*not important*) to 7 (*supreme importance*) in response to the question:

Not Important							Supreme importance
1	2	3	4	5	6	7	

I am concerned about environmental problems because of the consequences for...

Rating:

_____Animals

_____Birds

_____All children

_____Future generations

_____My community

_____Me

_____All people

_____My future

_____My health

_____My lifestyle

_____Plants

_____Marine life

Demographic Information (Time 1)

We would like to ask some important demographic questions about you. You may choose to skip any questions you prefer not to answer.

1. How old are you (in years)? _____
2. What gender do you identify with?
 - a. Male
 - b. Female
 - c. Another gender: _____
3. What are your ethnic origins? Ethnicity refers to the origins of the respondent's ancestors and should not be confused with citizenship, nationality, or place of birth. Check any/all that apply.
 - a. African
 - b. Asian
 - c. Caribbean
 - d. East Indian
 - e. European
 - f. Latin/Central/South American
 - g. Middle Eastern
 - h. Native American/Alaska Native/First Nations
 - i. Pacific Islander
 - j. Another ethnicity (please specify): _____
4. What is your current education level?
 - a. Does not apply/unknown
 - b. Primary school
 - c. Some high school
 - d. High school diploma
 - e. Some college/university
 - f. Associate's or Trade degree
 - g. Bachelor's degree
 - h. Master's degree
 - i. Professional degree
 - j. Doctoral degree
 - k. Other (please specify): _____
5. [If current education level is Associate's/Trade degree or higher] What was your major for your associate's, trade, or bachelor's degree? _____
6. [If current education level is Master's degree or higher] What was your field of study in graduate or professional school? _____
7. In which state/province do you currently reside?
 - a. Alaska
 - b. Alberta
 - c. British Columbia
 - d. California
 - e. Colorado
 - f. Idaho
 - g. Montana

- h. Nevada
 - i. Oregon
 - j. Utah
 - k. Washington
 - l. Other (please specify): _____
8. Did you grow up primarily in a rural, suburban, or urban area?
- a. Rural
 - b. Suburban
 - c. Urban

Citizen Science Experience (Time 2)

We would like to begin by asking you about your experience doing citizen science in The Living Snow Project.

1. How many times (i.e., different dates) did you collect samples or submit observations for the Living Snow Project this season?
 - a. 0 (did not collect any snow samples or submit observations during 2019 season)
 - b. 1-2 times
 - c. 3-4 times
 - d. 5-6 times
 - e. 7 or more times

2. [If 1 or more times in question 1] How many people, on average, were in your group while you were collecting samples or making observations this season?
 - a. 0 (I collected snow samples or made observations on my own)
 - b. 1-2 others
 - c. 3-4 others
 - d. 5-6 others
 - e. 7 or more others

3. In which state(s)/province(s) did you collect samples or make observations? Indicate all that apply.
 - a. Alaska
 - b. Alberta
 - c. British Columbia
 - d. California
 - e. Colorado
 - f. Idaho
 - g. Montana
 - h. Nevada
 - i. Oregon
 - j. Utah
 - k. Washington

1. Other (please specify): _____
4. Have you ever been involved in any other citizen science projects?
 - a. Yes (please specify project): _____
 - b. No
5. Please describe one or two highlights or favorite experiences from participating in The Living Snow Project: _____
6. In what way, if any, has your experience with The Living Snow Project changed your view of science?
 - a. Much more positive
 - b. Somewhat more positive
 - c. Same view (no change)
 - d. Somewhat more negative
 - e. Much more negative
7. How likely are you to participate in The Living Snow Project in the future?
 - a. Extremely likely
 - b. Somewhat likely
 - c. Neither likely nor unlikely
 - d. Somewhat unlikely
 - e. Extremely unlikely
8. At what age (in years) did you begin to consider yourself to be an outdoor recreationist? _____
9. During your childhood, how much of your free time did you spend in nature?
 - a. During the school year?
 1. All of the time
 2. Most of the time
 3. About half the time
 4. Sometimes
 5. Never
 - b. During the summer?
 6. All of the time
 7. Most of the time
 8. About half the time
 9. Sometimes
 10. Never

Appendix B: Participant Educational Background (Major)

Major for Associates, Trade, or Bachelor's Degree

	Frequency	Percent
	14	34.1
Biochemistry	1	2.4
Bioengineering	1	2.4
biology	2	4.9
Biophysics	1	2.4
chemistry	1	2.4
Civil and Environmental engineering	1	2.4
Computational Biology	1	2.4
Computer Science	2	4.9
Criminal Justice	1	2.4
Cultural Anthropology BA; K-8 teaching certificate	1	2.4
Earth science	1	2.4
Electrical engineer	1	2.4
Engineering	1	2.4
Environmental Studies	1	2.4
Environmental Studies (Geography Specialization)	1	2.4
French	1	2.4
Geography	1	2.4
History	1	2.4
Information Technology	1	2.4
Latin American Studies	1	2.4
Mathematics	1	2.4
Neuroscience	1	2.4
Nursing	2	4.9
Theatre Arts	1	2.4
Total	41	100.0

*note that 14 participants did not respond to this question (Blank)

Field of Study in Graduate or Professional School

	Frequency	Percent
	28	68.3
Business	1	2.4
Chemical Biology; Secondary science education	1	2.4
Environmental and Water Resources Engineering	1	2.4
Environmental Law	1	2.4
Environmental Science	1	2.4
Evolution	1	2.4
Law	1	2.4
medical school	1	2.4
medicine (medical school)	1	2.4
Microarchitecture & Security	1	2.4
Neuroscience	1	2.4
Nursing	1	2.4
Western Washington	1	2.4
Total	41	100.0

*note that 28 participants did not respond to this question (Blank)