MERGING ART AND SCIENCE: LESSONS LEARNED FROM AN ‘OTTERLY’ DIFFERENT CASE STUDY

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ABSTRACT

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Environmental art projects use artistic interpretation to tell stories about the natural world, often with the hope that they will inspire awareness or behavioral change. In 2019, an art project to raise awareness about North American river otters (*Lontra canadensis*) was launched in Northern California, using over 100 river otter sculptures painted and decorated by local artists. Through a mixed-methods approach, I quantified the initial outcomes of the project, North Coast Otters, as well as the response to the project by the public on social media as a case study in environmental art and outreach. Participating artists’ interviews and statements revealed inspiration from the natural world and the shared environments of humans and river otters. Art themes were equally distributed between abstract interpretations of their relationships with nature and direct representations of river otter ecology and the natural world. Responses on social media varied between the two platforms, suggesting that for this project different approaches to outreach had different levels of success. The findings add to the growing body of research in environmental art and serve as a baseline for understanding the impacts to a corresponding citizen science monitoring project when North Coast Otters is completed.
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>ii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>vi</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>viii</td>
</tr>
<tr>
<td>LIST OF APPENDICES</td>
<td>x</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>BACKGROUND</td>
<td>5</td>
</tr>
<tr>
<td>Social Psychology, Art and Citizen Science</td>
<td>5</td>
</tr>
<tr>
<td>Implementing an ‘Otter’ Idea</td>
<td>7</td>
</tr>
<tr>
<td>METHODS</td>
<td>10</td>
</tr>
<tr>
<td>Interviews and Artist Statements</td>
<td>11</td>
</tr>
<tr>
<td>Art Analysis</td>
<td>13</td>
</tr>
<tr>
<td>Social Media Analysis</td>
<td>14</td>
</tr>
<tr>
<td>Citizen Science Records</td>
<td>16</td>
</tr>
<tr>
<td>RESULTS</td>
<td>17</td>
</tr>
<tr>
<td>Interview Narrative</td>
<td>17</td>
</tr>
<tr>
<td>Interviewed Artists’ Designs – Nature as Inspiration</td>
<td>18</td>
</tr>
<tr>
<td>Views about Wild Otters - How Experience Leads to Appreciation</td>
<td>21</td>
</tr>
</tbody>
</table>

iv
LIST OF TABLES

Table 1. Percentages and counts of themes expressed in artist statements (N = 103) for North Coast Otters. Themes were not mutually exclusive. Artist statements were collected during the winter of 2019-2020 when artists returned their sculpture. .............................. 30

Table 2. Summary of categories for 108 otter art sculptures for North Coast Otter. Number determined by an online survey taken by six Humboldt State Graduate Students in November and December of 2020. .......................................................................................................................... 32

Table 3. Summary of sub-themes of 108 otter art statues created during North Coast Otters. Sub-themes were not mutually exclusive......................................................................................................................... 33

Table 4. Summary of Mann-Whitney U Test statistics comparing mean social media analytics between photos of otter art and environmental messages. Posts were made during summer of 2020 and winter of 2020-2021 on the North Coast Otters’ Facebook and Instagram pages. Sub-samples were 40 otter art images shared on both platforms, 30 environmental messages shared on Instagram and 29 environmental messages shared on Facebook........................................................................................................................................ 40

Table 5. Summary of means and standard errors of social media analytics attributed to photos of otter art (N = 40). Posts were made during summer of 2020 and winter of 2020-2021 on North Coast Otters’ Facebook and Instagram pages. Number of likes a post received as a proportion of the number of people it reached................................................................. 41

Table 6. Summary of Mann-Whitney U Test statistics for difference of means between social media analytics for environmental messages with a green photo and other colored photos. Posts were made during summer of 2020 and winter of 2020-2021 on North Coast Otters’ Facebook and Instagram pages. One less photo was shared on Facebook
than Instagram due to a technical issue. Number of likes a post received as a proportion of the number of people it reached. .................... 47
Figure 1. An internet meme featuring an otter laying on a wooden boardwalk. Otter’s expressive faces have led to many internet memes where their daily behaviors have been personified with human emotions.

Figure 2. Distribution of primary colors for otter art (N = 108) comparing natural colors (in grey) and other colors. More than half of the otter art color themes were dominated by blues, greens and browns.

Figure 3. The percentages for each sex of viewers on the North Coast Otters social media pages. Women made up 77% of total followers on Instagram (N = 757), and 80% of total followers on Facebook (N = 1108). Results were recorded in March of 2020.

Figure 4. Number of likes received over time and Number of people reached on Instagram (grey) and Facebook (black) for the North Coast Otters pages (N = 40). Each data point represents the likes or number of people reached respectively for a given post. Posts are numbered by the order in which they were published. Posts were made during summer of 2020 and winter of 2020-2021.

Figure 5. Comparison of the average reach for otter art photos (black bars) and the number of people who follow each social media platform (grey bars). Despite having more followers on Instagram, art photos reached more people on Facebook. Posts were made during summer of 2020 and winter of 2020-2021 on the North Coast Otters’ Facebook and Instagram pages. Followers were recorded in March of 2021.

Figure 6. Proportion of likes for images of art and environmental messages on Facebook (black) and Instagram (grey). While Instagram had higher proportions of likes for both types of posts, the difference between platforms is larger for art images. Posts were made
during summer of 2020 and winter of 2020-2021 on the North Coast Otters’ Facebook and Instagram pages. Figure 7. Average number of people reached on Facebook (top) and likes as a proportion of reach on Instagram (bottom) for each main theme. Indigenous art reached more people than other categories on Facebook. Environmental and Indigenous artwork received more likes as a proportion of reach than abstract artwork. Posts were made during summer of 2020 and winter of 2020-2021 on the North Coast Otters’ Facebook and Instagram pages. Figure 8. Otters with anthropomorphism reached more people on Instagram (black) than otters without anthropomorphism (grey). Posts were made during summer of 2020 and winter of 2020-2021 on the North Coast Otters’ Facebook and Instagram pages.
LIST OF APPENDICES

Appendix A .................................................................................................................. 66
Appendix B .................................................................................................................. 67
Appendix C .................................................................................................................. 69
Appendix D .................................................................................................................. 73
INTRODUCTION

North American river otters (*Lontra canadensis*) are found across the United States (U.S.) where functional watersheds provide adequate access to food sources (Lariviere & Watson 1998). This includes freshwater, estuarine and marine habitats ranging from natural to man-made wetlands (Melquist et al. 2003). For some, river otters are a charismatic species; their athletic swimming abilities have been portrayed in books and films (e.g. Tarka the Otter and Ring of Bright Water) (Williamson 1927; Maxwell 1960). More recently, their emotive faces have been the subject of internet memes (Figure 1). However, their charm has not protected them from population decline, and for other otter species their ‘cuteness’ is the cause of their persecution.

![Image of an otter on a boardwalk](image1)

Figure 1. An internet meme featuring an otter laying on a wooden boardwalk. Otter’s expressive faces have led to many internet memes where their daily behaviors have been personified with human emotions.
Following centuries of hunting, by the early 1900’s urbanization and pollution had reduced the North American river otter’s range from much of the U.S. to areas bordering large bodies of water such as the Great Lakes, Pacific and Atlantic Oceans (Lariviere & Watson 1998). River otters have also been a threat to fish stocks due to their ability to catch large quantities of profitable fish leading to continued conflict with humans (Lariviere & Walton 1998). There have been successful reintroductions in areas where North American river otters were extirpated through harvest for the fur trade; however, habitat loss and environmental degradation are still a threat to localized otter populations (Toweill & Tabor 1982; Melquist & Dronkert 1987). In places where river otter numbers are growing, continued monitoring and public education may help ensure these populations remain conserved (Serfass et al. 2018).

Otter populations around the world have experienced similar downward trajectories but have not benefitted to the same extent from recovery efforts (Dulpaix & Savage 2018). Illegal poaching and trading in Asia are threats to multiple species of otters who are hunted for their furs, meat, and use in traditional medicine (Dulpaix & Savage 2018). The smaller species of otters such as the Asian small-clawed otter (*Aonyx cinereus*) are captured and sold for thousands of dollars to be kept as pets, and increasingly are being used in exotic animal cafes (Hall 2019).

In 2018, the IUCN-SCC Otter specialist group released a plan to help protect all 13 otter species globally (Dulpaix & Savage 2018). Part of the vision for improving otter populations includes taking advantage of the role that otters play in their ecosystems as a charismatic flagship species (Dulpaix & Savage 2018). Flagship species help raise awareness for underappreciated habitats such as wetlands and help conservation through
One of the nine objectives cited in the plan was to increase awareness through education and outreach, including encouraging participation in citizen science (Duplaix & Savage 2018).

Since 1999, the River Otter Network Citizen Science program at Humboldt State University (HSU) has collected over 6,000 wild river otter observations in Northern California (Black 2009; Black et al. 2016). Citizen science river otter records have allowed comparisons in mean litter size over time, between coastal and inland watercourses, and shown variation in behavior patterns among social groups (Black et al. 2016; Chin & Black 2020). Sightings are opportunistic in nature and are therefore reported sporadically and concentrated in recreational areas. River otter numbers provided by citizen scientists have been shown to underestimate the total number of river otters in the Humboldt Bay Region (Brzeski et al. 2013). Therefore, continued and expanded participation in this long-term study is encouraged. In addition, project leads wanted to better inform the citizen scientists and the broader community about the river otter’s natural history and connections to functional, clean water habitats.

Inspired by an otter art project in England in 2017, an interdisciplinary art project was started in Northern California in 2019. One of the primary goals of the North Coast Otters – Public Arts Initiative (North Coast Otters), was to encourage a wider audience to participate in river otter monitoring by “merging art and science”. Another goal of North Coast Otters was to raise awareness of local river otter populations and their habitats through artistic interpretation. North Coast Otters consisted of 108 three-foot tall river otter sculptures painted by 111 artists. The sculptures were to be placed in northern California (Humboldt, Mendocino, Trinity, Siskiyou, and Del Norte counties). The initial
aim of my research was to describe the breadth and characteristics of this art and science merger, and to assess the goals of the art initiative by quantifying citizen science participation and awareness of river otters in multiple audiences in the community.

The project was scheduled to be launched in spring going into the summer of 2020, but the ‘in-person’ festival was postponed due to the COVID-19 pandemic. During lockdown, the project was restructured and launched online using the Instagram and Facebook pages that had been created early in the project’s development. Images of a portion of the otter sculptures were shared to maintain community engagement using the social media pages, alongside a series of environmental messages related to river otters.

Subsequently, the revised aim of my research was to describe the North Coast Otters project to serve as a baseline for further research. There are three areas that I focused on: the artists, the results of the artists’ work, and the initial response of the public to the ‘virtual’ presentation of otter art and environmental messages. My first goal was to describe the background and experience of a sample of the artists as a case study in interdisciplinary environmental engagement. Second, I evaluated the differences and similarities in the art that was produced. Finally, I compared the response analytics from social media viewers across different categories and sub-themes for a sample of the artwork. By doing this, I sought to describe the inspiration for the artists and their understanding of the scientific background of the project, identify common traits in the artwork, and quantify whether those traits generated different responses on social media. Lastly, I evaluated citizen science data for an increase in reports submitted by artists to see if involvement in North Coast Otters encouraged participation in the monitoring project.
BACKGROUND

This research was informed by multiple disciplines and guided by the desire to share river otter ecology with the public in an accurate yet entertaining way. The following is a summary of general principles from social psychology and sociology, previous relevant findings from environmental art research, and how this information informed the creation and research of North Coast Otters.

Social Psychology, Art and Citizen Science

The Theory of Planned Behavior (Ajzen 1985) suggests that people are more likely to participate in a behavior when they feel the benefits outweigh costs, and that the behavior is supported, or seen as positive through social norms. A way to apply the Theory of Planned Behavior to sub-disciplines of social ecology and human dimensions of wildlife is by studying pro-environmental behaviors (PEB’s). A person’s intent to participate in PEB’s may be influenced by: values and moral obligations towards the environment, understanding of the consequences of their actions, and the sense of control for their actions as well as the outcome (Abrahamse et al. 2009; Evans et al. 2012; Bolderdijk et al. 2013; Mtutu & Thondhlana 2016). While intent is a key predecessor to participation, there can also be barriers that intent cannot overcome such as lack of information, or cultural differences (Mckenzie-Mohr 2000; Sarigollu 2009).
Citizen science programs can allow people to make a positive contribution to the environment, while also deepening their connection to it (Groulx et al. 2017). As a PEB, there are more factors that influence whether someone will participate in citizen science. Monitoring programs that ask people to submit opportunistic sightings can be successful when there are positive attitudes towards the research, perceived control by the citizen scientist, and supporting social norms (Martin et al. 2016). When the barriers are removed for behavioral change related to PEB’s (Martin et al. 2016; Pocock et al. 2019), there are still specific barriers to participation in citizen science, such that there is a gap between supporting the idea of citizen science, but not participating (Davis et al. 2019). Suggested reasons for this gap include that the citizen science program may be perceived as too difficult for someone without prior knowledge, they interrupt the potential participant’s enjoyment of nature, and they require a certain level of interest in the species in question (Martin et al. 2016; Lucrezi et al. 2018; Davis et al. 2019).

Therefore, a logical first step in the process of generating interest in and removing barriers for a citizen science program is to raise awareness and create a positive attitude towards the project itself and its goals. This can be done by directly inviting participants and educating them about how to participate, which can give a feeling of control over the social situation and what will be required from them, or in other words gives them confidence to participate (Martin et al. 2016). Educating participants on the important role they play despite limited ecological knowledge can also encourage participation and can appeal to positive attitudes or values towards the environment (Martin et al. 2016; Lucrezi et al. 2018).
Examining how environmental art can change attitudes and behaviors is a growing field of research (Baldwin & Chandler 2010; Curtis et al. 2012, Curtis et al. 2014, Marks et al. 2016). The impact of art more generally in propaganda and marketing has been well established as a way to affect viewers’ attitudes and behaviors (Belfiore & Bennett 2007). More recently, studies using artwork to share scientific information have suggested that environmental art can affect beliefs, attitudes, and values while also raising awareness about environmental issues (Curtis et al. 2012; Curtis et al. 2014). When used in a community or festival setting, environmental art may aid in forming social norms, and builds community involvement in PEB activities while also communicating complex scientific ideas (Curtis et al. 2012; Curtis et al. 2014; Marks et al. 2016). Additionally, it is beneficial to add context, either in the form of information as was found by Keller (2020), or through place-based associations (Marks et al. 2016) to add personal meaning to the experience. Detailed studies of an Australian environmental art festival over multiple years showed that participation increased survey respondents’ hope towards the future of the environment, raised their awareness, and increased their desire to change personal behaviors to be more environmentally friendly (Baldwin & Chandler 2010; Marks et al. 2016).

Implementing an ‘Otter’ Idea

With this framework in mind, North Coast Otters sought to engage and inspire the public into caring about local watersheds, river otters, and ultimately encourage
participation in the citizen science program. The hope for the project was that by merging citizen art and science with the otter as the visual “spokesperson”, awareness of and value for our natural world would increase in the local community. Unfortunately, there were initial limitations to the project as a result COVID-19 in 2020. To keep the community safe and to discourage traveling and socialization, the sculptures were not released for public viewing, and the summer-long scavenger hunt did not take place. This meant that an increase in citizen science records as a result of North Coast Otters was delayed for the foreseeable future, and not possible to be studied within the timeline of my thesis.

However, a new opportunity arose from this challenge. Few published research studies have assessed the response from the public to environmental art on a social media platform. Wu et al. (2018) suggested that including pictures of wildlife on conservation-focused social media may increase the number of people that interact with the page. Others suggest that creatively sharing images of animals with the public may increase interest in the conservation of even un-charismatic species (Lenda et al. 2020). It may be as simple as the colors in a photo that affect the level of public response to the post (Thommes & Hayn-Leichsenring 2021). Building on these case-studies, North Coast Otters’ need for engagement while in lockdown lended itself to explore the public reaction otter art could receive on image-dominated social media platforms. A Facebook page and an Instagram page were already being used to promote North Coast Otters. While both sites are suited to sharing images, they can provide different services. Facebook can function as a Social Networking Site (SNS) through its groups, sharing function and event planning, while Instagram can serve as a microblog platform when used to share information with the public (Liu et al. 2019).
Understanding the role artists played, the kind of art they produced, and how that art was received online by the community is a first step in evaluating the results of the project. With this baseline information, the potential to inspire the public to participate in citizen science can be better understood. Since artists were not expected to make ecologically accurate artwork, an education campaign was created to go alongside the otter art. The intention was to provide ecological information that gave more context to the purpose of the project. Thirty environmental messages were developed ranging from humorous information about river otter behavior, somber facts about the local ecosystem, and cultural connections provided by local Tribal members. These environmental messages as well as the differences across the otter sculptures provided independent variables for subsequent analyses of the public’s response on social media. Altogether, I was able to tell a story about North Coast Otters using the quantitative results from the social media analyses, the qualitative components from information provided by artists, and descriptive statistics for the art sculptures.
METHODS

Artists were recruited for North Coast Otters in August 2019 through local community groups, social media, and word-of-mouth. An invitation that provided the project guidelines and application materials was emailed to artist groups and posted online. This invitation asked artists to design a piece of artwork around one of four themes that reflected the goals of the project:

- celebrating clean water and healthy habitats
- enjoying outdoor living and recreation
- embracing local vibe, culture and tradition
- connecting art, science and ways of knowing.

Artists were also encouraged to keep the overall objective of the project in mind, “promoting clean water and healthy habitats where we live and play!” Additionally, artists were given a ‘fact sheet’ about North American river otters (Appendix 1). After the otter sculptures were returned to the project coordinators, they were photographed from all four sides in high resolution.

Three datasets were created to address the range of my research. Interviews with participating artists were conducted to develop a deep understanding of their inspiration and understanding of the project. This was supplemented with artist statements which provided broad generalizations and a larger sample size. The high-resolution photos of each otter statue were used to identify common categories and sub-themes. Lastly, in order to reduce confounding factors when analyzing social media results, I standardized
the information and timing of posts shared on Facebook and Instagram. More detailed information on these datasets is continued below.

Interviews and Artist Statements

From November 2019 to February 2020, 17 interviews were conducted with artists participating in the project (Humboldt State University IRB 19-040). All artists participating in North Coast Otters were contacted via email invitation using purposeful sampling in October 2019. After the initial response from interested artists, follow-up emails were sent until an interview was scheduled or the artist became disinterested. Once an interview was scheduled, artists were emailed the consent form and interview questions ahead of time (Appendix 2). Artists were given a physical consent form to read and sign at the beginning of each interview. All consent forms were stored in a secure, private lab in the HSU Wildlife Building. Interviews were held in-person at a public location of the artist’s choice (e.g., public art studios and cafes). The semi-structured interviews ranged from 25 minutes to 1 hour and 15 minutes in length. They included questions about the artist’s artistic background, previous experiences in nature with river otters, and thoughts about conservation and citizen science. Each conversation was recorded using an iPhone, uploaded to the transcription software otterai, and removed from the phone. Transcripts were then double checked and edited for accuracy before analysis.

A Grounded Theory approach (Charmaz 2014) was used to assess whether the interview questions were successfully prompting desired information. This method of
interviewing suggests that small alterations to interview questions during data collection allows a researcher to maximize their time and explore unexpected themes, similar to an adaptive management plan in Natural Resources. Artists needed little to no prompting to describe their relationship with river otters but required more information about citizen science. After all the artists that were initially interested had been interviewed, no additional outreach of artists was attempted. Following a theoretical saturated sampling approach (Charmaz 2014), the information provided by this sample of artists was sufficient for the scope of this research. Responses related to the primary interview objectives were similar between artists, and small variations did not lead to new questions or themes.

Qualitative coding of each transcript began within one month of the interview. This entailed using a coding software (atlas.ti) to highlight quotes that contained information relevant to the research goals. Each quote was assigned an initial code to begin the process of finding similarities across artists (e.g. “excited to see otters swimming”). A secondary analysis grouped codes into themes that allowed for better comparisons of statements (e.g. “appreciation of otter behavior”).

Of the 107 artists or artist pairs, 102 submitted narratives (“artist statements”) with their art describing the inspiration or motivation for their design. Artist statements were also analyzed by initially identifying similar sentiments and vocabulary to create codes. A secondary analysis identified whether those themes were present for each artist statement. I conducted quantitative analyses of descriptive statistics (frequencies and proportions, information for visualizations) for both the art and artist statements using IBM SPSS v. 27 (IBM Corp 2020).
Art Analysis

To describe the general appearance of the art, all 108 sculptures were assigned to one of three categories. Six graduate students in the HSU Wildlife Department filled out an online questionnaire that asked them to look at an image of each sculpture to determine if it belonged in one of the predetermined groups (environmental, abstract, or indigenous) or “other” (Humboldt State University IRB 20-065). Indigenous art was kept as its own category because there was a specific focus to include local Native artists in the project. This survey was conducted using purposeful sampling because of the graduate students’ accessibility and interest in the project. In November 2020, all 24 currently enrolled Wildlife Department graduate students were sent an email to participate in the survey.

Sub-themes for the art were described as a secondary data analysis. Common traits or objects were identified in addition to the primary color for each sculpture. To find sub-themes, an initial review of the art listed every distinguishable trait or object for each sculpture (e.g. waterfall, river, salmon, redwood, clothing). These features were consolidated into five groups (realistic otter face, wildlife, water, landscapes, and anthropomorphism) and presence or absence of each feature was recorded. To see if there was an unequal distribution of otters from a certain category, a Pearson’s chi-squared test was used. Differences in frequencies between sub-themes and the themes expressed in artist statements were also compared using Pearson’s chi-squared test.

Initially, the primary color was subjectively determined using the high-quality images. To check for bias, 11 of the 108 photos were randomly chosen and analyzed...
using a website that identifies the most common colored pixel and a “color palette” from the majority of the pixels (Dhakar 2021). If the primary color came back as grey resulting from shadows, the ten colors in the palette were checked to see if a majority of the common colors matched the earlier assessment. Confirmation of the initial analysis suggested that bias in primary color selection is not expected to affect the results. Additionally, any subjectivity from the researcher is not expected to be different from that of another person viewing the image on social media.

Social Media Analysis

Otter sculpture photos and graphic text images of the environmental messages were posted on the North Coast Otters’ Instagram¹ and Facebook² pages from late May to late August 2020, and then again during the winter of 2020-2021. These posts happened Monday through Friday at noon for a total of five times per week. Images were alternated between art and environmental messaging, and categories and sub-themes were strategically stratified across the order of posts. The caption formatting (name of the art and artist, sponsor if applicable) and a set of hashtags were uniform across otter sculpture posts to maintain consistency. Environmental messages were posted with the same set of hashtags. Ultimately, 40 sculptures (Appendix 2) and 30 environmental messages (Appendix 3) were shared on the two platforms.

¹ https://www.instagram.com/northcoastottersart/
² https://www.facebook.com/northcoastottersart
To test for significant differences between the characteristics of the art, non-parametric comparison of means tests were used with social media analytics (reach, likes and comments) as the dependent variable across different categories and sub-themes. A comparison of means between two categories or two sub-themes was used instead of an analysis of variance of all groups for this small sample. Comparing one focus category at a time more closely reflects how a person may judge social media posts. Viewers were not given three posts at a time and asked to choose their favorite, they were comparing the photo on their screen to all other posts they have seen. Comparing two groups was done by combining the non-focus groups compared one category against the rest of the posts. Additionally, there was not a baseline, or themeless otter, to act as a baseline to compare deviation.

The main category for each otter sculpture was recoded into three dummy variables (abstract, environmental, indigenous), while sub-themes were recorded as present or absent. The “environmental messages” were put on three images (see Appendix 3) which had three different primary colors; blue, green, and purple. These colors were also treated as dummy variables for analysis using Mann Whitney U-Tests due to small sample size, lack of baseline, and the desire to compare one color against the other two. The environmental messages also had different themes based on their content. Most messages provided information on river otter behavior or habitat ecology (n = 24), while some shared cultural information (n = 6) provided to the project by local Native Tribal members. Otter facts were differentiated from ecology facts by looking at the subject of the message (e.g. otters or something else in the environment). These message themes were recorded as present or absent for analysis.
Wilcoxon rank-sum tests were used to describe the mean difference in complementary analytics (e.g. likes) for each post between the two platforms, Facebook and Instagram. Lastly, a Mann Whitney U-Test was used for the differences between average analytic response for photos and environmental messages regardless of category or sub-theme across the two platforms. All tests using social media analytics were done using SPSS v. 27.

Citizen Science Records

The river otter reporting database was searched for artists that participated in the monitoring project from June 2019 to December 2020. Artists that did participate since June of 2019 were recorded and searched for in records going back to 2015 to look for participation in the monitoring project before involvement with North Coast Otters. Additionally, the otter records were searched from January 2015 to June 2019 to see if any artists had participated in the project in recent history but had not submitted additional observations since involvement with North Coast Otters. I conducted a McNemar’s Test to see if there was a significant difference in the number of observations that had been submitted by artists before and after the project began.
RESULTS

Interview Narrative

The 17 artist interviews resulted in 11 hours, 54 minutes and 16 seconds of recorded audio, which yielded 639 quotations, and 153 codes. There were commonalities across interviewed artists, but sociodemographic differences prevented the group from being completely homogenous. Three of the 17 interviewed artists identified as male, the remainder identified as women. One of the interviewees was a full time professional artist, and two were retired from other professions. The remaining 14 artists had a variety of primary jobs, including teaching art (four interviewed artists) and work in natural sciences (three interviewed artists). Artists were asked to create a design under one of four themes: celebrating clean water and healthy habitats; enjoying wild places and outdoor spaces; embracing local vibe, culture and tradition; and connecting art, science and ways of knowing. Artists were not asked to state which theme(s) they were responding to in their application for the project. I chose to summarize the variation in themes from the interviewed artists’ sculptures using other information the interviewed artists provided. After reading their artist statements and taking the conversations from each interview into account, I assigned each sculpture to a theme. Ten of the interviewed artists depicted clean water and healthy habitats in their design, four connected art, science and ways of knowing, two celebrated outdoor spaces, and one depicted local vibe. Analytic categories resulting from the interviews are summarized below.
Interviewed Artists’ Designs – Nature as Inspiration

The interviewed artists depicted a range of motifs on their otter sculptures. These included landscape scenes, wildlife and food webs, and the personification of the otter using clothing or jewelry. The unifying characteristic was a deeper meaning to the design than what could be seen at first glance. In other words, the images that were used in the art held significance to the interviewed artists, and the interpretation of those images told a story.

For twelve of the interviewed artists, a love of nature and an appreciation for ecology guided their designs. By depicting food webs and river otter habitats, artists attempted to “[teach] a story to people, it tells a story, but then the food web is intermingled and the environment is intermingled with the otter” (Artist #11). Artist #11 had a scientific background, which guided their approach and led to an extremely accurate depiction of otter foods. Other artists, like Artist #3, tied their appreciation of nature to place and a personal narrative. “I had a spider web with a little spider hanging from it…a lot of things ended up having little different stories that I put in there” (Artist #3). Artist #3’s connection to river otter habitat is based in experience and sharing these habitats with other people, which ultimately creates a feeling of home that they share with river otters. Artist #6, a visual artist and a self-proclaimed “Guardian of Mother Nature,” noted the challenges with depicting food chains to inform the public. They explained, saying “my piece is all about the food chain and the healthy habitat and ... I'm like, oh wait a minute. This is for kids and yet here are these you know, savage hunters, otters, right? How they’re killing stuff all day long to eat it. So how do you like describe that reality to little kids? I'm not sure and I'm not sure I answered that. But I wanted to
just represent what a healthy habitat might look like.” By putting their own spin on food webs and the river otter’s habitat, it seems these interviewed artists tried to find a balance between depicting realistic wildlife scenes and expressing emotions that would connect with the general public.

While all of the 17 interviewed artists expressed some level of concern for river otters and their habitats, two artists were directly inspired by their fear for the safety of river otters. Artist #14, who called themselves a “rabid environmentalist” incorporated humor and whimsy into their piece to overcome the feelings of eco-grief they experience.

“The meaning behind it...you hear so many horrible things on the news of oil spills and things like that. Wildlife destroyed and you know, the environment destroyed and I was like, ”What if it was a spill of something wonderful? What if instead of an excess of oil all over the place, we just have an excess of otters?” You know, wouldn't that be, great, to just have wonderful things coming out instead of bad things coming out.”

As someone with a scientific background, Artist #14 was all too familiar with the issues the environment faces and the consequences of human actions such as oil spills. Their art acknowledges a problem facing river otters and other wildlife, while also depicting river otters thriving in clean water with food resources. In comparison, one of the artists embraced sadness, admitting “I'm pretty bad at [being hopeful]. I'm not an optimistic person. Things are bad. I'm a realist” (Artist #9). Artist #9 created otter pups that have “little expressions [that] kind of give them a voice kind of saying please help.” Their work draws people in but is not necessarily through happiness. It does not capture the characteristics of river otters that so many artists, including Artist #9, spoke to. “They're charismatic. They have a lot of character. They're playful. They're curious.” Rather, their work plays into our emotions, suggesting that there may be more to this species and they
playful demeanor. While Artist #9 explained the meaning of their art will be different for everyone, it highlights the challenges that all animals face in the presence of climate change and environmental degradation.

Many designs were not straightforward depictions of nature. However, the desired messaging for the project was behind the meaning of these sculptures. At first glance, Artist #2’s design did not show a connection between art and science, or humans and nature, but they explained that “you know, this idea of conservation and adaptation and coexisting with the natural world really kind of fit into the things that I really love about maps”. The design focused on the “vibrancy of the colors of the water” and how “this story of how we have been able to adapt, and how [the otters] then need to adapt to the environment that we’ve placed over them” (Artist #2). By wrapping an image of a map around the otter sculpture itself, the motif depicted “just kind of that relationship between one thing and nature and how… they just kind of like jive” (Artist #2). Given this meaning, abstract blue lines became a representation of our ability to both work with nature and at times suppress it. Another example comes from Artist #10, who used religious iconography on their otter design. The artist felt “that would give it a value that [people] recognize… It reads sacred.” Artist #10 reflected the importance of river otters’ role in their habitats by depicting their otter artwork with religious symbols (e.g. a halo). This approach for the otter artwork is aligned with the goal of raising awareness of river otters.

The goal “merging art and science” was present in four of the sculptures from interviewed artists. However, the definition and understanding of science was not the same across the group. Artist #12’s’s sculpture represented merging art and science
through depiction of the creation story told in their Indigenous culture. Therefore, the motifs on the sculpture are not commonly associated with Western science. They explained that “…this scientific side that I look at and this cultural side that I look at, the creation story really is, it really illustrates a lot of what science says, you know, stardust. It actually makes sense… it's a very similar story” (Artist #12). Art as an expression of culture was already merged with science in the eyes of Artist #12, because “everything starts with imagination and everything starts with an idea and a story”, including science. However, ecology and other natural sciences were merged with the other three sculptures in ways that were common for Western science and ideology. Ranging from small illustrations of plants to detailed portraits of female conservationists, interviewed artists incorporated science in different ways that suited their creative styles. For example, Artist #11’s intricate drawings of wildlife on their otter sculpture were the latest in a collection of animal paintings. Artist #11 has been working on this series “because you need artists to essentially duplicate what you find” and their “end-all game is to essentially duplicate and draw a lot of these creatures but to give them a kind of fantastically look.”

Views about Wild Otters - How Experience Leads to Appreciation

The interviewed artists expressed that the project was appealing to them because they already shared the same goals as the initiative. Responses to questions about artists’ existing opinions about river otters ranged from the species being their favorite animal to a rather neutral position of otters (e.g. understanding that river otters play an important ecological role). Overwhelmingly though, opinions about otters were positive. Stories of seeing wild river otters or sentiments in support of river otters were the second-most
common theme in the interviews (other than descriptions about artists’ art), mentioned over 30 times. These included references to their “personalities”, athletic swimming abilities, cute faces and physical similarities to domestic dogs.

Artists that described strong attachment or appreciation for otters had direct experiences with them in the wild. For one artist, a love of otters was tied to river otters’ presence at a “really magical camping space” (Artist #4). Where “there's always traces of river otters and you can hear them at night you know, smashing rocks together. And so, it's like a very enchanting part of” (Artist #4) the camping experience. Perhaps the most intimate connection that was discussed was with an Indigenous artist. They explained that the river otter had a spiritual importance, in addition to personal experiences with wild otters. “All water creatures are very sacred. And so that is... one of our animals, and totem is not the right word. But just to communicate that I think other people would use that word” (Artist #12). Growing up on the river, Artist #7 had countless experiences with river otters, such that their appreciation was almost inherent. They explained this, stating “I grew up with them. You know, it wasn't like it's any mystery.” Having watched river otter behavior in such detail, Artist #7 understood and appreciated that the river otter “has to hunt, he's a product he eats, lives, breathes, all of the things Earth and he's just another life form. As we all are.” Overall, the impact of an encounter with a wild otter was tied to the level of appreciation and understanding of otter behavior that the interviewed artists expressed.

Despite having wild river otter experiences, some artists felt the need to research to help them understand “what the otters of this area are and why is that important” (Artist #2). Artist #11 used books for their research, spending a day and a half reading up
on river otters and their prey species. As a “nature lover”, having ecological knowledge
added to Artist #11’s appreciation of river otters, and the experience made them feel
“closer to the otter”. Two interviewed artists went to the river otter exhibit at the local
zoo to see them “zooming around” (Artist #17). These experiences helped depict
scientific accuracy and interpret the movement of the otters in water. Artist #17 described
the way the otters at the Sequoia Park Zoo moved: “they twirl a lot when they’re
swimming” and so in her design she “just took her tail and ... made a nice swipe that went
all the way up her body.”

Views about Citizen Science – Why doesn’t enthusiasm lead to action?

One of the main goals of the North Coast Otters initiative was to spread
awareness of the ongoing citizen monitoring project of wild river otters. Discussing
citizen science with the interviewed artists allowed for a better understanding of this
stakeholder group’s opinion of the monitoring project. This is with the understanding that
the artists are more likely to have positive opinions, based on their involvement with
North Coast Otters. One artist ended the interview early, and one interview experienced
recording issues, resulting in data for 15 interviewed artists’ opinions of citizen science.
Twelve of the 15 interviewed artists had heard of the river otter citizen science
monitoring project before participating in the interview. One interviewed artist expressed
that they became aware of the monitoring project because of North Coast Otters. Every
interviewed artist expressed positive opinions of citizen science, although one artist
expressed concern over the quality of the data. Of the 13 interviewed artists that were
familiar with the monitoring project, four stated that they had previously submitted
records of wild river otters. However, only one of the interviewed artists’ names was found in searching the monitoring records (see Citizen Science Results). Interviewed artists that had not submitted observations were asked if they may be likely to participate in the future. Of the artists that said they had not participated, nine suggested they would submit observations in the future. Two interviewed artists expressed a lack of interest in participating. One interviewed artist said this was because they do not recreate along rivers or other otter habitat regularly.

The general support for science and positive feelings towards river otters were reflected in the support interviewed artists showed for citizen science. Nine of the interviewed artists had a scientific background in either research or environmental education. For this group, experience with research may have contributed to their positive opinion. An additional benefit of citizen science is that it gets the public to be more hands-on with nature, even if there are issues with the validity of the data. In other words, the benefit of contributing to a research project may be “more about the process than about the data” (Artist #10). Citizen science was seen by the interviewed artists as a good way to raise awareness when recreating as “it kind of encourages people to be a little more watchful” (Artist #8) when they are in nature. The overall sentiment was that citizen science in principle is “fabulous”, even for interviewed artists that needed some explanation. My conversation with Artist #17 showed that in fact very little explanation was needed if an interviewed artist had positive opinions towards nature.

J. Barger: One of my other, kind of components of my research is trying to gauge people's opinions of citizen science. Are you familiar with that term?

Artist #17: No.
J. Barger: Okay, so um, citizen science is typically a volunteer-based project or program where people, just the average person goes out and collect some sort of information on the natural environment, on animals. And then that information ends up being a part of a larger set of data that scientists can use. And then we have a citizen science, river otter monitoring project.

Artist #17: You do? Well that's cool. Do we have a lot up here?

J. Barger: Oh yeah.

Artist #17: Oh good. I have a little creek that runs through my yard, but I've never seen an otter in there. Yeah, so.

J. Barger: Well now that you're aware...

Artist #17: Now I'll be looking.

J. Barger: Now you'll be looking. And if you were to say, see an otter, and do you think that you would be...

Artist #17: Oh definitely.

J. Barger: Yeah, you'd be interested in sharing that information?

Artist #17: Uh huh (nods yes).

The overwhelming support for citizen science from interviewed artists left questions to be answered as to why there is a lack of participation. The second interviewed artist with a lack of interest expressed that a river otter sighting “in a way sometimes it's just kind of a private thing. Yeah. You know, that's just a personal thing” (Artist #7). This suggested that sharing the observation would take away from their enjoyment of the encounter. However, in general Artist #7 supported citizen science noting that “you'd have to pay so much money it'd be so expensive to get this information any other way, you'd have to have a whole army of people going out researching, and here's you have a willing army by just getting them interested in it.”
The time it takes to submit a sighting after an unexpected river otter encounter could also be an issue with this citizen science monitoring program. For example, one artist noted that despite knowing about the project, they had not reported sightings because they would have to “go straight back to work” (Artist #14). The same artist also shared that they did not know where to report otters they had seen at a location without flyers. This suggests that the project as a whole is not being communicated thoroughly with the current information located at trailheads or visitor centers where river otters could be seen. Artist #9 proposed that the barrier might be a larger problem that will be very difficult to overcome.

“The barrier [to citizen science] is life. People's careers and family and the way we live our lives right now...So we cut all kinds of corners with trash and the way we eat, the way we live...all that stuff and then we're exhausted so we fly somewhere for two weeks, and then we come back. It's just, it's a bad bad rat race. And so I think life is your barrier there.” – Artist #9

While the interviewed artists do not reflect the entire community the river otter monitoring project is hoping to engage, their responses provide insight into what some of the barriers to citizen science may be.

**Artist’s Goals – Public inspiration and environmental action**

Overall, what the public takes away from these pieces of art will vary, and ultimately is unknown to the project creators and the artists. However, the interviewed artists overwhelmingly expressed concern for the environment. They shared a desire to bring happiness to their art while also raising awareness of the importance of clean water and protecting the environment in general. The art that was produced speaks to the goals
of promoting river otter awareness and conservation in a way that is inspiring. Artist #11 captured that when they said:

“...but because [animals] are fantastical, they are so beautiful, and magical...and so that’s the combination of art and science. You have to be creative thinking, it’s that creative thinking to get these projects through, you have to be creative thinking to get people to change their minds.”

For other artists, their connection to the land inspired their art and their desire to see conservation actions in their community. A spiritual connection was mentioned by five of the interviewed artists, leading to their concern for the future of nature. When speaking to their otter art concept, Artist #7 explained that they felt that “we're completely and absolutely a product and a result of the world around us. So we're in, unmistakably, and undeniably tied to every part of it.” Growing up in a rural part of Humboldt County led to their personal connection to the rivers and forests along the Trinity River, and therefore their desire to share these places to the world. Artist #7 shares the beauty of the natural world with their art, letting their “brush walks the landscape”, the landscape that they have seen change over the years. Although protecting natural resources is more common that it once was, it is important to still practice stewardship, “you know you just take care of your own mess. If everybody did that it'd be much better” (Artist #7).

Taking care of trash was one way interviewed artists expressed their desire to protect the environment. “A lot of people like to throw their garbage out [in nature]. And it's weird because like, especially here, there's like, all these beautiful wonderful unspoiled places and then there's like this huge pile of trash. But yeah, we're gonna pick it up. Custodians of Mother Nature.” (Artist #6). Overall, the level of participation in pro-
environmental behaviors in the interviewed artists varied widely. Stewardship, donating to conservation groups, volunteering and helping educate others were some of the ways that the artists eased their concern for nature.

The weight of environmental concern that the interviewed artists carry may also be part of their inspiration for creating art. In the conversation with Artist #4, after discussing the fragility of our planet, they explained how “there is an inherent sense of conservation through everything that [they do] ... which sometimes feels incredibly hard.” Despite this difficulty, they still seek to share messages about the natural world through their art, as did almost every other artist I spoke with. Artist #6 came to a realization during our conversation about why doing environmental art is important to them:

“So, there's definitely you know, a language and a conversation that happens with visual art. And I would like to be in a place where I am part of that as an artist. Yeah, perhaps that's something that's motivated me a little bit to improve my skills, is so that that could be that! Because I'm sitting here going 'Why are you putting like all this time energy into it?' Maybe that's it, maybe I just you know, have that that I want to talk about, in addition to like 20 other subjects.” - Artist #6

The enthusiasm expressed by the interviewed artists about participating in this project reflected an appreciation for otters and the wild rivers of Humboldt County, but more generally, a desire to help tell a story. The story of the river otter and local watersheds was shared in different ways by the 17 artists, but an appreciation for nature connected them all.
Artist Statement Analysis

Of the 108 sculptures, 103 were returned with statements describing the design concept. Artist statements resulted in 188 quotations assigned to 11 codes related to the goals of the project. Across these statements, the inspirations and meanings for the artwork varied from lacking any reference to the goals of the project, to closely tied to one or all the suggested messages provided to guide artists. Coding and qualitative analysis resulted in 11 themes that were frequent in the statements and provided insight into artists’ relationships with otters, local ecology, and nature in general.

The most common theme expressed in the artist statements was a love or inspiration for nature, with almost a quarter of the artists including phrases that fit this theme (Table 1). This included references to local flora and fauna, the natural world, and places on the north coast such as local rivers. Almost as many artists expressed a desire that their art would help to inspire conservation or environmental awareness (Table 1). Some referenced specific actions such as reducing waste and encouraging environmental stewardship, but general ideas about inspiring conservation were more prevalent. The least common themes were most directly related to the messages provided in the artist application (e.g. ‘clean water and healthy habitats’ and ‘merging art and science’ Table 1).
Table 1. Percentages and counts of themes expressed in artist statements (N = 103) for North Coast Otters. Themes were not mutually exclusive. Artist statements were collected during the winter of 2019-2020 when artists returned their sculpture.

<table>
<thead>
<tr>
<th>Artist Statement Theme</th>
<th>Percentage</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspired by nature</td>
<td>23.3%</td>
<td>24</td>
</tr>
<tr>
<td>Desire to inspire conservation or awareness</td>
<td>22.3%</td>
<td>23</td>
</tr>
<tr>
<td>Concern for or awareness of environmental issues</td>
<td>17.5%</td>
<td>18</td>
</tr>
<tr>
<td>Inspired by or mentioned love for rivers and watersheds</td>
<td>14.6%</td>
<td>15</td>
</tr>
<tr>
<td>Expressed appreciation of or connection with nature</td>
<td>13.6%</td>
<td>14</td>
</tr>
<tr>
<td>Loves or is inspired by otters</td>
<td>13.6%</td>
<td>14</td>
</tr>
<tr>
<td>Understanding of ecology</td>
<td>11.7%</td>
<td>12</td>
</tr>
<tr>
<td>Desire for clean water or healthy habitats</td>
<td>10.7%</td>
<td>11</td>
</tr>
<tr>
<td>Inspired by otter sightings</td>
<td>7.8%</td>
<td>8</td>
</tr>
<tr>
<td>Mentioned merging of art and science</td>
<td>5.8%</td>
<td>6</td>
</tr>
<tr>
<td>Representing clean water or healthy habitats</td>
<td>2.9%</td>
<td>3</td>
</tr>
</tbody>
</table>
Art Analysis

The artists were given white otter sculptures or a ‘blank canvas’ so that they could answer the question, “what would you like your otter to say to the word?” When the 108 sculptures were returned, they had designs that ranged in complexity, style, materials, and biological accuracy. Summarizing all the variation in these designs is outside the scope of this research. However, patterns and commonalities that were used for analysis are described below.

Categories

The broad categories of ‘environmental’, ‘abstract’ and ‘Indigenous’ were used to group the sculptures based on how explicitly the sculpture was connected to nature and the overall messaging of North Coast Otters. Thirty-nine of the otters had unanimous responses from the category survey. For the remainder of the sculptures, the most common survey answer was used. In circumstances where there was either a different answer provided by every survey response or an even split between two categories, my response to the survey was used to break the tie. The most common otter art category was environmental, making up half of the otters (Table 2). Abstract otters, or otter sculptures that lacked a direct reference to nature made up almost forty percent of the otters. The last category, Indigenous art, included the work of 12 patriating Native artists (Table 2). The proportion of environmental and abstract otters were not significantly different than equally distributed ($\chi^2 = 1.5$, df = 1, P = 0.22) when the Indigenous otter artwork was removed from the data for analysis.
Table 2. Summary of categories for 108 otter art sculptures for North Coast Otter.

Number determined by an online survey taken by six Humboldt State Graduate Students in November and December of 2020.

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>50%</td>
<td>54</td>
</tr>
<tr>
<td>Abstract</td>
<td>38.9</td>
<td>42</td>
</tr>
<tr>
<td>Indigenous</td>
<td>11.1</td>
<td>12</td>
</tr>
</tbody>
</table>

Sub-themes and Colors

Wildlife (salmon, insects, river otters, etc.) were the most common object to be depicted on the otter sculptures (Table 3). Of the 47 otters that depicted wildlife, 12 specifically depicted salmon. Over a quarter of the otters had a realistic otter face (Table 3), including sculptures that were not painted realistically overall. Water was slightly more common on otters than depictions of landscapes (e.g. coastlines, redwood forests and river scenes), owing to the fact that artists depicted underwater scenes and included interpretations of water in more abstract designs. Anthropomorphism, adding clothing material or painting ‘clothing’ on the otters, made up exactly a quarter of the designs (Table 3). However, the range of depicted objects and sub-themes was wide; references to movies and pop culture, music, space, and use of found objects and collage supplemented the more common painted depictions of nature.
Table 3. Summary of sub-themes of 108 otter art statues created during North Coast Otters. Sub-themes were not mutually exclusive.

<table>
<thead>
<tr>
<th>Sub-theme</th>
<th>Percent Present</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildlife</td>
<td>43.5%</td>
<td>47</td>
</tr>
<tr>
<td>Realistic otter face</td>
<td>27.8</td>
<td>30</td>
</tr>
<tr>
<td>Water</td>
<td>27.8</td>
<td>30</td>
</tr>
<tr>
<td>Anthropomorphism</td>
<td>25.0</td>
<td>27</td>
</tr>
<tr>
<td>Landscape</td>
<td>24.1</td>
<td>26</td>
</tr>
</tbody>
</table>

The most common color for otter sculptures was blue (31.5%) followed by otters whose dominant color did not fall into a clear color category (e.g. gold) or was purposefully ‘rainbow’ (18.5%). When combined, blue, green and brown - i.e. more natural colors - make up almost 60% of the otters.
Figure 2. Distribution of primary colors for otter art (N = 108) comparing natural colors (in grey) and other colors. More than half of the otter art color themes were dominated by blues, greens and browns.

Connections between artists’ statements and sub-themes

There were 14 artists that expressed an appreciation for or a connection to nature. The motifs of these artists were equally split between depicting landscapes on their art and not having landscapes. However, of those that did not mention an appreciation for nature, over three-quarters of the artists did not depict a landscape. Therefore, artists that expressed an appreciation for nature were more likely to depict nature in the form of a landscape on their art ($\chi^2 = 4.192$, df =1, $P = 0.041$). Similarly, artists that were concerned for nature (Table 1) were equally split between depicting a realistic otter face and not, while artists that did not mention a concern for nature in their statement were
three times less likely to depict a realistic otter face on their artwork ($\chi^2 = 4.604$, df = 1, $P = 0.032$). Artists that were inspired by nature (Table 1) were almost four times (odds ratio of 3.9) more likely to depict wildlife than other artists ($\chi^2 = 7.541$, df = 1, $P = 0.006$).

Native Artists that expressed their cultural connection to nature or wildlife in their statement were less likely to depict a landscape ($\chi^2 = 5.172$, df = 1, $P = 0.023$) or water ($\chi^2 = 6.114$, df = 1, $P = 0.013$). The comparisons for presence of the remaining sub-themes did not come back with positive associations for Native Artists, but they were present in the artwork in small numbers, compared to landscapes and water which were absent.

Social Media Analysis

The demographics of users on Instagram and Facebook were similar. A majority of followers were women (77% and 80% respectively), and between the ages of 25-44. While women made up most of the viewers, the proportions of each sex were similar across all age groups. However, Instagram viewers were more likely to be under the age of 44, while Facebook viewers were relatively evenly distributed across all age categories excluding adults under 24 (Figure 3). It should be noted that Instagram also reports statistics for viewers ages 13-17, and a negligible (0.1%) number of followers (all women) in this age category have been excluded.

While some social media analytics are self-explanatory (e.g., likes and shares) others require interpretation. Both platforms use “reach” to describe the number of users that were shown the post on their newsfeed or through searching. Instagram uses a metric
called “impressions” which is the number of times a post could have been seen. While this is like reach, it represents number of views as opposed to the number of people who viewed it. When impressions are higher than reach, this means users are viewing a photo multiple times. Facebook does not differentiate between the number of people that saw a post versus the number of times a post was seen. Therefore, reach was used for Instagram and impressions were excluded to maintain similarity between the analytics for each platform. Anecdotally, impressions were higher than reach for some posts on Instagram.

Another difference between platforms is how they report the number of people who have expressed interest in your content, or your audience. Facebook requires users to ‘like’ a page. Total ‘page likes’ can give insight into how people see your content in their newsfeed. As of April 2021, the North Coast Otters had 757 Facebook likes. This does not include the number of people who may see your content through it being shared, without ‘liking’ the page. Instagram reports your audience as your ‘followers’, which North Coast Otters has 1,108. Additionally, Instagram allows a user to ‘like’ a post, whereas Facebook has multiple reaction options (likes, loves, cares, etc.). For this sample, likes and loves on Facebook were combined because they represent similar emotions, other reactions were excluded because there was no Instagram equivalent. The other reactions were infrequently used. Photos received an average 1.77 ‘wows’ (min. 0, max. 14), 0.13 ‘haha’, and no ‘cares’.

Number of likes in general decreased on both platforms over time, however there was considerable variation in the number of likes received (Figure 4). Towards the end of the project, the pattern of likes between the two sites were similar, despite differences in the beginning of the project. While the reach for otter art photos on Instagram was
relatively stable after an initial drop-off in viewers, reach on Facebook varied by the thousands throughout the project (Figure 4). The order in which a post was made was negatively correlated to the reach on Instagram ($r = -0.33, p = 0.036$), as well as reach on Facebook ($r = -0.43, p = 0.006$). However, the distribution of posts from different categories, sub-themes and colors were stratified across the order the posts were made.
Figure 3. The percentages for each sex of viewers on the North Coast Otters social media pages. Women made up 77% of total followers on Instagram (N = 757), and 80% of total followers on Facebook (N = 1108). Results were recorded in March of 2020.
Figure 4. Number of likes received over time and Number of people reached on Instagram (grey) and Facebook (black) for the North Coast Otters pages (N = 40). Each data point represents the likes or number of people reached respectively for a given post. Posts are numbered by the order in which they were published. Posts were made during summer of 2020 and winter of 2020-2021.
Table 4. Summary of Mann-Whitney U Test statistics comparing mean social media analytics between photos of otter art and environmental messages. Posts were made during summer of 2020 and winter of 2020-2021 on the North Coast Otters’ Facebook and Instagram pages. Sub-samples were 40 otter art images shared on both platforms, 30 environmental messages shared on Instagram and 29 environmental messages shared on Facebook

<table>
<thead>
<tr>
<th>Social Media Analytic</th>
<th>Type of Post</th>
<th>U</th>
<th>Otter Art Photo (n₁)</th>
<th>Environmental Message (n₂)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook reach</td>
<td></td>
<td>174.5</td>
<td>40</td>
<td>29</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Instagram reach</td>
<td></td>
<td>305.0</td>
<td>40</td>
<td>30</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Facebook likes proportion</td>
<td></td>
<td>176.0</td>
<td>40</td>
<td>29</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Instagram likes proportion</td>
<td></td>
<td>45.0</td>
<td>40</td>
<td>30</td>
<td>&lt;0.001</td>
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<td>Facebook comments</td>
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<td>149.0</td>
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<td>29</td>
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<tr>
<td>Instagram comments</td>
<td></td>
<td>230.0</td>
<td>40</td>
<td>30</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Differences between types of posts

Across both platforms and every analytic that was tested, otter art photos had more social media presence than environmental message posts (Table 4). Photos of otter art reached more people than environmental messages. Otter art also received more likes as a proportion of reach and more comments than environmental messages.

Differences between platforms

Posts of otter art photos reached more people ($Z = -3.777$, $P < 0.001$; Table 5) and had more comments as a proportion of their reach ($Z = -5.511$, $P < 0.001$; Table 5) on Facebook than on Instagram. However, there were more likes as a proportion of their reach on Instagram than on Facebook ($Z = -2.678$, $P = 0.007$; Table 5). It is notable that despite having fewer followers, the otter art photos reached more people on average on Facebook than Instagram (Figure 5).
Table 5. Summary of means and standard errors of social media analytics attributed to photos of otter art (N = 40). Posts were made during summer of 2020 and winter of 2020-2021 on North Coast Otters’ Facebook and Instagram pages. Number of likes a post received as a proportion of the number of people it reached.

<table>
<thead>
<tr>
<th>Social Media Analytic</th>
<th>Mean</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook reach</td>
<td>1162.38</td>
<td>173.512</td>
</tr>
<tr>
<td>Instagram reach</td>
<td>512.25</td>
<td>30.267</td>
</tr>
<tr>
<td>Facebook likes proportion</td>
<td>0.1034</td>
<td>0.00434</td>
</tr>
<tr>
<td>Instagram likes proportion</td>
<td>0.2135</td>
<td>0.00662</td>
</tr>
<tr>
<td>Facebook comments</td>
<td>0.0062</td>
<td>0.00075</td>
</tr>
<tr>
<td>Instagram comments</td>
<td>0.0039</td>
<td>0.00056</td>
</tr>
</tbody>
</table>
Figure 5. Comparison of the average reach for otter art photos (black bars) and the number of people who follow each social media platform (grey bars). Despite having more followers on Instagram, art photos reached more people on Facebook. Posts were made during summer of 2020 and winter of 2020-2021 on the North Coast Otters’ Facebook and Instagram pages. Followers were recorded in March of 2021.

Environmental messages reached more people on Instagram (mean 433.3, SE 23.7, N = 30) than on Facebook (mean 340.8, SE 49.7, N = 29; Z = -2.173, P = 0.03). Messages also had more likes as a proportion of their reach on Instagram than they did on Facebook (Z = -4.703, P <0.001; Figure 6).
Figure 6. Proportion of likes for images of art and environmental messages on Facebook (black) and Instagram (grey). While Instagram had higher proportions of likes for both types of posts, the difference between platforms is larger for art images. Posts were made during summer of 2020 and winter of 2020-2021 on the North Coast Otters’ Facebook and Instagram pages.

Differences between artists’ statements and sub-themes

When combined, environmental and indigenous artwork reached more people (mean 1290.2, SE 202.1) than abstract artwork (mean 989.2, SE 305.7; U = 119.0, P = 0.036). The combined categories of environmental and indigenous otter art (mean 0.227, SE 0.007) received more likes as a proportion of their reach than abstract otter art did on Instagram (mean 0.196, SE 0.011; U = 100.0, P = 0.009; Figure 7). Indigenous art images reached more people (mean 1964.8, SE 446.9) than environmental and abstract otter art on Facebook (mean 961.78, SE 171.0; U = 47.0, P = 0.006). Indigenous art images
received more likes as a proportion of reach on Instagram (mean 0.241, SE 0.011) than other art images (mean 0.207, SE 0.041; U = 59.0, P = 0.02; Figure 7).
Figure 7. Average number of people reached on Facebook (top) and likes as a proportion of reach on Instagram (bottom) for each main theme. Indigenous art reached more people than other categories on Facebook. Environmental and Indigenous artwork received more likes as a proportion of reach than abstract artwork. Posts were made during summer of 2020 and winter of 2020-2021 on the North Coast Otters’ Facebook and Instagram pages.
Otters with anthropomorphism reached more people on Instagram compared to otters without anthropomorphism (U = 57.5, P = 0.004; Figure 8).

![Bar graph showing average number of people reached with and without anthropomorphism.](image)

Figure 8. Otters with anthropomorphism reached more people on Instagram (black) than otters without anthropomorphism (grey). Posts were made during summer of 2020 and winter of 2020-2021 on the North Coast Otters’ Facebook and pages.

On Instagram, environmental messages that contained facts about ecology or information about native language and culture (mean 470.7, SE 44.5, n = 15) reached more people than environmental messages about otter behavior (mean 395.9, SE 12.2, n = 15; U = 62.0, P = 0.036). Environmental messages that had the primarily green photo for their background received more likes as a proportion of their reach on Facebook (mean 0.081, SE 0.005) and Instagram (mean 0.134, SE 0.011) than purple or blue photos on Facebook (mean 0.068, SE 0.003) and Instagram (mean 0.1076, SE 0.0059; Table 6).
Table 6. Summary of Mann-Whitney U Test statistics for difference of means between social media analytics for environmental messages with a green photo and other colored photos. Posts were made during summer of 2020 and winter of 2020-2021 on North Coast Otters’ Facebook and Instagram pages. One less photo was shared on Facebook than Instagram due to a technical issue. Number of likes a post received as a proportion of the number of people it reached.

<table>
<thead>
<tr>
<th>Social Media Analytic</th>
<th>U</th>
<th>Green (n₁)</th>
<th>Not Green (n₂)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook likes</td>
<td>55.0</td>
<td>10</td>
<td>19</td>
<td>0.044</td>
</tr>
<tr>
<td>Instagram likes</td>
<td>45.0</td>
<td>10</td>
<td>20</td>
<td>0.016</td>
</tr>
</tbody>
</table>

Number of likes a post received as a proportion of the number of people it reached.
Citizen Science Records

One artist submitted wild river otter observations before the start of the project. There were four artists who submitted an observation after the North Coast Otters project was launched in July 2019. All four artists submitted one submission, ranging from September 2019 to May 2020. No observations were submitted by this group of artists from June 2020 to February 2021. The artist who had previously submitted observations had not submitted any additional sightings after June of 2019. Of the 111 artists, less than 4% submitted observations after participating in the project. The difference in frequency of citizen science observations made by artists before and after the start of the project was not significantly different ($\chi^2 = 0.8, P = 0.371$). However, it should be noted that otter sightings are inconsistent by nature. It is very likely that participants in the art initiative are aware of the monitoring project, but simply have not seen any otters to report.
DISCUSSION

In their interviews, artists discussed why nature is important to them, how their work expresses their connection to nature, and an overall appreciation of river otters on the North Coast. While there was a trend across artist statements expressing appreciation or concern for nature, there were an equal number of explicitly nature themed sculptures and abstract sculptures. Social media posts of otter art received more social media response than posts of environmental messages. Additionally, responses were similar across the categories and sub-themes. Artist interviews, statements, and the online response to the artwork on the North Coast Otters’ social media pages anecdotally supports the idea that river otters were viewed positively by this community. The artists’ sentiments were positive towards river otters, ranging almost indifferent to “favorite animal”, and the social media pages generated thousands of likes and hundreds of comments.

These playful predators may serve well as a flagship species, as the public connects emotionally to river otters. Evidence that the interviewed artists connected to river otters is seen in the prevalence of personified otters. Artists portrayed otters wearing clothing representing hobbies (birdwatching, scouts, and dancing), connections to the HSU, and local culture. Amiot and Bastian (2016) suggested that anthropomorphism may be one way that we show solidarity with animals. By reflecting themselves through their interests, artists express a similarity with or empathy towards otters, blurring the line between human and animal. Additionally, ‘anthropomorphism’ was the sub-theme that
had significantly higher social media engagement, reaching more people on Instagram than otter sculptures without anthropomorphism. Beres (2019) had a similar finding using personification on social media posts of un-charismatic animals, suggesting that using emotion to relate to an animal increases the social media engagement. My finding supported the hypothesis that certain aspects of the otter art might be more impactful on social media than others.

One characteristic of otters that might facilitate an emotional connection is their ‘cute’ faces, with large eyes and puppy-like features. Artists commented on the pleasing aesthetic of otters, and the frequency of realistic otter faces on the artwork highlights an appreciation of these furry faces. This idea is supported by studies that have applied the concept of ‘Kindchenschema’ to non-human species (Little 2012; Golle et al. 2013). Kindchenschema described by Lorenz (1943) is the attraction to faces that possess infant-like features (large eyes and round faces) and perceiving them as cute. Another characteristic that grabs public attention is their behavior which can be both athletic and ‘playful’. While the interviewed artists represent a small portion of the group, descriptions of wild otter sightings and the otter’s role in enjoying local watersheds expressed that river otters were important to the enjoyment of these shared habitats. These stories of wild otters complement the number of painted motifs depicting otters swimming together on the actual otter sculptures.

There may be costs to preferentially promoting large, charismatic flagship species in awareness campaigns as opposed to promoting biodiversity (Clucas et al. 2008). Roberge (2014) found that a bias towards charismatic species is present on at least one
social media site, Twitter. However, for this community river otters may be a valuable in use as an umbrella species to protect less charismatic species such as wetland plant species. While it may be possible to raise awareness in the community for broader ecosystem conservation, river otters not only are engaging in-person, but they are able to do so through a screen. Their cute faces and observable social interactions emotionally engage a viewer, forming lasting connections to the river otters as well as the places where these “magical” moments can be witnessed.

A love of nature was expressed in both interviews and in the artist statements. Surprisingly, the proportion of environmental and abstract themed otters was similar, despite three of the four suggested messages given to artists being focused on nature or science. Artists represented the environment in a variety of ways that may not explicitly appear to be environmentally themed. Leaving the interpretation up to the artists, as opposed to directing the art to be specifically related to local flora and fauna led to a wide range of images that ultimately allows for a wider audience to be engaged with the project. This is supported by the fact that social media responses were not higher for otters with environmental sub-themes (e.g. wildlife). The full effects of variety in the sculptures will be seen upon completion of the in-person festival and outreach events. A follow-up to this study would be to survey participants of the in-person festival to see if this pattern continues.

There were many motifs that depicted wildlife species that river otters share their habitat with. In environmental education, understanding local food webs has been suggested as one way to connect children to nature (Sobel 1996). North Coast Otters
seeks to educate both children and adults during the in-person festival. The depictions of food webs and ecosystems on the otter sculptures will hopefully serve as an educational tool for all ages. We cannot know how many of the artists that included wildlife had that knowledge already or educated themselves before painting. However, under the assumption that this sample of the local population has relatively similar ecological knowledge as the rest of the greater community, this provides some hope that there is awareness of river otters and their importance in the ecosystem. Alternatively, it suggests that people may be interested in learning about river otter ecology after learning about this project. This of course would require further research to help determine.

In an increasingly globalized world, online platforms provide access to stakeholder groups that may not be in the geographic area of a focal species or habitat. For example, a payment for ecosystem services project that utilized the Bobolink (Dolichonyx oryzivorus) as a flagship species for grassland conservation in New England has generated support across the country, with donors from California and 14 other states contributing to the project (Chakrabarti et al. 2019). While most of the followers for the North Coast Otters pages were in the U.S., between 1 and 5% of follows on both platforms were from the U.K., Australia, New Zealand, other European countries and Indonesia. Baldwin and Chandler (2010) suggested that environmental art projects may have different impacts on residents of the area and tourists, with tourists expressing concern on a more global scale. The appeal of environmental art may help promote awareness of the North American river otter in places where the species does not exist or could extend to appreciation of other otter species globally. The scale for this project is
currently small, however this information adds to previous knowledge of how environmental art may be impactful and adds an online component.

Whether conservation groups are generating support through funding or citizen science, spreading education and awareness is an integral part of the process. Social media can be used specifically to educate the public about wildlife conservation. However, not all sites are created equal. Social networking sites (SNS; e.g. Facebook) help to spread information from person to person through fostering dialogue between experts and non-experts (i.e. posts), as well as information between non-experts (comments). In marketing, these conversations are referred to as electronic word of mouth (eWOM), and they have been shown to build connections on open SNS such as Facebook (Gvili & Levy 2018). Suggesting that while visuals are important to catch a viewer’s attention, the social interactions on these types of pages are sharing information as well. Microblogs (e.g. Instagram) are platforms that allow expert groups to publish information in a way that forms a story as more posts share information over time. While Instagram has also been shown to help develop two-way communication, it can reach a wider audience than platforms like Facebook (Dale et al. 2021).

There are a few takeaways from the social media analysis. It is of note that over three-quarters of the followers on social media were women. A large body of evidence has shown that women have stronger pro-environmental values than men, due to underlying personality trait differences such as consciousness (Desrochers et al. 2019). Despite demographic similarities between users including gender and geographic location, there were significant differences in the reactions to posts. Some of these
differences may be explained by the differences in SNS and microblogs. The variation in findings is consistent with research done on the difference in motivations to use SNS and microblogs; SNS users are more influenced by the social interaction aspect of the site and microblogs are more often used to share information (Liu et al. 2019). This may explain why there were more comments on Facebook posts than on Instagram posts of otter artwork. Not surprisingly, otter artwork reached more people than environmental messages. Understanding why this is important requires some knowledge of how social media algorithms work. Posts are “sorted” to prioritize what the algorithm thinks you would like to see, using a “snowball effect” (Barnhart 2021), resulting from the likes and comments a post gets. That means that likes and reach are reciprocal, although not directly related because of other factors such as timeliness of the post and how often a user interacts with a page. The artwork created more of a “buzz” than the environmental messages, and this allowed it to be spread even further.

Between platforms, Facebook users interacted with and therefore spread images of art more than users on Instagram. Anecdotally, we saw that many of the people following and liking the Facebook page posts were both participating artists and other artists in the community. We also saw that photos were frequently “shared”, which may have been the reason for the high reach of some photos. The public interest in art may have helped generate support for our project, and therefore helped spread awareness better on Facebook than on Instagram. Conversely, environmental messages reached more people on Instagram than they did on Facebook, showing different trends for the types of posts. Dale et al. (2021) showed that Instagram may be able to “cast a wider net”
of engagement than Facebook for communicating scientific information. The findings from the North Coast Otters social media pages builds on the results of Dale et al. (2021), although there are some differences between the findings. There were more followers on the North Coast Otters Instagram, and otter art posts received more likes as a proportion of reach, however they reached less people on average than the same post on Facebook. Environmental messages did reach more people on Instagram than on Facebook, and also had more likes as a proportion of reach than they did on Facebook. It seems that for the North Coast Otters’ audience, information in the form of text was better received on the microblog platform. There is a missing piece of information that requires further investigation to understand the overall differences between the two platforms. More research should look to see what drives reach on each site and methods of improving reach. Possible solutions include marketing techniques to maximize the snowball effect of the algorithm, or creating content that is more likely to be shared by viewers.

With insufficient funding for wildlife conservation coupled with increasing need, it is important to maximize available funds (Echols et al. 2019). Programs such as citizen science may maximize their audience by focusing on SNS where participants can virtually come together and discuss sightings. The communication and sense of community developed on these sites can assist with maintaining and recruiting citizen science volunteers (Dickinson et al. 2012). Facebook also has event-planning functions that allow users to learn about citizen science events, bringing a virtual community to the field. Educational campaigns may better focus their efforts into visual microblogs where the audience is more receptive to direct information. Martin and McDonald (2020) found
that compared to Twitter (a non-visual microblog), Instagram may be better at engaging a non-scientific community in scientific communication. While SNS foster interactions about current topics, when an event or conversation has passed it becomes lost in the algorithm. Microblogs on the other hand can be picked up at any time, and a viewer can scroll back through the artistic tile images and easily learn about information that was shared long ago. Conservation initiatives with limited funding may benefit from directing their time and money to SNS for local community engagement, and to microblogs for widespread education campaigns.

From an outreach and management standpoint, it is a logical deduction that visualizing nature would be the best way to engage this audience. However, engagement on Instagram or Facebook between environmental themed otters and other artwork were similar. The category that did ‘the best’ was the otters painted by Native artists which contained indigenous symbols and images. The indigenous artwork analysis showed high standard deviation and standard error, either as a result of an outlier or because the test is a false positive result for significance of difference in mean values. However, it is included in the analysis and this discussion because of the ethical ramifications. The project sought out Native artists, inviting them to participate as an attempt to be equitable in the distribution of artistic opportunity and to raise marginalized voices. Whether the images themselves or the inherent resiliency in indigenous art caused higher viewer engagement cannot be known. Native American art is often romanticized and monetized (Rangel 2012). This project sought to promote Native artists, not to promote North Coast Otters using Native artists.
North American river otter numbers in the United States have greatly expanded in the past 50 years (Roberts et al. 2020), however continued citizen science monitoring will help maintain an accurate understanding of local population dynamics (Black 2009). I was not able to unravel the disconnect between appreciating citizen science and river otters, but not participating in the monitoring project. Overall, opinions toward citizen science were very positive. Two artists expressed hesitancy towards the project but were still in favor of it. In a survey of South African divers, Lucrezi et al. (2018) found that a barrier to participation in citizen science was that divers just wanted to enjoy themselves when they were out. This sentiment was expressed by one artist and should be further explored among citizen scientists and the public.

Interviewed artists overwhelmingly expressed both a concern for nature and a desire to participate in pro-environmental behaviors. This data from a small sample of the artists is supported by the fact that 90 of the 103 statements contained one or more of the themes expressing a connection to or understanding of nature. In addition, many artists expressed specific appreciation or concern for otters or their habitat in their statements. Artists were informed of the impact this project would hopefully have on the citizen science, as well as information on how to submit observations. After establishing that this group of stakeholders has the attitudes, values, and knowledge to participate in citizen science, we are waiting to see an increase in river otter observations. There may be an unknown barrier for participation in this river otter monitoring project, at least for this group of artists. Additionally, the impact of the art on awareness and education may not be the same for artists as will be for the general public. There is still hope that the art
produced in this project will share the appreciation of river otters that artists have, and that there will be benefits to the citizen science project in the future. Quantifying the impacts of art are difficult because impacts from art are self-reported and may be difficult to measure (e.g. emotional changes) (Newman et al. 2003). However, this merging of art and citizen science provides a unique opportunity to track an increase in behaviors in the near future. This project would benefit from supplemental information from citizen science participants to learn more about what has engaged them about the project, especially for those observers who frequently submit observations.

Color theory research looking at the impact of the color of simple objects has found that blue objects are preferred by viewers (Schloss et al. 2013). Thommes and Hayn-Leichsenring (2021) found preferences for images of blue birds on Instagram when compared to green, yellow and red birds. For North Coast Otters, blue otter sculptures were the most common, however the response on social media was similar across all colors when tested. For environmental messages, green posts were the ones that showed higher levels of engagement. The high levels of variability in each post despite attempts to standardize the process may have affected this outcome. While color may be important for social media marketing, more research could look at the effects of color as contributing factors to complex images on social media.

There may be lessons from this project that could be applied to other otter conservation programs around the world. The third “stepping-stone of otter conservation success” put forward by the IUCN Otter Specialist Group is to “engage community support and develop respect for otters” (Duplaix & Savage 2018). Portraying otters that
are persecuted either for their fur or their cuteness in an artistic and unique way may provide a new platform for conversation, education and hopefully awareness. This research was limited in part due to the relatively small sample size of quantitative data, as well as its applicability to other environmental art projects. Additionally, there are not standardized methods for evaluating art in the context of scientific communication, or environmental behavior engagement. Future studies should address the need to compare community-based arts initiatives and their impacts. The information describing the artwork will serve as a baseline for further research when the North Coast Otters art festival is able to go on as initially planned. Hopefully, environmental art and social media research will continue, and the ideas brought up in this research can be developed further.
REFERENCES


Appendix A

Appendix A. River otter Fact sheet given to North Coast Otters artists during the summer of 2019.
Appendix B

Appendix B. Interview Guide used in artist interviews from November 2019 to February 2020. Interviews took place in public locations in Humboldt County, CA.

1. Would you like to share a little bit about yourself?

2. How did you get involved with the North Coast Otters Project?
   a. Probe: artist background, previously held values about nature

3. What were your ideas about river otters before the project?
   a. Probe: experiences in nature, type of encounters with wild otters, awareness of local natural history, wildlife biology, general knowledge that may affect values

4. Can we talk about what you thought about nature before participating in the project?
   a. Probe: process of art changing values

5. I’d be interested in hearing about your artistic approach if you’d be willing to share?
   a. Probe: interests in nature and how that affected the art process, similarities/differences to other projects

6. What are your ideas about watersheds and wetlands in our community?
   a. Probe: awareness of local natural history, wildlife biology, general knowledge, environment and the sense of self

7. Are there other ways you are involved with our wild places and the animals that live there?
   a. Probe: reasons for environmental responsibility, how values play into action

8. What is your opinion of citizen science?
   a. Probe: participation in citizen science, knowledge of River Otter Citizen science network, likelihood of future participation
9. Is there anything else you would like to share about your experience?

a. Probe: any parts of the project you enjoyed more/less than others, suggestions for things to do differently?
Appendix C

Appendix C. Photos of otter art used on the North Coast Otters Facebook and Instagram pages during the summer of 2020 and the winter of 2020-2021. Photos are shown here in the order that they were shared on social media. Categories are abstract (A), environmental (E), and indigenous (I).
Appendix D

Appendix D. Photos of environmental messages used on the North Coast Otters Facebook and Instagram pages during the summer of 2020 and the winter of 2020-2021.
River otter moms on the North Coast may have 1 - 4 pups a year and provide milk for the pups' first weeks of life.

On the hunt in unusual places! Otters can be found in places on the North Coast like dunes, beaches, even the ocean in their never-ending search for food.

Otter latrines aren't just bathrooms for river otters - they also serve as sites for investigation and communication through the sense of smell.

Scientists have learned a lot about otters by looking in unlikely places...their scat or spraint provides clues to what our neighbors found for a tasty meal.

For native artists on the North Coast, every natural being has her or his own story, and/or it's own song. This includes the water, plants, and animals. There is an interconnectedness at an emotional level.

Some river otters forage along the shallower parts of the ocean along our coasts, but they need fresh water for bathing and drinking each day.

Think your couch is lumpy? River otters make places to relax by flattening reeds and cattails in dense marshes.

Twelve of the 13 species of river otters are listed as endangered or near-threatened; our river otters in northern California are making a comeback.

Mother river otters lead the way by teaching their young how to survive through play.

Just like us, river otters need clean water and fresh food each and every day.

Despite their cute appearance, river otters are the top predators in coastal watersheds, rivers, and wetlands.

Our community's commitment to saving water now means that this finite resource can be protected for generations of people and otters to come!
Only 1% of the native saltmarsh that once covered the edges of Humboldt Bay exists today, making our restored and protected wetlands important habitats.

Whether they’re looking for food to eat, or friends to play with, you rarely see river otters sitting still! Being as active as they are, they must eat well to stay healthy.

Healthy habitats make the difference between well-fed & hungry otters. When you see a wild river otter, wish them good luck in their search for clean water.

The clean, cold waters of the North Coast have ample nutrients for fish and other water creatures, making healthy habitats for river otters.

River otter numbers have expanded thanks to efforts to restore and clean up habitats, but otters need our continued vigilance for a secure future.

Seeing a river otter in the wild is a sign of a healthy habitat, clean water, and one tough otter!