Communicating the Science of Climate Change:
Connecting with the Public

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Executive Summary:
59% of the American public denies that climate change is the result of human activity (Leiserowitz et al. 2013). Without the support of the public, organizations like the Vermont Department of Fish and Wildlife cannot maintain the finances needed to protect their natural areas and the organisms that inhabit them. The goal of our project is to create an effective communication plan for the Vermont Department of Fish and Wildlife. It will communicate conservation issues in an effective and easy to understand manner. This will also be used as a template that other organizations can base their own communication plans from.

We have several objectives pertaining to this goal, including: researching effective science communication, creating a film on the effects and mitigation techniques of Tropical Storm Irene, creating a flood resiliency conservation plan for the Vermont Department of Fish and Wildlife, and developing a survey to assess public outlook on our conservation issue. We will utilize the information we gain from the surveys and interviews to aid in our current understanding of proper science communication, which is presently supported by our research. The main idea is to communicate the importance of conservation to the public (which will indirectly aid in supporting climate change) in a friendly and easy to understand manner.

What is the issue at hand and why is it important?
A large portion of the general public denies human-caused climate change despite overwhelming scientific consensus that global climatic shifts are related to increased CO2 emissions. This is a product of the disconnect between scientific consensus and public understanding (Figure 1). Due to this dilemma, organizations such as the Vermont Department of Fish and Wildlife, whose mission statement and goals are impacted by climate change, struggle to gather much needed support for conservation issues. It is important that the public develops a relationship with the world around them and understands the role science plays in that union. It is essential that effective communication takes place to bridge the disconnect and foster support for pressing issues at hand, such as increased flood events and the importance of flood resiliency.
Figure 1. This figure illustrates the disconnect between the public perception and scientific agreement (theconsensusproject.com)

Our Goal:
The goal of our project is to provide a medium for the Vermont Department of Fish and Wildlife that can communicate conservation issues in hopes for increased public support and funding. This medium can also be used as a template for other organizations.

Our Objectives:
1. Research and utilize literature on effective science communication techniques.
2. Develop a short film on Tropical Storm Irene, its impacts, and mitigation techniques.
3. Develop a conservation plan on flood resiliency for Vermont Department of Fish and Wildlife.
4. Develop a survey designed to assess the general public's outlook on certain conservation issues.

Our Plan:
There are two groups for this project, each maintaining the following focuses:

1. Conservation Group:
   Stressor: Flood events
   Receptor: People living within the floodplain and the surrounding ecosystems
   Assessment Endpoint: Improved infrastructure and flood prevention techniques

2. Communication Group:
   Stressor: Climate Science Deniers
   Receptor: Local and Global Population
   Assessment Endpoint: Potential changed outlook on issue presented to audience member
Methods/Approach:

In order to approach the problem, gathering stakeholder opinions is critical. By exploring the lasting impacts of Tropical Storm Irene we aim to engage stakeholders and the general public in a productive dialogue designed to further our understanding of flood resiliency and its implications for the future. Through engagement with public groups, we are attempting to develop a more holistic view of the issues at hand while facilitating community involvement and cooperation. We engaged with the public through a few different mediums, one of which is a survey on the experience of Tropical Storm Irene. The survey allowed us to gauge the variety of understandings and opinions held by the general public, as well as prompt the people taking the survey to think about the situation. Another medium we used is film. Film is a method that allows people to physically see something, to relate to it, and to develop emotions on the subject because of what they are seeing and hearing. We also conducted several interviews with a variety of different people. These interviews were used in the film to give people an idea of how the storm affected others. It is not our intent to force any beliefs upon anyone but to provide facts and experiences that individuals can draw from in order to further develop their own position on the issues at hand. Producing a short narrative documentary film about the impacts of Tropical Storm Irene, using personal interviews as well as footage of the major storm event, will be used in an effective communication piece that agencies like the Vermont Department of Fish and Wildlife can utilize in the future.

Findings:

The Science of Climate Change:

Earth’s climate is changing in ways that influence weather, oceans, snow, ice, ecosystems, and society. Natural causes cannot explain all of these changes. It is the consensus of the scientific community that human activities are the root cause of these drastic changes (US EPA, 2014).

Due to the release of carbon dioxide (CO₂) from very old, large stores of carbon deep underground in the form of fossil fuels, the Earth’s average temperature is rising. This is because CO₂ is a greenhouse gas, trapping heat in the Earth’s atmosphere like a blanket. The more CO₂ released, the more heat is trapped. All life forms that are currently on the Earth are used to living within a certain temperature range. If temperatures continue to rise, we will see changing environments for all of Earth’s life forms, including humans. Some impacts of a rising global temperature include but are not limited to; sea level rise, ocean acidification and loss of coral reefs, increased extreme weather events such as drought in some places and precipitation in others, and all-around changes in community types that are capable of living in certain regions of the Earth (Adair, 2015).

State of Public Knowledge:

97% of climate experts agree humans are causing global warming (Doran et al. 2009, Anderegg et al. 2010). However, only 41% of the American public agrees that climate change is
happening and that it is the result of human activity (Leiserowitz et al. 2013). Not only does the public not agree with scientists on this issue, but 55% of the public does not think that there is a scientific consensus on global warming (theconsensusproject.com). Clearly, there is a gap in understanding between scientists and the general public. What impacts people’s belief systems and how to effectively communicate controversial issues in light of people’s beliefs is further explored.

There is a large array of various media and news outlets available to the public, offering people the opportunity to choose which sources they derive their news from. It has been found that people most often select new sources that align with their own belief systems and political attitudes, consequently leading people to insulate themselves into an “echo chamber” (Feldman et al. 2014). This “echo chamber” effect, begins when an audience’s belief about something, global warming for example, drives them to select a media source or news channel that supports their understanding or beliefs about global warming, which in turn further strengthens their views about global warming and thus continues in an on-going vicious cycle. The “echo chamber” effect can help explain why the large amount of scientific evidence stating global warming is happening and is caused by human activities has failed to make significant traction amongst conservative or viewers of conservative media, because conservative media dismiss any idea of global warming so no new information enters the audience’s chamber or worldview (Feldman et al. 2014). This makes it extremely challenging for policymakers, climate scientists, or environmental organizations like the Vermont Fish and Wildlife to achieve mutual understanding and the ability to settle on some of the most pressing issues of today.

**Basic Science Communication:**

Chris Mooney, author and journalist who focuses much of his research and writing on global warming and the evolution-creation controversy published an article titled, “Science of Why We Don’t Believe Science.” Mooney points to the theory of motivated reasoning to help explain why some people are so polarized to certain subjects and cling to false beliefs despite proven evidence. The theory of motivated reasoning states that reasoning is emotion-biased and our emotions color how we see facts (Mooney, 2011). Our positive and negative feelings about things, beliefs, or theory arise much more rapidly than our conscious thoughts, and it’s these quick-fire emotions that create highly biased thinking.

Arthur Lupia, political scientists at the University of Michigan acknowledges the basic human survival skill, our fight-or-flight reflexes don’t just apply to predators, but to information itself and the fact that we tend to push threatening information away and pull comforting information close (Mooney, 2011). Climate scientists should use this information and work to relay their data in a non-threatening way so as not to trigger the fight-or flight reflex. It’s important to offer solutions in order to foster hope to promote action rather than feelings of helplessness, which lead to inaction. According to Feinberg and Willer (2010), people that are presented with a climate scenario which “doom and gloom” was an inevitable outcome are less likely to accept the science when compared to a scenario in which solutions were offered. In addition, it’s important to frame the scientific message with words or phrases that allow the audience to connect with rather than threaten them, and this can be achieved by knowing your
audience and relating their personal experiences to the issue at hand. Commonly, people will not care about or do not understand certain issues if they are perceived as being “distant issues affecting far away places,” so first hand experiences allows individuals to resonate with issues, like global climate change (Egan & Mullin, 2012). For example, people working and living closely with nature such as skiers or farmers experience weather changes more intimately and are able to witness first-hand the direct impacts of climate changes, such as decreased snow on the ski slope or a bad crop year for a farmer. It’s important to note that by putting a positive spin on your message instills hope amongst your audience, which is crucial so as not to discourage people from thinking the problem is out of their hands and unchangeable. For example, instead of saying, “we must reduce or regulate X or else CO2 levels will reach X,” one can positively spin the statement to “we have the innovation, ingenuity, and entrepreneurship to rise to the challenge of X.” Determining the appropriate word choice for presenting to one's target audience is critical for effective communication. Technical scientific jargon does not have the same meaning to the public. Figure 2 demonstrates common scientific terms and their different meanings to the non-scientific community and should be referenced before engaging in a presentation.

![Figure 2: Commonly used terms amongst the scientific community that possess double meaning and can be interpreted in a completely different way among the public (Somerville & Hassol, 2011).](image)

One obstacle climate experts face in communicating to the public is changing people’s original thinking. An article by Cook & Lewandowsky (2011) explains how myth debunking can be studied and implemented in order to overcome the consensus gap. It is crucial to know your audience and take care not to further reinforce the myth or falsity by avoiding three specific backfire effects. First is the Familiarity Backfire Effect in which attempting to debunk a myth actually further reinforces the myth (Figure 3).
Figure 3. Simply illustrates the Familiarity Backfire Effect - The details of the myth become blurry and the more the myth is brought up, even with details to debunk it, the more the myth is remembered (Cook & Lewandowsky, 2011).

An approach to ensure this does not happen is to stick to the facts and avoid bringing up the myth all together. Next is the Overkill Backfire Effect. Schwartz et al. (2007) found that information that is easier to process is more likely to be accepted as true. The bottom line is to keep it simple with a few memorable facts, rather than spitting out as much information as possible about a subject because understanding leads to accepting the science as true. Lastly, the Worldview Backfire Effect must be avoided in order for people to not feel threatened by information and subsequently closed minded to new ideas that threaten their worldview. As effective communicators, scientists need to recognize the cognitive processes that can lead to unconscious information bias. Taber & Lodge (2006) show that when people are presented with facts, they tend to gravitate toward facts that they already agree with. The main approach to avoiding this backfire effect is to know your audience, connect with their values, and ensure that you do not threaten their worldview by working to reframing statements to be non-threatening. Scientists need to understand that it is not what people think but how they think. The last and possibly most important aspect of successful myth debunking is to fill the gap that is created in the audience’s mind with an alternative factual explanation (Figure 4).

Figure 4. Fill the gap that has been created with the factual explanation you want the audience to walk away remembering (Cook & Lewandowsky, 2011).
Figure 5 shows how scientists are trained to think and therefore think the same when communicating to the public, where background and details lead to the results. Rather than boring the public with details and losing their attention, an effective communicator should begin with the bottom line - encapsulating the public’s attention with something they value, communicating why they should care, and then following up with supporting details.

![Figure 5](image)

Figure 5. Scientists are able to communicate more effectively by inverting the way they present results to their fellow colleagues (Somerville, 2011)

A study conducted by Brendan Nyhan and Jason Reifler took a group of people with the same political background and misperceptions about climate change and broke them up into two separate groups. The first group was given information on rising global temperatures in text form such as a report a scientist would write up. The second group was given a graph that relayed the same conclusion. Afterward, they discovered the group with the graph had less misperception than the group given the text. Figure 6 shows the results of people who continued to believe the global temperature was still decreasing based on how the information was presented. The study concluded presenting graphical information on scientific calculations is easier to communicate to the rest of the public than a detailed scientific report. At the same time, there are other factors that influence public support such as how well the economy and job availability are doing in one’s country. Shown in Figure 7, as unemployment rate increases, priority levels for the environment and jobs alternate. If unemployment rate is high, jobs overtake the environment and global warming as top priority. Linking job availability with environmental action can fill the gap and show the public both priorities can be addressed at the same time without damaging the economy.
Figure 6. Percentage of people who still believed global temperatures were decreasing after either reading the text or interpreting the graph.
Tropical Storm Irene Survey

The ten-question survey we constructed is designed to develop an understanding of the public opinions surrounding the events that took place during and after tropical storm Irene. Over 100 people took our survey online and a majority of the responses we received indicated that there is support for increasing flood resilience in Vermont. Many people who took this survey experienced the storm event first hand and believe that this type of storm could happen again in their lifetime. Figure 8 shows the breakdown of responses we received for two of the questions asked in the survey which indicates that there is in fact support for altering our infrastructure yet people remain undecided as to whether we are better off during the next storm.
The sample size of our survey remains small and likely is not representative for the entirety of Vermont residents. Majority of the responses came from college students who likely have a different opinion and outlook than other Vermont residents and the results of this study should be taken lightly. However, if this survey were to reach out to a larger audience it could be useful for land managers and policy makers across the state as a springboard to further develop the flood resilience dialogue.

Conservation Plan

Vermont is a nationwide leader in attempts to prepare communities for catastrophic floods (Planning for Flood Recovery and Long-Term Resilience in Vermont, 2014). Many towns are located directly in the floodplains of the state’s rivers, especially within the Lake Champlain and Connecticut River basins (Figure 9). During large storm events with high peak flow developed areas alongside the river channels are put at risk to flooding and destruction (figure 10). Tropical Storm Irene devastated towns located in floodplains across Vermont and cost the State millions of dollars in disaster relief funds (Pealer, 2012). The Environmental Protection Agency has created a flood resilience checklist for communities; since towns can not simply be moved, this checklist helps ensure a town is as prepared as possible for the next flood event. This includes having storm water infrastructure or drainage ponds, lining up recovery plans with FEMA, and ensuring new development occurs outside of floodplains. Vermont itself created a comprehensive long-term flood resilience plan in 2014 that the EPA, on its website, encourages other communities to use.
Figure 9: This illustration shows the different areas within the greater watershed and their associated risk.
Figure 10: This series of images illustrates the processes that take place in river corridors that lead to unintended property damage and ultimately reduced flood risk.
Those strategies, however, are simply suggestions. Many of those suggestions are vital to protecting towns and mitigating flood damage, but more direct action needs to be taken in order to ensure resilience to floods, as it is a matter of when, not if, the next flood is coming. The Vermont Fish and Wildlife Department is charged with protection of many of the state’s rare and vulnerable habitats. The department works with the Natural Resource Conservation Service to run the Wildlife Habitat Incentives Program (WHIP), which has projects to assist landowners interest in conserving habitat. Projects related to riparian communities include installing culverts for fish passage, improving stream bank stability, creating larger riparian buffers, and improving degraded wetland habitats. All of these improvements have a positive effect on flood control. Wetlands and riparian buffers slow rising waters. Culverts often have the capability to allow greater flow in the face of rising water. Stable stream banks greatly reduce the risk of erosion. (Hoorman, 2014). Legislation concerning wildlife is often overlooked; many chunks of land are dedicated to protecting habitat for endangered species or rare natural communities. Floodplains and wetlands should not be an exception so they can be utilized to also protect communities from floods.

The list of specific conservation actions that aid in flood resilience is long. However, the plans laid out by the state and the EPA tend to focus on engineered solutions as opposed to conservation actions that also have a major role in improving flood resilience. Flood resilience plans should include wetland and floodplain protection and restoration. Wetlands provide one of the main forms of defense for uplands in the face of floods as they act as a reservoir for rising waters, reducing the peak flow and prolonging the discharge in more manageable increments. and slow down faster flows. Figure 11 shows the differences in stream behavior following tropical storm Irene within the Otter Creek watershed in two different urban areas. Rutland is located upstream of Middlebury and thus it is surprising that peak flow experienced in Middlebury is less than that of Rutland. The author of this study (McDavitt, 2015) attributes the significant network of wetlands that exist between the two urban areas as the likely cause in the reduction of peak flow. This supports the notion that land use and water retention in wetlands plays a major role in mitigating flood risk. In areas that are already developed the creation of artificial wetlands should be considered for long term flood resilience plans (Kadlec, 2004).
Discussion and Recommendations:

This report includes findings from an extensive and in depth literature review pertaining to science of communicating science. Many of the findings and figures detailed in this report could be of use to our community partner and other people/agencies who desire to be more influential to the general public. The visual piece is designed to provoke emotional responses to real life events thus grounding our communication findings in reality. The effectiveness of this remains to be seen yet the film has the potential to reach a large audience. To further understand how this visual piece affects public outlook one could develop a before and after questionnaire that could be filled out during screenings. This questionnaire could be a springboard for further dialogue within community groups as to how they wish to address flood resilience moving forward. Our conservation plan focuses on the issues at hand and the relationships between land use and flood events but it falls short in providing specific recommendations and prioritization. Thus it remains the task of the Vermont Department of Fish and Wildlife to provide management alternatives to communities across the state. The purpose of this report is not to determine the areas that need to be focused on but to provide effective techniques to present and gather support from local communities.

Figure 11: Mean daily flow and unit discharge in the Otter Creek watershed in both Rutland and Middlebury.
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