The Salish Sea Expedition: Science Outreach from the Gangplank

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1 Introduction

It is becoming more widely recognized that geoscientists lack the training to communicate their science effectively to the public and policy makers and have a somewhat poor track record in doing so. This is particularly important for those geoscientists whose research has an impact on public policy and community sustainability in areas such as landslides, floods, earthquakes, and other natural hazards, some of which are arguably going to increase in frequency and timing under global climate change (Liverman et al. 2008). It is an enormous challenge to communicate the implications of geoscience issues in language that does not lose a general audience in jargon yet does not gloss over real scientific uncertainties. For example, in recent years climate scientists in particular have been struggling with issues of communication of science to the public, and a growing body of literature is helping in bridging the disconnect between climate science and climate policy (Environmental Protection Agency 2012). If, as a scientist, you aren't able to translate your science to the public realm of comprehension, you're leaving that task in the hands of people who may not understand the nuances of the research – you've jumped off the ship and are swimming with sharks.

Perhaps there is no better example of this than the trial that challenges the role of science in L'Aquila, Italy. The court will decide if six Italian seismologists and one government official are responsible for the deaths of 309 people, injuries to more than 1,500, and the destruction of infrastructure that resulted in the displacement of 65,000 people from their homes, following an earthquake on

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April 5, 2009 (Hall 2001). With over 300 witnesses to be called, the trial is expected to reach a verdict by the fall of 2012. The prosecutors accuse the seven of "negligence and imprudence… of having provided an approximate, generic and ineffective assessment of seismic activity risks, as well as incomplete, imprecise and contradictory information" (Hall 2001).

As the 2011 Nature article by Hall states, the seismologists are not on trial for failing to predict an earthquake; they are on trial because they failed to communicate the risk of an earthquake to the public and public officials. This is a clear demonstration of the disconnection between the scientific community and the publics' understanding of science. A citizen of L'Aquila, Vincenzo Vittorini, is quoted in the article saying, "I feel betrayed by science…either they didn't know certain things, which is a problem, or they didn't know how to communicate what they did know, which is also a problem." Although global condemnation of the trial has been expressed by many in the scientific community, the Nature article suggests that accusations of "scientific negligence" may become more common as "extreme" natural disasters associated with global climate change events occur. Even more troubling, right at the moment when scientists are most needed to communicate our scientific knowledge and uncertainties with clarity, the L'Aquila earthquake trial may have the opposite impact of having a "chilling effect on scientist's willingness to share their expertise with the public" (Hall 2001).

2 The Salish Sea Expedition, British Columbia, Canada

The Salish Sea Expedition was an attempt to bridge the disconnect between the scientific community and public understanding of science by stepping out onto the gangplank of public outreach – over waters that aren't always comfortable or familiar for scientists. In October 2010, the Salish Sea Expedition took a Canadian marine research vessel, the *CCGS* Vector, to five communities around the inland Salish Sea, British Columbia, Canada, during the Canadian Science and Technology Week. The Salish Sea, named after the Coast Salish people who lived on its shores for thousands of years, is the new official name for the body of water crossing the international border and encompassing the inland coastal waterways of southern British Columbia, Canada, and Washington State, USA. It includes the Strait of Georgia, Juan de Fuca Strait, and Puget Sound. The densely populated shores of the southern regions of the Salish Sea, similar to the L'Aquila area in Italy, are at risk from major earthquakes and tsunamis due to the proximity of the Cascadia subduction zone just offshore the Pacific coasts of the USA and British Columbia (Clague and Turner 2003).

The objective of the Salish Sea Expedition was to bring marine geoscience topics to high school students and local community members. Small communities on the coast of British Columbia can be isolated by both land and sea, and community members don't enjoy the same access to centers of learning such as museums and universities that exist in larger communities. With a small budget, we weren't able to compete with richer organizations and events in the large population centers.

Fig. 1 High school students from Salt Spring Island in British Columbia, Canada, leave their afternoon tour of the Canadian research ship, the *CCGS* Vector, during the Salish Sea Expedition, in October 2010. The goal of the Salish Sea Expedition was to connect students and community members with the scientific research being done in their local region and give scientists and community members an opportunity to meet face to face and discuss how the science done on *CCGS* Vector is helping their communities plan for climate change and long-term community sustainability in this tectonically active region

By going to small communities, we were able to utilize local newspapers' free community announcement pages, work with individual schools, and have large cross sections of society attend the event. For 1 week, the ship *CCGS* Vector became a floating, interactive science exhibit. Over 2,000 students and community members were invited to tour and talk to working scientists about the science performed on the ship. Information was specifically tailored to link scientific research with the local areas, including how scientific research is helping those communities to plan for climate change and long-term sustainability (Fig. 1).

Each morning the ship docked in a new community. High school level students visited science stations set up around the ship, including stations on sediment coring, plankton sampling, multi-beam imaging, and visits to the bridge of the ship and safety stations. First Nations students in each community were specifically targeted as a group underrepresented in science and technology. Small groups of students

talked directly to scientists about the equipment on board the ship, what research is performed, and how fieldwork translates to work in the lab and eventually policy by decision makers. By demonstrating how the science specifically impacts the region they live in, students were able to see the value and importance of the research and how it directly relates to their lives. In the afternoons, members of the community were invited aboard the ship for the same tour and access to information. From these community tours, we learned that we get a lot of "bang for our buck" by visiting smaller places because everyone in the community comes out to an event.

The limitations of the Salish Sea Expedition were both geographical and confined by tight ship spaces. Scientists and Coast Guard crew on board the ship during the expedition used blogs to describe the event each day. The goal of the blog, website, and two videos created for YouTube was to address the limitations and reach a wider audience beyond the confines of the ship. In a future event, these activities could be further expanded. However, much of the value of the event was having students and members of the public physically explore the ship and talk to the scientists in person. They were able to see scientists out in their environments doing exciting research near their local communities and widening the base of environmental knowledge in the region. And, by tailoring the information to each community, the science became meaningful because people could see how science had a role in their everyday lives.

3 Planning for the Salish Sea Expedition

The Salish Sea Expedition was a unique collaboration between three federal government departments: the Canadian Coast Guard, two Canadian universities, and a private sector aquarium. Development and implementation of the Salish Sea Expedition involved enthusiastic staff of local universities, the Government of Canada, and private organizations, many of whom volunteered their time and squeezed in the planning and writing activities around already full schedules. In the competitive world of science, it can be a difficult choice to dedicate time and energy to outreach while one's peers are using that time to write the always pressing research grants and papers. In the USA, the National Science Foundation has an outreach component to every research grant application requiring a "broader impact statement." This goes a long way to promoting science outreach as part of the stewardship of a scientist's profession and as an important outcome of public research dollars. Such a system in Canada would perhaps also encourage scientists to participate in science outreach activities and help to develop best practices for outreach. It is important to note that although the Canadian federal science funding body, the Natural Sciences and Engineering Research Council of Canada (NSERC), does not require an outreach component of research grant applications, the seed funding for the Salish Sea Expedition came from an NSERC PromoScience grant, a program designed to foster science outreach activities.

The expedition planning team had a multidisciplinary background, including scientists, communications and media specialists, educators, and public outreach specialists.

A similar structure functioned on the ship during the event, with scientists specializing in marine geology, oceanography, and multi-beam technology. Scientists were chosen based not only on their area of research but especially for their ability to explain scientific concepts to people with a variety of educational backgrounds. They were also provided with media training before the event – how to pick a few key messages they would like to get across to their audiences. The Coast Guard crew were also active participants during the event and, while not chosen specifically for their ability to talk to the public, very quickly picked up on the rhythm of outreach activities. Having multidisciplinary groups involved in the project allowed tasks to be assigned to expert groups and ensured a coordinated approach to all aspects of the events.

Because of the varied goals and interests of the organizing parties, it was essential to establish a common goal, key messages, and media strategy to which all members could agree. The overall goal of the event was to interest students and community members in the marine environment around them. The hoped-for outcome was that some of the students will consider a career in science or technology, and that the community members have more information on the environment they live in and some of the geohazards, such as earthquake risk, tsunami, and climate change, that may have an impact on the future and livelihoods of their communities. All members of the planning committee agreed to the goal, and key messages were developed to promote that goal. Committee members also agreed to a coordinated media strategy: all media releases, communications activities like video and blogs, and interviews were developed, approved, and coordinated by the group but with a single person designated as the media contact. This allowed the media contact person to develop a relationship with local media and communities but, perhaps more importantly, presented a seamless, professional "face" for the event.

4 Salish Sea GeoTour Guidebook and Map

As a legacy item, the Salish Sea GeoTour guidebook and map were created during the Salish Sea Expedition. Two thousand copies of the maps were handed out to visitors of the ship. The guidebook and map are government publications by Natural Resources Canada and part of a GeoTour series (Turner et al. 2009, 2010, 2011).

The guidebook and map use a combination of multi-beam imagery, photos, maps, and snapshots of geological information to explain the geology of the Salish Sea region in a format that is easily understandable and appealing to people with no or little education in geology. The snippets of information and visual appeal of the publication were designed to create an interest in the geology of the region for a reader who would not normally pick up a wordier, more scientific publication. The balance between providing some information – but not too much – and written in a format that would be accessible to the target groups was achieved by a collaborative effort between experienced writers and graphic designers with only a basic geological understanding and scientists who perform the research in the geographical areas described in the guidebook. It was a collaborative effort, and a unique and fruitful learning experience for everyone involved.

During the writing process, the biggest "light-bulb" moment for the communications staff was recognizing that scientists see and understand the world very differently than the public does. A "simple" geological concept or method for a scientist can be a completely foreign concept in the public realm of knowledge. For example, text in the guidebook says, "You're looking at granitic bedrock that was once far below the Earth's surface but has been pushed upwards between 175 and 45 million years ago." Editors kept changing it to *45–175 million years ago* because in the public realm of knowledge, the lower number, 45, should come before the higher number, 175. For someone with a nonscientific background, it made perfect sense but was of course completely incorrect.

The scientists' "light-bulb" moment came during the call for photos for the map and guidebook. The communications staff thought they would get lots of great photos of people working in the field, yet instead they got a lot of photos of rock and perhaps a pencil or ruler to show scale. Scientists were surprised to learn that pictures of geologic features are not as interesting to the public as they are to scientists. They learned that every research field trip should include taking some photos that are suitable and intended specifically for public outreach. For example, attractive and compelling photos of geoscience features, which also contain people working, can help the public connect more readily to the science. By having a human in the photo, it makes the science accessible: "what is that person doing?" and leads into the "what" and "why" of the science. Often, scientists are trained to keep "people" out of their writing, but for public outreach, we need to put the "people" factor back in. Our experience during the Salish Sea Expedition was that by adding the "human element," we were able to draw the public into the science and give them a starting point for understanding scientific concepts by making the science meaningful to them.

As another example, during the creation of the guidebook, we struggled to find a way to explain glacial loading and rebound. Our test readers weren't able to actively understand the concept because they couldn't visualize how it works. Once we added in that glacial loading and rebound is like pressing a hand into memory foam, the concept became much easier for them to grasp. Many people understand how memory foam works, so we were able to say the hand pressing into the foam is like an ice sheet, and even after the hand/ice sheet is removed, the foam/land takes time to rebound. By using the human element – memory foam – to explain the scientific concept, guidebook readers were able to relate the science to their own human experience and understanding of a concept.

These examples demonstrate just how differently the public and scientists see and understand the world. They're often speaking totally different languages even when both sides think they're being understood. To be considered credible and unbiased, scientists often remove all reference to people in their discourse. However, to make science more accessible, the public needs to have the human element in the picture. The human element helps the public to relate science to their own lives and experiences. Scientific language can be very exact, while public language is not.

We hope that some of the students who visited the ship will 1 day choose a career in science because they were able to imagine themselves in that role during the

Salish Sea Expedition. As a result, the Salish Sea Expedition was a resounding success judging by local community comments and interest.

Public outreach is a leap out onto a gangplank, but if we don't learn how to do it well, there will be more situations like the L'Aquila trial in Italy.

Overview

Status Quo and/or Trends

- On a small scale, our experiences with both the Salish Sea Expedition and creation of the guidebook and map provide a glimpse into the disconcerting disconnect between science and public knowledge.
- If the public doesn't know and can't understand what science is telling them, we can end up with fairly frightening and possibly life-threatening situations similar to the events in L'Aquila, Italy.
- Scientists believe they are communicating their science to the public and decision makers, as the scientists did in L'Aquila, when in fact it is very easy for their audience to hear and understand a completely different and unintended message.

Challenges to Overcome

- We live in an age where communicating science to a public audience is increasingly important. Science is being used by nonscientific decision makers to make far-reaching policies.
- Science information via the Internet has created a worldwide audience but also an environment where credentials and credibility can be unknown or unproven. The validity of Internet content is a special challenge for youth, where 39 % of children aged 9–17 believe all online content is correct (Scholastic 2010). So, for example, with climate change, science has new meaning to the safety, sustainability, and future of many communities around the world.
- The challenge to scientists is to step out onto the "gangplank" of public outreach and bridge the disconnect between scientific language and public information.

Recommendations for Good Practices

- During the Salish Sea Expedition and writing of the Salish Sea GeoTour guidebook and map, we tried to put the human element into the science so people could understand and relate to our key messages.
- We talked about the research and how that science impacts their community, making the science meaningful to peoples' everyday lives.
- We put faces to the science by having students and members of the public talk to and see scientists doing the work.

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