Envisioning sea level rise in Golden Gate National Recreation Area

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Much of climate science communication tends to focus on the global effects of climate change, highlighting the impacts expected in the coming century. In reality, the impacts of climate change are already being seen and felt, with many United States national parks containing natural and cultural resources that are threatened. Research shows that the vast majority of park visitors are interested in learning about how climate change is going to affect the places they already care about (Thompson, Davis, and Mullen 2013). The challenge for National Park Service (NPS) interpreters is to convey the urgency of acting to address climate change—here and now—to their audiences. Luckily, NPS and parks are uniquely positioned to have productive conversations on this topic, as trusted messengers and as living laboratories of climate change, respectively.

Capitalizing on this opportunity, a number of parks are offering interpretive talks on climate change and also providing visual aids to explicitly call out site-specific impacts visitors may anticipate. This paper tells one such story, detailing how Golden Gate National Recreation Area (Golden Gate) inspired a nationwide climate change exhibit project in NPS. It provides an overview of how Golden Gate's exhibits came to be and presents lessons learned.

In 2016, Golden Gate installed two exhibits in the form of eye-catching future sea level marker poles. They were designed to engage visitors and help them envision how a range of sea level rise scenarios might affect the area. The poles are located at Crissy Field on the Presidio of San Francisco and at Rodeo Lagoon in the Marin Headlands. The base of each exhibit pole sits in shallow water near sea level and marks projections of rise for different times in the future. The marked levels were based on scientifically reviewed studies (e.g., Knowles 2010; National Research Council 2012; Ballard et al.

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2016), and show the severity of sea level rise based on a range of future emissions scenarios. Wayside panels—panels along pathways—installed near the exhibit poles indicate what the pole markers depict, providing interpretation on how those probable future sea levels will impact the important natural and cultural aspects of the sites. Together, the two exhibits are available for view by the upwards of 17 million visitors to Golden Gate each year.

This pair of exhibits was inspired by an earlier prototype developed using a seed grant from the National Parks Conservation Association in 2009. With the grant, Golden Gate was able to create a first-of-its-kind exhibit for a national park at Crissy Field. Additionally, it paved the way for other coastal parks to collaborate on shared wayside projects funded and directed by the NPS Climate Change Response Program across the country. The grant-funded prototype at Crissy Field is the focus of the case study we present in this paper.

After receiving the 2009 National Parks Conservation Association grant for a climate education tool in the parks, Golden Gate staff started thinking about creating an outdoor exhibit that would help visitors visualize the effects of future sea level rise on the park's shorelines. Two of the authors of this paper (Elder and Castellini) initiated discussions in the park and with outdoor exhibit designers at the local Exploratorium science museum to come up with ideas for this type of exhibit (Figure 1). Several different visual options were considered, ranging from artsy to provocative to scientific-looking. Also considered was whether the exhibit should be installed next to or directly in the ocean.

After entertaining a variety of possibilities and presenting the ideas to the park leadership team, a decision was made to design the exhibit with a scientific look, since the park wanted to represent the science accurately. A variety of high-visitation shoreline locations were considered for in-water installations, and photo simulations (Figure 2) were prepared for each. Ultimately a location for the sea level pole was selected along the popular walking promenade at Crissy Field in San Francisco. This site had very high visitation and minimal vandalism, and the location was ideal to mount a sea level marker pole and interpretive sign in a high-visibility area. At the time, the seed grant funding was not sufficient to purchase materials suitable for a permanent exhibit at Crissy Field, so the prototype exhibit was installed with the hope that a more permanent installation could be funded in the future, which fortunately happened.

Figure 2. Exhibit simulation at proposed site at Crissy Field.

The next steps involved hiring an exhibit designer, choosing a preferred design, dealing with constraints and challenges, and installing the prototype exhibit, which occurred in October 2009 (Figure 3). In order for the pole to catch the attention of passing visitors, it needed to be taller than the bridge deck, which was nearly the same height as the highest projected sea level rise at 2100 (1.4-m sea level rise plus 1.5 m to account for a 100-year storm). This led to the inclusion

Figure 1. Initial design ideas brainstorm after discussion with Exploratorium staff.

of a marker at the top of the pole (6 m above current mean high tide) showing where sea level would be if all the ice on Greenland were to melt (estimated to happen in 400 years or so; see Kintisch 2017, and Figures 4 and 5). The interpretive panel also included a map showing flooding of the nearby San Francisco Bay shoreline based on future model projections. The map included tactile elements that indicated the different flooding levels with raised surfaces to allow people with visual impairments to perceive future shoreline by touch (Figures 6 and 7).

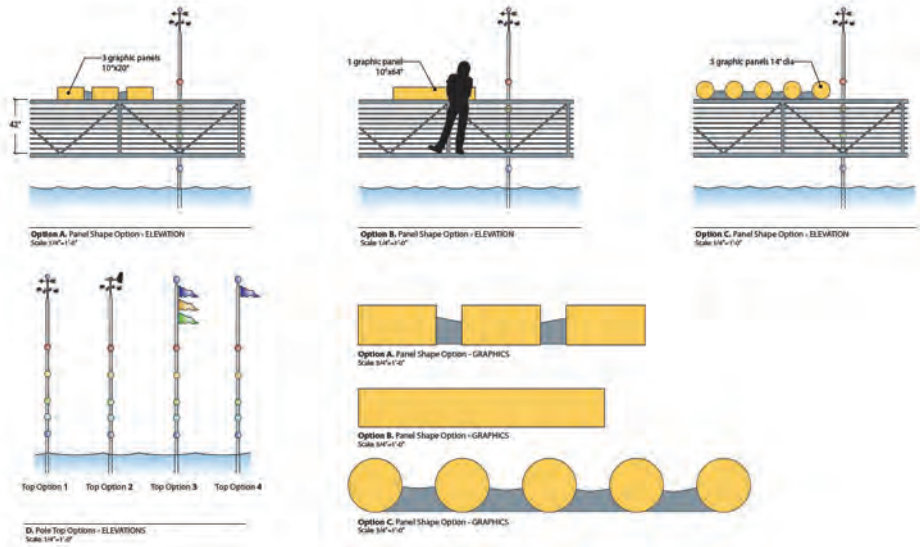

Figure 3. Schematic alternatives for first Crissy Field exhibit.

Figure 4. Installing the first sea level exhibit pole at Crissy Field.

Figure 5. Prototype exhibit after installation.

Figure 6. Interpretive panel on prototype exhibit.

Figure 7. Close-up of interpretive panel showing layered tactile map with future sea levels.

In the spirit of assessing the exhibits' success, public feedback was collected in a handful of formats. On the International Day of Climate Action in October 2009, soon after the exhibit had opened, we asked a small sample of visitors to share their reactions to the exhibit. Most visitors thought the exhibit was appropriate and a good thing to have in the park for visitors to see; however, several did not believe that climate change was human-caused or felt that the exhibit was alarmist. On the exhibit panel itself, we included a phone number for visitors to provide feedback on the exhibit. While one caller thought the new exhibit was cluttering the viewshed at Crissy Field, the other dozen or so callers in the first year offered positive feedback. The following is a transcript of a positive and particularly eloquent message left on the automated recorder in 2009 that sums up precisely what we had hoped visitors would get out of the exhibit:

> I just saw the sea level rise exhibit sign which is over the mouth to the tidal inlet. I just want to say how fabulous I think it is. I think it is wonderful that the National Park Service is partnering with other people to provide this kind of information to the public, where it is such a clear opportunity to give very specific, cogent and unassailable evidence of the issues that the world is facing. Not when people are just sitting in their homes thinking about it, but when they are actually out here. By being here they are voting with their feet and by seeing this sign they will begin to vote this way, and I hope you get lots of positive feedback.

In the months following the exhibit's opening, the wayside panels and poles garnered more press coverage and visitorship. In December 2009, the *San Francisco Chronicle* included the Crissy Field exhibit on a front-page spread associated with coverage of the adoption of a California Climate Change Action Plan (Buchanan 2009; see Figure 8). This featured article reached hundreds of thousands of people. More exposure was provided to the exhibit by the nearby Crissy Field Center, which delivers environmental programming for youth groups. The center started using the exhibit as an element in some of their programs, including an elementary school program called It's Electric!, which focused on energy production and climate change. The coverage, conversations, and visitorship associated with the exhibition demonstrated the success of the prototype and reinforced the importance of science-based climate information in our parks.

With more permanent exhibits of this type in mind, the team started trying to generate interest from

potential funding sources, both in and outside NPS. In late 2011, a proposal was created that requested funding from the NPS Climate Change Response Program for an exhibit project that would include but also go beyond Golden Gate. The proposal included six other NPS sites across the country: Point Reyes National Seashore, Biscayne National Park, Everglades National Park, Big Cypress National Preserve, Dry Tortugas National Park, and Kenai Fjords National Park. The project was funded, and the NPS Harpers Ferry Center was selected to manage it. Project representatives from each park worked to ensure that the messages at each site would clearly state that climate change was happening and that NPS was monitoring, mitigating, and adapting to the impacts at each site. The efforts to unify a nationwide project resulted in a consistent and interconnected set of exhibits, including, in 2016, a permanent Golden Gate installation, which represents in real time the impacts of climate change on our parks (Figures 9, 10, and 11).

San Francisco Chronicle

SFGATE.COM | Thursday, December 3, 2009 | PRINTED ON RECYCLED PAPER $1.00 ★★★★★

CLIMATE CHANGE

Worst-case planning

How high the sea?
What the balls on the pole at right represent:

19 feet, 8 inches Sea level if Greenland ice Cap melts (if the ice at both poles melted, the ocean would reach the road deck of the Golden Gate Bridge)

9 feet, 6 inches 100-year flood level with a 4-foot, 6-inch rise in sea level and a storm surge

4 feet, 7 inches High end of predicted sea level rise by 2100

3 feet, 3 inches Moderate estimate of predicted sea level rise by 2100 (approximately today's 100-year flood level)

1 foot, 8 inches Low end of predicted sea level rise by 2100

Source: March 2009, Pacific Institute study

McNair Maror / The Chronicle

On the waterfront path at San Francisco's Crissy Field, a pole marks the different levels of rising ocean waters that might occur due to global warming over the next century.

Governor's new panel to suggest actions in case warming can't be stopped

By Wyatt Buchanan
CHRONICLE SACRAMENTO BUREAU

SACRAMENTO — California has set an ambitious agenda to combat climate change, but on Wednesday Gov. Arnold Schwarzenegger said the state needs to prepare for the worst if human action cannot stop global warming and the rise of sea levels.

In an announcement on San Francisco's Treasure Island, Schwarzenegger said he is creating a panel of 25 California leaders to recommend specific actions to prevent the destruction of infrastructure and deal with a depleted snowpack, the spread of disease, intense wildfires and other calamities that would result within the century from climate change.

"I normally never make a Plan B because then you start concentrating on that and

Climate continues on A19

Land that would be underwater if sea level rises 5 feet

Source: San Francisco Bay Conservation and Development Commission

The Chronicle

Figure 8. San Francisco Chronicle front page article showing exhibit pole.

Figure 9. Panel for permanent sea level rise exhibit at Crissy Field.

Figure 10. Panel for sea level rise exhibit with pole at Rodeo Lagoon.

Figure 11. Panel for sea level rise exhibit at Fort Point.

As the first of their kind, these wayside exhibits each provide a place-based, locally focused way for visitors and environmental education students to envision how future sea level rise as a result of climate change may affect these sites (Figures 12 and 13). Visually impactful and intentionally spread around the country, these waysides are intended to motivate individuals to be part of the solution, or at least a part of the conversation. As the first of their kind, however, they serve as a jumping-off point. There is additional potential for digital engagement with the public, considering that the wayside signs' QR codes were accessed hundreds of times during the first six months of 2017. These codes currently link visitors to a webpage with added site-specific content related to sea level rise, as well as to similar wayside signs across the country.

As consequences of climate change unfold, it is important to think about how best to convey pertinent information to the public in a way that's interesting, accessible, and accurate. Place-based interpretation through wayside signs is just one piece of the puzzle that taps into different learning styles to explore unseen effects of climate change, such as projected sea level rise. Golden Gate National Recreation Area plans to explore more ways to bring climate change information to the public, building on the successes of innovative prototypes and nationwide projects like this one.

Figure 12. Permanent sea level rise exhibit installed at Crissy Field.

Figure 13. Permanent sea level rise exhibit installed at Rodeo Lagoon.

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