Communicating HABs

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Communicating Harmful Algal Blooms: Does Design Really Matter?

Abstract

Harmful algal blooms (HABs) are occurring with increased frequency, duration, and severity (Anderson, 2009). In an effort to alert citizens of California of HAB events, the Central and Northern California Ocean Observing System (CeNCOOS) communicates important HABs issues through their website (http://www.cencoos.org). In general, HAB outreach resources are often created with little attention to research-based design principles, an audience's knowledge of HABs, or an evaluation component (Kirkpatrick et al., 2004; Fleming et al., 2007; Kuhar et al., 2009, Nierenberg et al., 2010). To improve informal science outreach efforts, and future allocation of resources, it is necessary to understand web visitorship and interaction (Goldsmith et. al. 2014). Based on the outreach goals and the issues mentioned above, the author and CeNCOOS staff focused this project around four main questions; 1) What do Google analytics reveal about CeNCOOS web visitorship?, 2) What do people know about HABs?, 3) What resources and design aspects are best suited to achieve outreach goals?, and 4) How can the updated resources be evaluated? Results indicate that most visitors to the CeNCOOS website are

18-30 year old males who spend an average of three minutes on a particular page and do not engage in additional web resources beyond the first page they visit. The HABs knowledge survey revealed misconceptions about HABs, which were addressed during the subsequent redesign of existing resources. This project strives to build on the growing research base for iterative web design and evaluation of informal science outreach efforts, as well as public knowledge and perceptions related to HABs.

Introduction

Harmful algal blooms (HABs) are increasing in frequency, duration, distribution, and severity (Anderson, 2009). HAB events can negatively affect marine organisms and humans alike (Landsberg, 2002; Hoagland et al., 2014). One such example of this occurred in 1991 when a *Pseudo-nitzschia* bloom in Monterey Bay, California produced a harmful biotoxin called domoic acid, which contaminated sardines and anchovies and resulted in the death of the pelicans and cormorants who prey on them (Walz et al., 1994). In 2015, a bloom of *Pseudo-nitzschia* species, *P. australis,* produced the highest concentrations of domoic acid ever recorded in Monterey Bay (Ryan et. al. 2017). This bloom caused hundreds of seabird and sea lion deaths, as well as significant economic loss to fisheries and the shellfish industry (Kudela et. al. 2016). It is estimated that due to the 2015 HAB event, the Dungeness crab and rock crab fisheries lost nearly $49 million (Howard, 2016). Humans can be exposed to HABs through swimming in or drinking contaminated water and ingesting toxic shellfish. The human health impacts range depending on consumption level; exposure to domoic acid for example, can cause vomiting, diarrhea, confusion, seizures, permanent and short term memory loss, or death (National Institute of Environmental Health Services, 2018). Although *Pseudo-nitzschia* does

not always produce a biotoxin, the devastating events of the 1991 and 2015 blooms underline the importance of understanding and communicating the role HABs play in managing coastal resources and public health. *Pseudo-nitzschia* is just one example of a species monitored by the Central and Northern California Ocean Observing System (CeNCOOS) (See *Appendix 1: CeNCOOS pier station parameters monitored.)*. Through sustained and coordinated measurements, modeling of nowcasts and forecasts, and integrated products, CeNCOOS disseminates information and data on HABs issues via its website (www.cencoos.org).

Communicating HABs is essential to CeNCOOS outreach efforts (CeNCOOS, 2014-2019) and overall outreach goals include: 1) provide access to HAB data, 2) educate the public about the HAB data available on the website, 3) provide engaging resources on general HAB issues and California specific HAB issues, and 4) tell better stories about the work that CeNCOOS does- HAB research, forecasts, modeling and sampling efforts.

Typically, HABs outreach materials are created with little attention to audience aligned design principles, the audience's knowledge of HABs, or an evaluation component (Kirkpatrick et al., 2004; Fleming et al., 2007; Kuhar et al., 2009; Nierenberg et al., 2010; Nierenberg et al., 2011; Smith, Blanchard and Bargu, 2014). Limited resources, including lack of qualified or appropriate staff, time, software and hardware, and budget are often the culprit for reduced quality of outreach resources (Nierenberg et al., 2010; Nierenberg et al., 2011). CeNCOOS HAB outreach resources suffer from similar constraints. The original outreach resources could be described as simple, text heavy, static web pages, many of which had not been updated since 2007. The site is also lacking a protocol for assessing web resources.

Based on the outreach goals and the issues mentioned above, the author and CeNCOOS staff focused this project around four main questions; 1) What do Google analytics reveal about CeNCOOS web visitorship?, 2) What do people know about HABs?, 3) What resources and design aspects are best suited to achieve outreach goals?, and 4) How can the updated resources be evaluated? The project objectives are to establish a web audience profile, HAB public knowledge baseline, and evaluation plan to update, consolidate, and better align web outreach resources to the audience and outreach goals.

What do Google analytics reveal about CeNCOOS web visitorship?

Google analytics from the CeNCOOS website were used to determine the audience of web visitors between the years of 2015 and 2017. This was done by reviewing standard visitor demographics such as: age, gender, location of visitors, method of viewing website (e.g. desktop, mobile); length of time visitors spent on particular pages; top visited CeNCOOS web pages; and visitor website behavioral pathways (e.g. additional CeNCOOS resources used, and visitor website exit behaviors).

From the analysis, a primary target audience was identified as 18-30 year old American males who mostly use their desktop to view CeNCOOS web pages for an average of three minutes. Though most accessed the website from a desktop, the analytics show that between 2015-2017, there has been an increase in visitors accessing from mobile devices. Visitors typically exit the CeNCOOS site after viewing the page they originally began on, not including landing on the homepage. Several additional project goals emerged from identifying the target audience: to expand on the visitor base, draw in more visitors to the website, get visitors to spend more time viewing and engaging with CeNCOOS HAB resources, and ensure web resources can

be accessed on multiple platforms. The audience profile determined from the analysis was used to make design and resource selections later in the project.

What do people know about HABs?

Using Google Forms, the knowledge survey was created by collaborating with CeNCOOS staff to establish a set of basic questions and desired responses. The survey was then disseminated three different ways: by crowdsourcing responses through facebook, posting the survey as a link on the CeNCOOS homepage, and by asking outreach event attendees to take the survey in-person. The survey was used to assess the general public's knowledge about HABs, identify misconceptions and establish a baseline of knowledge to make decisions as to what topics to highlight and focus on in redesign. The HABs knowledge survey data was also used for structuring questions for interviews conducted with marine scientists and researchers. The interviews were then used to provide the content for the "CeNCOOS Shorts" video series discussed in the following section. Participants' prior knowledge about HABs is unknown and CeNCOOS website respondents could have had exposure to HABs outreach resources.

The HABs knowledge survey solicited 319 respondents from Facebook, 19 from the CeNCOOS website, and 36 from a public open house event. There was a mostly equal mix of women and men respondents across survey groups, with slightly more, 63.2%, of respondents from the CeNCOOS website identifying as female. The age groups, 31-39 and 50-59 year olds were the biggest groups represented in both the CeNCOOS website and Facebook samples, while most participants from the open house group were 18-23 and 12-17 year olds.

In each group, at least 50% of respondents selected undergraduate and about 30% of respondents from each group selected master's or doctorate degree as the highest level of

education obtained. For the question, “what is a HAB?” few answered correctly, “none of the above” nearly 50% of respondents from all three groups selected “rapid and uncontrolled growth of algae that secretes toxins when they reach certain densities,” or “rapid and uncontrolled growth of any kind of algae.” Respondents typically correctly identified that algal blooms occur in both freshwater and marine environments but in all three groups people more frequently selected “marine” or “I dont know” over “freshwater” as an incorrect response. Over 70% of people from all groups selected “whenever conditions are favorable” to the question, “when do HABs occur?’ followed by “I don't know.” When responding to “what contributes to HABs?” 46.4% from Facebook and 36% from open house frequently incorrectly identified “trash and plastics” as a contributing factor, as compared to 10% of CeNCOOS respondents. Most people from all groups correctly selected the other contributing factors. Likewise, most people correctly selected the effects HABs have on the environment. Interestingly, CeNCOOS respondents were less likely to recognize marine mammal stranding where as Facebook respondents were less likely to recognize effects to business and industry. Where as, open house respondents were less likely to recognize compromised drinking water quality as an effect of HABs. For the question, “what does HABs impact?” “marine mammals” was the most frequently selected response, with over 90% selection from Facebook and open house responses. “Are all algal blooms harmful?” elicited variable responses, nearly 30% from each group incorrectly answered the questions with a “yes” or “not sure” response. Analysis was done using Microsoft Excel for Mac, version 16.15. For complete list of questions, desired responses, and results, see *Table 1:HABs knowledge survey questions.*

Prior research conducted by Nierenberg et. al. (2010) through a comprehensive survey of tourist versus residences' knowledge of Florida red tide showed that out of the 100 tourist and 92 residence only one tourist had not heard of a Florida red tide. Questions that are similar to those in the HABs knowledge survey are: When can a red tide occur?, What can cause a red tide?, and What can a red tide cause?. Nierenberg et. al. (2010) report that responses to "when can a red tide occur?" showed the greatest range between tourist and residence, that tourist frequently thought that red tide is caused by weather changes and most people identified pollution and fertilizers as the main cause for red tide, despite the correct response being "it isn't known." A subsequent survey conducted by Smith et. al. (2014) to understand what fishermen know about freshwater HABs in Louisiana indicate that all participants had heard of algal but that only 40% had heard of HABs. Both studies found widely inconsistent and incorrect responses across participating groups, likely signifying a substantial lack of knowledge and prevalence of misconceptions in the public's knowledge of HABs (Nierenberg et. al. 2010 and Smith et. al. 2014). These results are similar to the results from the HABs knowledge survey.

Questions from the HABs knowledge survey that had highly variable responses and a majority of incorrect or inaccurate responses were used as guiding themes to organize content information and highlight subtopics for resource design (Nierenberg et al., 2010; Nierenberg et al., 2011; Smith, Blanchard and Bargu, 2014). It was surprising that a large number of people incorrectly selected "trash and plastics" as a contributing factor to HABs and that people also were less likely to recognize that HABs can occur in freshwater environments. "Trash and plastics" were selected as a topic to highlight because of the high number of respondents who incorrectly selected this as a response to "what contributes to HABs?" indicating that people do

not understand how their actions may cause favorable conditions for a bloom. "Rainfall" was also selected as a subtopic of the same question because there is great overlap between marine and freshwater blooms due to rain "flushing" out rivers or lakes and moving that algae to a marine environment where it can cause a HAB or other negative consequences, like clogging up harbors or estuaries with algae. Highlighting this as a subtopic could address multiple misconceptions people have about the impacts of HABs, such as where HABs can occur and when. To summarize, the results from the HABs knowledge survey are riddled with misconceptions regarding general HAB knowledge, what, where, when and how HABs occur. Instead, respondents more frequently correctly identified the effects and impacts HABs have on people, animals and the environment, excluding the role trash, plastics and rainfall play in the HAB cycle.

Table 1:HABs knowledge survey questions, all possible responses, desired responses and percent of responses.

Questions	Responses (desired responses italicized and in bold)	CeNCOOS homepage (19 respondents)	Facebook (319 respondents)	Open-house (36 respondents)
Gender	Male Female Prefer not to say	36.8% 63.2% -	52.4% 47% 0.6%	41.7% 52.8% 5.5%
Age	12-17 18-23 24-30 31-39 40-49 50-59 60-69 70+	- - 21.1% 31.6% 5.3% 31.6% - 10.5%	1.9% 21% 13.5% 27.3% 7.5% 23.8% 4.1% 0.9%	16.7% 33.3% 8.3% 11.1% 8.3% 16.7% 5.6% -
Education	Middle or high school High school graduate Undergraduate degree, BS, BA Vocational or professional training Master's degree	- 5.3% 52.6% 10.5% 15.8%	2.2% 16.9% 55.2% 2.8% 18.2%	16.7% 25% 33.3% - 19.4%

	Doctorate degree Elementary school Liberal arts, AA	15.8% - -	4.4% - 0.3%	2.8% 2.8% -
What is a harmful algal bloom?	-Rapid and uncontrolled growth of algae that ALWAYS secretes toxins -Rapid and uncontrolled growth of algae that secretes toxins when they reach certain densities -Rapid and uncontrolled growth of algae that DOES NOT secrete toxins -Rapid and uncontrolled growth of any kind of algae ***-None of the above*** -I have no idea	15.8% 47.4% - 36.8% 5.3% 10.5%	19.1% 43.9% 8.8% 49.5% 0.3% 11.9%	25% 58.3% 8.3% 38.9% - 16.7%
Where do harmful algal blooms occur?	Marine environments Freshwater environments ***All of the above*** I have no idea	- - 94.7% 5.3%	6% 2.8% 82.4% 8.8%	8.3% - 83.3% 8.3%
When do harmful algal blooms occur?	Rarely, once every few years ***Seasonally*** More than once a year, not related to the seasons ***Whenever conditions are favorable*** None of the above I have no idea	- - - 78.9% 5.3% 15.8%	0.6% 0.3% 1.3% 86.8% - 11%	- 11.1% 8.3% 72.2% - 8.3%
What contributes to harmful algal blooms?	***Runoff from fertilizers*** ***Sunlight*** ***Nutrient availability*** ***Temperature*** ***Climate change*** ***Rainfall*** Trash and plastics in the water None of the above I have no idea	84.2% 73.7% 84.2% 78.9% 68.4% 57.9% 10.5% 5.3% 10.5%	84.6% 75.5% 82.1% 81.8% 75.2% 55.8% 46.4% - 11.3%	80.6% 63.9% 86.1% 77.8% 69.4% 44.4% 36.1% 2.8% 11.1%
What are the impacts of harmful algal blooms?	***Environmental damage*** ***Business and industry loss of money and products*** ***Marine mammals strandings and deaths*** ***Death of seabirds*** ***Death of fish*** ***Poisoning from eating toxic shellfish and crabs*** ***Drinking water quality compromised*** None of the above I have no idea	78.9% 84.2% 73.7% 84.2% 89.5% 89.5% 89.5% - 5.3%	85.9% 71.5% 82.4% 81.2% 89.3% 83.4% 78.1% 0.3% 8.5%	86.1% 75% 77.8% 75% 83.3% 80.6% 66.7% - 5.6%
What do harmful algal blooms affect?	***Humans*** ***Water quality*** ***Marine animals*** ***Other types of algae*** None of the above I have no idea	73.7% 84.2% 78.9% 63.2% - 10.5%	83.7% 89% 90.3% 74.6% - 9.1%	80.6% 80.6% 91.7% 69.4% - 5.6%

Are all algal blooms harmful?	Yes ***No*** Not sure	21.2% 68.4% 10.5%	17.6% 62.4% 20.1%	5.6% 72.2% 22.2%

This figure shows the percentages of survey responses by question and group, CeNCOOS website, Facebook and open house attendees.

What resources and design aspects are best suited to achieve outreach goals?

The existing web content, the "Learn" section of the "Algal Bloom" tab on the CeNCOOS website (https://www.cencoos.org/learn/blooms), was designed by numerous contributors to CeNCOOS over many years and it is the foundation for the content used in the new resources. Aspects of redesign focused on: consolidating duplicate information between sections, updating existing content, designing for the web audience determined from Google analytics, and highlighting specific misconceptions and topics revealed from the HABs knowledge survey data.

Given the audience determined by Google analytics, web design elements need to appeal to adult learners of 18-30 years old. Characteristics of adult learners include a need for self-directed control of content and an importance for open-ended learning opportunities that promote problem solving or investigating an issue utilizing a number of different resources (Conner, 1997; Baird and Fisher, 2005; Cercone, 2008; O'Toole and Essex, 2012). After reviewing the literature, interactivity, using multimedia resources, scaffolding information, storytelling, and short videos were selected for their potential to engage visitors with web resources (Sims, 1997; Chou, 2003; Alexander and Levine, 2008) and support characteristics of

adult learners (Conner, 1997; Cercone, 2008). Incorporating interactivity and multimedia in web resources allows visitors the opportunity to pursue multiple learning pathways, choosing their method and pace for learning (Alexander and Levine, 2008). This should appeal to adult learners because of their preference to have control over what is being learned and how they are learning (Cercone, 2008) Scaffolding information creates chunks of information or content that is more manageable and digestible (Alexander and Levine, 2008). Scaffolding information is an effective way to highlight specific topics (Alexander and Levine, 2008). Storytelling in science has shown great potential in building trust between the general public and the scientific community (Dahlstrom, 2014). As well, storytelling, especially narratives, have been shown to increase comprehension, engagement and interest in non expert audiences (Dahlstrom, 2014).

ArcGIS Story Map, a web app that allows you to combine narrative text with maps, images, and multimedia content, was used as the main platform because it is a free resource that allows one to create an immersive learning environment utilizing interactivity, web storytelling and embed additional content pathways for users to explore at their own pace. Storytelling in this way encourages the exchange of information by including additional resources as part of interactive design (Chou, 2003; Alexander and Levine, 2008).

The resources created for this project are an interactive multimedia story timeline about HABs in Monterey Bay, CA, three multimedia ArcGIS Story Maps about CeNCOOS HAB specific long term initiatives, an ArcGIS Story Map about HABs in California, an interactive top CA HABs species map, and a series of eleven videos titled,"CeNCOOS Shorts." Visit https://www.cencoos.org/content/revisedhabscenter to view all HABs redesigned resources, see

Appendix 2: Description of redesigned web resources and Appendix 2.a. CeNCOOS shorts title list.

"CeNCOOS Shorts" was produced and edited using the approaches described by Guo, Kim and Rubin (2014) to be most engaging in online learning. Techniques include use of first person perspective, short video duration, interspersed talking with other pictures, video or slides, and filming in informal settings as opposed to longer and more formal "talking head, big-budget studio production styles" (Guo, Kim and Rubin, 2014). An iPhone 6S Plus was used for most of the videos, which were produced and edited using iMovie 11' software. Video topics were selected from the HABs survey questions and results, see *Appendix 2.a. CeNCOOS shorts title list* and https://www.youtube.com/playlist?list=PLHVgtcQonadMVbQqMZp_TxV00SCj_D3ia to watch the video playlist. "Monitoring water quality," "SPATT and mussel toxin," and "The imaging flow cytobot" videos were embedded in the ArcGIS Story Maps of the same title. The remainder of the videos were embedded in the HABs test discussed in the following section.

How can the updated resources be evaluated?

Several stipulations needed to be considered when devising the evaluation plan. There are no staff or resources assigned to evaluating any outreach resources on the website beyond fixing broken links. For this plan to be feasible it needs to be easy to collect and analyze data, without costing time or requiring additional resources to execute the plan beyond the available Google forms and analytics. The evaluation plan for this project uses a combination of Google analytics, an emoji visitor scale, and a HABs test to assess visitor engagement, satisfaction, and potential learning outcomes.

Google analytics would be used to compare the original web resources with the new web resources. Gender, age, time spent on HABs content, and visitor behavioral pathways will be analyzed to better understand how people have engaged with redesigned web resources (Greller and Drachsler, 2012; van Barneveld, Arnold, and Campbell, 2012). The results would be used to improve aspects like visitor knowledge of and accessibility to the resources.

The emoji visitor scale is featured on all the redesigned resources and is essentially a Likert scale that consists of a series of emojis to represent visitor satisfaction ranging from "unamused" to "love it." Emoji were selected to represent the Likert scale because of the potential emoji have shown in marketing research to elicit visitor feedback and for emoji growing popularity for use in communications research (Sundar, Kim, and Gambino, 2017). The emoji visitor scale is free and the data can be easily collected and analyzed.

The HABs test is a *modified* version of the HABs knowledge survey discussed in a previous section, which provides participants with a performance score and an answer key upon completion. The answer key provides links to the CeNCOOS shorts videos so visitors have the option of viewing an explanation as to why their answer selections may have been incorrect. The evolution of the original HABs knowledge survey into a scored test was based on interest from Facebook respondents requesting feedback associated with their survey responses. The HABs test was then included in the evaluation plan. Resulting data would be used to assess how well visitors understand HABs issues after interacting with web resources in order to inform content or design changes.

The emoji visitor scale and HABs test will also be used as indicators of engagement; the idea being that if visitors find their experience with web resources to be pleasant and engaging,

they are more likely to participate in additional activities associated with the topic (Guo, Kim, and Rubin, 2014; Oblinger, 2014; Aguiar, Nagrecha, and Chawla, 2015). The data would be used to make modifications to web resources, inform future resource design, and to assess the overall effectiveness of HABs outreach resources on the CeNCOOS website.

Of course one of the drawbacks with this method is there is no depth to the feedback, it only provides a quick and general outlook on visitor satisfaction. The emoji visitor scale and HABs test are meant to add an additional layer to the results that can be obtained from google analytics.

Discussion

Continuing to investigate public knowledge and misconceptions about HABs and refining the "HABs knowledge survey" is a critical next step. It would be useful to incorporate targeted questions, including respondent location demographics, to assess knowledge of local and regional HAB issues. In addition, a more thorough analysis of HABs survey results using significance values to look at responses between different demographic groups could be beneficial for tailoring content to a more specific outreach audience (Nierenberg et al., 2010). Though the questions were different, the HABs knowledge survey results were similar to those of public surveys conducted by Nierenberg et al. (2010) and Smith et. al. (2014) in that responses varied greatly, and there were numerous misconceptions, inconsistent and incorrect responses regarding basic HAB information.

One limitation of the HABs knowledge survey besides its small sample size, is that it is not possible to assess how many people guessed when responding with a correct or incorrect answer. In addition, people who participated in the survey are self selected, but they likely have an interest in the ocean and issues that affect it, as demonstrated by their attendance at the open house outreach event or spending their own time on completing the survey online. Expanding evaluation methods to include possible visitor interviews or in analyzing the utility of resources for younger audiences would be valuable in providing further insight into the limitations of the content and design of resources.

This project is a unique example of marine scientists, science organizations and science education researchers working together to gain valuable information about public knowledge of HABs and how to better engage the public in informal science outreach efforts. The tools used for both redesigning resources and in evaluation are free, easily accessible and can be applied to nearly any topic. Incorporating interactivity, multimedia, scaffolding information and storytelling allows visitors the opportunity to pursue multiple learning pathways. By being able to choose their method and pace for learning, it is likely visitor engagement with web outreach resources will increase (Chou, 2003; Baird and Fisher, 2005; Alexander and Levine, 2008).

This project strives to build on the growing research base for public perceptions on HABs, iterative design, and evaluation of informal science education outreach efforts (Varner, 2014). Project objectives to establish a web audience profile, HAB public knowledge baseline, and evaluation plan to update, consolidate, and better align web outreach resources to the audience and outreach goals were achieved. However, necessary future project development includes publishing the new resources, implementing the evaluation plan, and analyzing the data

and feedback to make appropriate recommendations for revisions to HABs web resources and assess their ability to engage audiences. We hope that sharing the story of this partnership and project is beneficial for other science organizations looking to maximize the potential of their outreach efforts and allocation of limited resources.

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Appendix 1

Appendix 1: CeNCOOS pier station parameters monitored.
This figure summarize the parameters and HAB species monitored by two CeNCOOS shore stations.

Monterey Municipal Wharf and Santa Cruz Municipal Wharf
CeNCOOS region stations sample various parameters at their pier stations including: 1) Specimens for HAB taxonomy 1. *Pseudo-nitzschia* spp. 2. *Alexandrium* sp. 3. *Cochlodinium* spp. 4. *Lingulodinium polyedra* 5. *Prorocentrum* spp. 6. *Dinophysis* spp. 7. *Heterosigma* spp. 8. *Akashiwo sanguineum* 9. *Phaeocytis* sp.

2) DA concentrations in plankton section
3) Extracted chlorophyll concentration in plankton sections
4) Real time data: temperature, salinity, chlorophyll, dissolved oxygen, pH, and turbidity

Appendix 2

Appendix 2: Description of redesigned web resources.
This figure summarizes design elements and objectives for new web resources.

New Web-resource	Description	Objectives	Design elements used and other notes
The Haps on HABs Resource Center https://www.cencoos.org/content/revisedhabscenter	Homepage for resources	-Organize and provide platform for accessing resources -Simplistic -Accessible on mobile platforms	-Responsible for icon design and web coding for rollover script, inline with current web design trends
Timeline "Algal bloom history of Monterey Bay" https://www.cencoos.org/content/revisedmonterey-bay-algal-bloom-timeline	A timeline of the history of algal blooms in Monterey Bay from 1991 to present.	-Address the survey question "Are all algal blooms harmful?"	-Interactivity -Use of multimedia -Storytelling -Scaffolding information -Update content
ARCGIS story map "Meet the HABs" https://www.cencoos.org/content/revisedhabsspecies	A spyglass map that introduces visitors to nine of the most harmful algal species in CA.	-Increase awareness about key HABs species -Provide access to continued exploration of resources by	-Interactivity -Use of multimedia -Storytelling -Scaffolding information

		highlighting relevant CeNCOOS data and tools	
ARCGIS story map "Understanding algal blooms" https://www.cencoos.org/content/understanding-harmful-algal-blooms	A cascading story map where visitors learn about the basics of harmful algal blooms.	-Address survey misconceptions: What is a HAB, when and why do they occur, what are the impact of HABs -Increase awareness about the types of HABs and the trend towards an increase in HAB events	-Interactivity -Use of multimedia -Storytelling -Scaffolding information -Update content -Consolidate duplicate content in existing resources
ARCGIS story map "CeNCOOS work with HABs" See https://www.cencoos.org/content/revisedhabscenter for all remaining story maps	A cascading storymap where visitors learn about the work CeNCOOS does in monitoring for, forecasting, coordinating, communicating, and teaching harmful algal blooms in CA.	-Highlight CeNCOOS data resources -Share story of California Harmful Algal Risk Mapping model development and use -Provide information and access to additional CeNCOOS related HABs data and resources. -provide a narrative for CeNCOOS data collection and sampling	-Interactivity -Use of multimedia -Storytelling -Scaffolding information -Update content
"CeNCOOS Shorts" https://www.youtube.com/playlist?list=PLHVgtcQonadMVbQqMZp_TxV00SCj_D3ia	A video series developed using interviews with marine scientists and CeNCOOS researchers.	-Augment and support other redesigned web resources -Highlight current CeNCOOS work on HABs -address survey misconceptions (see Appendix 2.a.)	-Shot from a first person perspective -3 minute duration -Realistic production quality -Storytelling -Scaffolding information

Appendix 2 continued

Appendix 2.a. CeNCOOS shorts title list

This figure summarize the rationale for each CeNCOOS short.

CeNCOOS Shorts title list https://www.youtube.com/playlist?list=PLHVgtcQonadMVbQqMZp_TxV00SCj_D3ia	Rationale
Monitoring water quality at Monterey Wharf	Created as part of CeNCOOS initiative, narrative
The imaging flow cytobot	Created as part of CeNCOOS initiative, narrative
SPATT and mussel toxin testing at Santa Cruz Wharf	Created as part of CeNCOOS initiative, narrative
What is harmful algal bloom?	Created because nearly all of the respondents from all three groups incorrectly answered survey question
When do HABs occur?	Created because at least 30% of total respondents

	incorrectly answered survey question
What contributes to HABs?	Created because survey responses were highly variable
What contributes to HABs? Plastics?	Highlighted as a subtopic because nearly 50% of respondents from two survey groups incorrectly selected it as a contributing factor
What contributes to HABs? Rainfall?	Highlighted as a subtopic because in the question, “where do HABs occur,” at least 30% of survey respondents incorrectly answered, the overlap of the two questions is important to understand how rainfall can contribute to HABs in multiple environments
What are the impacts of HABs?	Created because survey responses were highly variable
Are all algal blooms harmful?	Created because at least 30% of respondents answered incorrectly
When do HABs occur?	Created because at least 30% of respondents answered incorrectly