



The art of red tide science

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ABSTRACT

Over the years, numerous outreach strategies by the science community, such as FAQ cards and website information, have been used to explain blooms of the toxic dinoflagellate, *Karenia brevis* that occur annually off the west coast of Florida to the impacted communities. Many state and federal agencies have turned to funded research groups for assistance in the development and testing of environmental outreach products. In the case of Florida red tide, the Fish and Wildlife Research Institute/Mote Marine Laboratory (MML) Cooperative Red Tide Agreement allowed MML to initiate a project aimed at developing innovative outreach products about Florida red tide. This project, which we coined “The Art of Red Tide Science,” consisted of a team effort between scientists from MML and students from Ringling College of Art and Design. This successful outreach project focused on Florida red tide can be used as a model to develop similar outreach projects for equally complex ecological issues.

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1. Introduction

Over the last 20 years, research on the Florida red tide organism and its effects has made significant progress. Unfortunately, both Florida residents and tourists have misconceptions about even the basics of Florida red tide (Kuhar et al., 2009; Nierenberg et al., 2010). We initiated a movement called “The Art of Red Tide Science” to try to address these challenges by combining the artistic talent of the Ringling College of Art and Design (Sarasota, FL) students with the Florida red tide research team at Mote Marine Laboratory (MML) also in Sarasota, FL. This is a unique collaboration in part because Mote Marine Laboratory is co-located with Mote Marine Aquarium, an aquarium opened to the public 365 days a year with a visitorship of nearly 400,000/year. Mote Marine Aquarium exhibits specifically reflect the research projects

conducted at MML and thus make a collaborative project such as this easily viewable to visitors to the Aquarium.

Florida red tide (*Karenia brevis*) is an almost annually occurring dinoflagellate bloom that produces harmful toxins. The airborne release of the toxins can cause human illness as well as have harmful effects on the environment (Kirkpatrick et al., 2004; Fleming et al., 2005, 2010; Nierenberg et al., 2011). The ecology of Florida red tide is complex and not completely understood (Vargo, 2009). Many efforts have been made to study, monitor, and understand the complexities of these blooms including interdisciplinary, multi-year research projects and monitoring programs (Vargo et al., 2008; Pierce et al., 2011), technological advances (Walsh and Kirkpatrick, 2008), and outreach tools (Nierenberg et al., 2011).

Some impacts from Florida red tide that are understood include its effects on local fauna. *K. brevis* blooms can kill fish in vast numbers and has been shown to kill other marine animals including sea turtles, manatees, dolphin, and seabirds (Landsberg et al., 2009). There have also been several documented cases where *K. brevis* blooms have killed invertebrates (Roberts et al., 1979; Landsberg, 2002). For example, in Tampa Bay, Florida, at least 17 invertebrate species normally present were killed from a red tide bloom (Landsberg, 2002).

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Research has also shown that there may be benefits of Florida red tides. For example, brevenal, one of the compounds that are naturally produced by *K. brevis*, has been shown to act as a blocker to the more toxic compounds that *K. brevis* produces (Bourdelaïs et al., 2004). This compound is currently being evaluated as a possible treatment for cystic fibrosis, a debilitating lung disorder (Potera, 2007).

Economic and social science studies on the public perception of Florida red tide effects have consistently revealed widespread misconceptions. The public is generally unclear on what is and what is not safe to do during Florida red tide, such as swimming in a bloom, consumption of organisms from the Gulf of Mexico, or whether there have been any deaths directly attributed to these harmful algal blooms (Kuhar et al., 2009; Nierenberg et al., 2010; Larkin et al., 2011). General knowledge questions about what causes Florida red tide to bloom, what Florida red tide affects, and when blooms occur are also a source of confusion for most residents and tourists of Florida (Nierenberg et al., 2010).

Present efforts for outreach include FAQ cards, wallet-size information cards, websites, social media outlets, and student and teacher workbooks. These are all informative sources of information; however an evaluation of the utilization of all of these tools has not been thoroughly conducted. Measuring and comparing the success of each of these outreach efforts is challenging. For example, FAQ cards that may still be sitting on a hotel shelf somewhere cannot be compared easily with website hits or number of active users on a Facebook page (Nierenberg et al., 2011). Furthermore, tracking dissemination of information through either numbers of cards distributed or website hits is not a measure of the understanding of that material by the user.

The future of outreach tools is rapidly changing. Groffman et al. (2010) found that scientists need to become more active in communicating information, and to do that they must engage audiences in new ways. One way is to involve people outside of the science realm, who have skill sets, or who have been trained in areas in which scientists are not typically trained. Artists, for example, are very creative and often present ideas that suggest alternate ways of visualizing. This can be important considering that the target audience for many public outreach topics may not always absorb written information, whereas a visual image of an environmental issue may be easier to comprehend. Additionally, scientists and policy makers now consider online resources like Facebook and YouTube not only popular places for the public to get information, but also as a catalyst for collaboration and innovation (Nisbet et al., 2010; Pace et al., 2010).

Our goal in initiating “The Art of Red Tide Science” was to create an innovative outreach program on Florida red tide. After presenting our approach/methods, we discuss ways of evaluating the program’s success as well as lessons learned.

2. Methods

In collaboration with college leadership, this project was incorporated into coursework for Ringling College of Art and Design students as part of the science curriculum, in four parts: a proposal, a paper, a project, and a final presentation of work. Students formed groups of three to four people (assigning one person from each group as team leader/spokesperson) and chose from a list of different topics on Florida red tide to address. Topics included: control and prevention, economic/real estate/tourism issues, nutrients, monitoring, mitigation (how to “get rid of” red tide and should you), history/culture, human health, and technology. Class time was used for basic information sharing, regarding Florida red tide and for the development of specific projects. After researching one of the topic areas, the student groups were required to conduct at least one interview with a

Table 1
Types of project mediums and appropriate age groupings.

	Targeted age group		
	K–12	Adult	General
Web (blogs etc.)		3	
Video	2	4	
Video game	1		
Book	2	1	1
Clothing line			3
Poster	1	1	
Pamphlet		2	
Smart phone app		2	
Physical object	3	2	
Total	9	15	4

Florida red tide expert (a list of potential interviewees was provided) on their specific topic as a “fact checker” to minimize misinterpretations with other species of red tides. Students were expected to create a list of questions prior to the interview. The interview was required to be recorded and a synopsis of the interview was part of the grading criteria for the assignment. To encourage students to gain knowledge from other scientists, the course professors were not available for interviews, but acted as advisors to the students throughout the duration of the project.

Groups were given the option to create their project in any medium of their choice, such as: videos, posters, books, clothing lines, video games, and smart phone applications (Table 1). Each group was given a maximum budget of \$200.00 for project supplies. One person in each group was in charge of the budget and was required to turn in a written request for funds, as well as provide receipts at the end of the project to emulate actual proposal and project development and completion.

The final projects were presented as a one-night event at Mote Marine Aquarium in an art gallery/science fair format. During that time, projects were judged by invited MML staff, Fish and Wildlife Research Institute staff, Ringling College staff, and other members of the Florida red tide community. Each student group was available for interviews during this event. Judging criteria was based on scientific accuracy, creativity/originality, artistic approach, and complexity (Fig. 1). Projects were placed on display for one week as a temporary exhibit at Mote Marine Aquarium and made viewable to the aquarium visitors. These visitors were also given the opportunity to vote and comment using a general voting form (Fig. 2).

Awards were given to the winning group as determined by the judges and to the winning group as determined from the aquarium visitors voting consensus. The winning projects were displayed as the main object of the Facebook page (<http://www.facebook.com/pages/The-Art-of-Red-Tide-Science/191835257510999>) and the winning group was also announced via press release. Thusfar, projects have been completed and presented for two semesters (Fall 2010 and Spring 2011, Figs. 3–5).

3. Evaluation

Accurate records for number of judges and number of viewers to the exhibits were maintained by MML staff and volunteers (Table 2). The number of visitors to the exhibit was much greater during the spring semester for two reasons: the location of the exhibit within Mote Marine Aquarium was more accessible and presentable to aquarium guests during the second semester; and the time of year (Easter week) of the exhibit was a more popular time for guests to visit Mote Marine Aquarium than the first semester (the week following Thanksgiving weekend).

A Facebook page was formed (<http://www.facebook.com/pages/The-Art-of-Red-Tide-Science/191835257510999>), which

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