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Frontiers in Outreach and Education: The Florida Red Tide Experience

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Abstract

To enhance information sharing and garner increased support from the public for scientific research, funding agencies now typically require that research groups receiving support convey their work to stakeholders. The National Institute of Environmental Health Sciences-(NIEHS) funded Aerosolized Florida Red Tide P01 research group (Florida Red Tide Research Group) has employed a variety of outreach strategies to meet this requirement. Messages developed from this project began a decade ago and have evolved from basic print material (fliers and posters) to an interactive website, to the use of video and social networking technologies, such as Facebook and Twitter. The group was able to track dissemination of these information products; however, evaluation of their effectiveness presented much larger challenges. The primary lesson learned by the Florida Red Tide Research Group is that the best ways to reach specific stakeholders is to develop unique products or services to address specific stakeholders needs, such as the Beach Conditions Reporting System. Based on the experience of the Group, the most productive messaging products result when scientific community engages potential stakeholders and outreach experts during the very initial phases of a project.

Keywords

Florida red tide; *Karenia brevis*; communication tools; outreach and education; evaluation of outreach and education; harmful algal blooms and public knowledge

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1. Introduction

To enhance information sharing and garner increased support from the public for scientific research, funding agencies now typically require that research groups receiving support convey their work to stakeholders. However, many research teams do not include individuals with the expertise to develop, implement, or evaluate appropriate messages (Burggren, 2009). One example of how scientific outreach and education was managed over time by an environmental research group involved the National Institute of Environmental Health Sciences-(NIEHS) funded Aerosolized Florida Red Tide P01 research group (Florida Red Tide Research Group, FRTRG). The P01 group is comprised of scientists from the University of North Carolina Wilmington, the University of Miami, Mote Marine Laboratory, Lovelace Respiratory Research Institute, Centers for Disease Control and Prevention, Mount Sinai Medical Center, and Cincinnati Children's Hospital. This was a highly interdisciplinary group of marine chemists, toxicologists, epidemiologists, and public health specialists. Florida red tides cause human illness through the airborne release of bioactive chemicals produced during a bloom. This research group employs both laboratory studies and beachside work to understand the human consequences of exposure to aerosolized toxins, to explore therapies for intoxication, and to develop new drugs exploiting red tide bioactive materials. Additional funding was leveraged through a cooperative agreement with the Centers for Disease Control and Prevention and the Florida Department of Health that provided additional outreach efforts. The grass roots citizens organization, START, or Solutions to Avoid Red Tide, also joined the outreach team.

Over the decade during which the FRTRG received funding, on shore *Karenia brevis* blooms occurred, some lasting several months to over 1 year. For the FRTRG, the blooms provided the opportunity to implement their interdisciplinary research program to study the human health impact of aerosolized Florida Red Tides (Fleming et al., 2010; Fleming et al., 2005; Kirkpatrick et al., 2004a). While lengthy blooms were advantageous to the research program, they also fueled public confusion about the possible adverse human health impacts from exposure (Nierenberg et al, 2010). The blooms also caused considerable economic distress for the tourism industry, local businesses, and fisheries and added to the community burden of health care (Hoagland et al., 2009; Nierenberg et al., 2010). The FRTRG recognized an opportunity to apply new scientific findings to develop new and innovative Florida red tide outreach and education programs (Nierenberg et al., 2010; Kirkpatrick et al., 2004b).

This paper will describe the progression of methods and products the FRTRG developed, implemented, and evaluated during the 10-year funding cycle. The approaches are categorized in time intervals of the early years (2000 to 2003), the middle years (2003 to 2006) and the later years (2006 to 2010). The discussion will include assessing lessons learned during this evolving outreach program and the possible implications for harmful algal bloom (HAB) outreach and education programs in general.

2. Background and Methods

2.1 The Early Years (2000 – 2003)

When the FRTRG was established in 2000, traditional outreach activities were initiated. These included press releases and interviews with local media, connections with various health care institutions, and collaborations with the Poison Information Centers and the Florida Department of Health. FRTRG also created a range of public outreach products to enhance their scientific research strategies, such as study recruitment fliers and posters, and giveaway items for study participants (t-shirts, sunglass holders, travel mugs, baseball caps, drink koozies, recycled thermo bags, pens, and lip balm containers).

A logo for the research project was created by a professional artist (Figure 1) and was used on scientific presentations as well as on promotional and outreach items (Figure 2 and Figure 3). These materials initially were used specifically to recruit and retain research participants, but with support from the Florida Department of Health, these materials were distributed at outreach and education events involving a range of audiences including healthcare providers, public health personnel, environmental managers, the media, and the general public. The logo served as a branding strategy so people could easily identify products associated with FRTRG activities.

In addition, Mote Marine Laboratory, Florida Fish and Wildlife Conservation Commission-Florida Fish and Wildlife Research Institute, and the grassroots group, START, in cooperation with the Florida Department of Health Aquatic Toxins Program, created two general Florida red tide information items: a Frequently Asked Questions (FAQ) card (4.24' × 11' "rack card") and a wallet sized Florida red tide "contact number" card. Both cards were distributed for free by START to a variety of groups with a primary target population of coastal hotels and businesses (http://www.start1.com/pdf/RedTide_factcard_07.pdf).

Although difficult to believe today, little information was provided electronically during this period and information that was provided electronically (websites) were agency or organization specific, not research topic focused.

2.2 The Middle Years (2003 – 2006)

During this time, the FRTRG began publishing project results, attracting scientific attention interest on Florida red tides. In addition, during 2005, a Florida red tide bloom occurred and lasted over a year. This extensive bloom captured media and public attention and raised public awareness of and concern about Florida red tide specifically and harmful algal blooms in general. This was an ideal time to expand the outreach program by creating a website (<http://mote.org/niehsredtidestudy>) that provided the public and study participants with basic Florida red tide information, and details of FRTRG activities (Figure 4). The website also gave visitors an opportunity to email a researcher questions about Florida red tide, report the presences of dead fish, or report human illnesses (Kirkpatrick et al., 2004b). The website also fulfilled the funding agency's, National Institute of Environmental Health Science (NIEHS), outreach requirement at the time. As the group became productive in results and publications, the outreach program and website took on a life of their own, requiring constant attention and updating by the researchers.

2.3 The Later years (2006 – 2010)

As the FRTRG documented and published results describing the impacts of Florida red tide aerosols on asthmatics and occupationally exposed lifeguards, several major efforts were implemented to inform beach visitors about what to expect during a Florida red tide. First, FRTRG members created and distributed "Better Breathing during Red Tide" signs that could be used on beaches to warn tourists and residents about the possible health effects of aerosolized Florida red tide. The information was particularly targeted to provide needed information to asthmatics (Figure 5). A standardized press release was also created using the same theme. Of note, cooperation by local tourism boards and business owners in Sarasota, Florida (USA) was essential to the successful development and distribution of these outreach materials.

During the Florida red tide that began in 2005 and lasted over a year, Mote Marine Laboratory in Sarasota, FL and the county health department received daily barrages of calls from local citizens and tourists seeking information on red tide. Typical questions included: 1) Where is the bloom?, 2) How long will it last?, 3) Are the beaches safe?, and 4) Is the fish

safe to eat? To alleviate the burden of phone calls, the researchers created an automated phone messaging system that would report where Florida red tide was affecting beaches and specific Florida red tide related health information. With pilot funding provided by the Florida Department of Health's Aquatic Toxins Program and CDC, the Beach Conditions Reporting System (Beach Conditions) was created. Staffed by one part-time Information Technologist (IT) and one part-time outreach coordinator, the staff created a public website providing information on beach conditions, including the occurrence of red tide, trained lifeguards and beach managers to report beach conditions data directly to the website, and troubleshoot website and reporting issues. All website outputs were constructed by the IT specialist (<http://coolgate.mote.org/beachconditions/>; tel: 1-941-BEACHES) (Figure 6).

With occasional input from the Mote Marine Laboratory Communications Division, evaluations and suggestions for changes were addressed and implemented by a three-person team. This included the IT specialist, outreach coordinator, and the program's manager. In order to introduce the product to the public, the reporting lifeguards and beach managers were given refrigerator magnets and bookmarks imprinted with website information to distribute. Signs were posted at the entry points of the most popular Sarasota and Manatee County beaches. In addition, Mote Marine Laboratory's Communication Division sent out press releases to the various media outlets throughout the county.

From 2006 until 2010, beach sentinels used either desktop computers or Blackberry™ PDA's to input real-time, subjective reports of beach conditions, such as amount of respiratory irritation, quantity of dead fish on the beach, and surf conditions. With additional funding, the Verizon based Droid™ Smartphone, functioning on Google's Android™ operating system, eventually replaced 25 of the 33 desktops and Blackberry™ PDA's. The introduction of the Android™ (also known as "Droid"), provided additional benefits for the reporting system. Sentinels began to provide daily photographs of the beaches along with their reports. The photographs were integrated seamlessly from the Droid to the website. The use of the Android™ operating system also provided additional statistics and evaluations beyond counting the number of times people accessed particular beach sites and the online satisfaction survey. The administrators could now see originating IP addresses, the internet pathway that led users to the website, how long users remained on the website, and other previously unavailable details about users.

In 2010, administrators took the monitoring and data information to Twitter and Facebook. Now users could get up to date information on changing conditions of county beaches as a twitter-feed or Facebook update.

The third major product took advantage of the burgeoning public use of on-line video, such as YouTube, to share information. In 2008, just days prior to a field study in Sarasota, members of the field study research project of the PO1 aerosolized Florida red tide research group discussed the creation of a video. The audience, topic, structure and look of the video, as well as the production timeline were discussed and agreed upon, with the target audience being new and current research participants. The following day, members of the research project (with professional filming experience) filmed the field study, and interviewed various participants and researchers. Filming lasted four days, accumulating 8–10 hours of footage with 7 in-depth interviews conducted. Production (including logging tapes, script writing [with multiple rewrites], voice-over recording, and video editing) and post-production (consisting of audio production and graphics) took 8 months to complete. The video, "Red Tide Research in Paradise", was designed to be shown on the Florida red tide research group website, primarily as a recruiting tool for potential asthmatic participants for the field study portion.

As a lower technology alternative to videos, the researchers (in collaboration with the Florida Department of Health Aquatic Toxins Program and the Florida Poison Information Centers) created a series of annotated PowerPoint's on exposure to and health effects from Florida red tide targeted at healthcare providers, environmental managers, and the general public (<http://www.miamipoison.org/x57.xml>).

3. Dissemination and Evaluation

3.1 The Early Years

In general, the measure of distribution of the outreach products such as FAQ cards, fliers and posters were basic counts of the number of items disseminated. For example, Table 1 shows all the Florida red tide materials distributed by START, totaling 211,532 pieces in five years time. However, there is no way of really knowing if those items were put in the hands of interested public or remain on a shelf somewhere in an office or store room. In addition, the NIEHS study logo has been added to every presentation, t-shirt, promotional tools, and participant incentives. The NIEHS study logo works as an outreach tool because it incites people to ask "What is that character breathing in to and why?" thus opening the door for public education to occur. Unfortunately, there is no measure of how often that door was opened. During this period, the group realized they had no true measure of outreach material effectiveness; a frustrating finding.

3.2 The Middle Years

As the outreach products evolved from primarily print material to an information rich website, the ability to assess use improved. There was now a way to count the number of people who accessed the site: however, there was no ability to assess how long visitors stayed on the website or what information was viewed most often.

3.3 The Later Years

As the research group continued to publish and produce important human health results, the ability to disseminate and evaluate outreach products improved. The video, "Red Tide Research in Paradise", was primarily aimed toward asthmatics who were potential study participants for the FRTRG. However, it was also disseminated as an outreach tool for the general public, policy makers, funding agencies, the media, and others. The video is currently on the NIEHS P01 website, the University of Miami NSF NIEHS Oceans and Human Health website (www.rsmas.miami.edu/groups/ohh), Facebook (www.facebook.com/redtideresearchgroup), and Bad Juju Productions website (www.badjujuproductions.com), the video production company owned by one of the authors. Additionally, "Red Tide Research in Paradise" will be added to a new educational website developed by Plymouth National Marine Aquarium in Plymouth, England in the Oceans and Human Health section. The video has also been incorporated into college-level curriculum domestically and internationally (New Jersey, Latvia, New Zealand), and there are plans to make it available to educators at HAB-related scientific conferences.

The PowerPoint presentations developed for the healthcare community were disseminated through websites, distributed as DVDs, and also narrated and presented over public television with linkages to all the county health departments in Florida (the latter with over 500 participants).

Although the grant monies allowed for creation of the outreach materials, funding was not provided in the grant to formally evaluate them. The FRTRG would recommend to funding agencies that evaluation strategies be outlined and budgeted for in future grant applications. Public interest in the Beach Conditions website has steadily increased, with a rise in website

visits from 100,000 in 2006, to the cumulative visits of 2.7 million by September 2010. From September 2006 through September 2010, the Beach Conditions website averaged 10,470 clicks per month. The 2009 usage logs indicate an average of 68,000 web hits with about 3300 unique visitors each month. Unsurprisingly, when the visitors are mapped by location, the majority of users are in Florida. Of note, there are a large number of users along the eastern seaboard who are interested in the conditions of Florida beaches.

There has been sustained and increasing public interest in the other forms of outreach as well. For example, as of September 2010, there were 370 Facebook Fans and 183 Twitter followers. In response to user feedback, the Beach Conditions Program began emailing individual county reports to subscribers from the website twice a day and, as of September 2010, there were 770 subscriptions. The automated telephone line provided information to approximately 1000 callers per year. The value of the automated phone line and the public knowledge of its existence and trust of the information was further demonstrated when calls nearly doubled following the Deepwater Horizon Oil Spill.

The recent addition of the Droid™ smartphones, and the Android™ operating system, has allowed for tracking of the users via weekly Google Analytics™ (provided by Google free to the public). Tracking parameters that can be accessed include site usage, visitor overviews, traffic sources overviews, and map overlays. Site usage information includes how many visits were made to the website; how many pages of the website were viewed; the average time spent on the site; and what percentage of the visits were from new users. The visitor overview information includes the technical profile of the users; the web browser used to navigate to the page; connection speeds; and specifics on the site usage, such as the absolute number of unique visitors to the site versus total visits overall. The traffic sources information includes what sources (links) visitors are coming from to get to the site; and what keywords they used to find the site. The overlays are comprised of maps and tables of what countries from which visitors are accessing the site; how long they are staying on the site; what percentage are new users; and how many pages they are viewing on the site (data not shown).

4. Discussion: Lessons Learned

The first lesson learned by the FRTRG is that options for effective outreach strategies are multiplying as communication technologies advance. Early efforts relied on print materials such as fliers, posters, and giveaways. While these items are useful if they can be successfully provided to targeted audiences, they can be limited in their usefulness. For example, fliers can be provided to organizations or entities, but there is no guarantee they will be distributed. Even when distributed, it is difficult to determine if the information is valued and retained without detailed evaluation efforts.

The FRTRG also found that delivering the message to the right audience through a particular medium was challenging. For example, the FRTRG included someone with videography expertise; however they lacked the requisite background in web design, graphic arts, and marketing to create an integrated outreach product. The group was fortunate to have monies to outsource the creation of the branding logo by a graphic artist and creation of the initial home page for the project website by a professional website designer.

Initial attempts to address the effectiveness of outreach and education materials comprised simple counts of the number of fliers or posters disseminated. Later methods included using tools such as Google Analytics™ to obtain specific, sophisticated information about how the website was being accessed and who was visiting the site. The FRTRG recommends that

research groups look for and use pre-existing data collection platforms such as this instead of trying to build their own website metrics.

In addition, formal evaluation (if possible conducted through objective external evaluation) of these outreach and education efforts should be undertaken to assess the value of these materials to those who access or use them. Clearly, there are experts better trained in these fields who possess the knowledge and experience to reach, engage and evaluate intended audiences through emerging mediums. During the proposal process, specific funding should be designated to pay for these services; this funding can be easily justified since the level of expertise required to undertake and maintain effective outreach and education is often outside the realm of a researcher's skill-set. The outreach plan should be developed as a part of the project, much as the statistical methods to be used should be on the front end, not an 'add on' feature as the project develops.

4.1 Website, logo and other outreach materials

Another lesson learned is that websites, particularly ones with rapidly changing information, require constant monitoring and updating. If possible, updating should be the responsibility of a study coordinator or staff personnel. Although graduate students appear to be an appropriate choice for updating websites, the transient nature of graduate students does not mesh well with a long term project such as this one. One study found that on average, scientific educational websites had a "half-life" of 55 months, about 4.5 years (Markwell, 2002), often only as long as a topic is "hot," or funding lasts.

A formal evaluation of the effectiveness of the website and other outreach materials addressing issues should include: are the materials and their message reaching the target group?, what message is actually being received and processed by visitors?, does the message result in behavior changes?, etc. As noted above, formal evaluation can be time consuming and expensive, but can provide both subjective and objective measures of effectiveness (Fleming et al., 2007). Also the high cost of printed materials (and other outreach materials) must be taken into account, as well as reprints due to updated or corrected information.

4.2 Outreach Videos and other visual materials

Even though one member of the aerosolized Florida red tide research group was experienced in creating short films/videos, the production and filming of "Red Tide Research in Paradise" was occasionally problematic and ultimately completed about six months after the agreed upon date. This was due to various changes to the script and film concept which took months of supplementary filming and script rewrites.

Once the final script was approved by reviewers and considered "locked" by the filmmaker, no further changes could be made to the script. In three months the video was completed and the "rough cut" version of the film was screened for the reviewers. Only after the reviewers viewed the video did the implications of the word choices become apparent. The video had to be completely re-edited, the narration re-recorded, and music and sound effects had to be produced from scratch given the change of timing. This took an additional 2–3 months to complete. The lesson learned on this project was the filmmaker now makes sure to clearly define "scriptlock" as well as secure signatures of all the reviewers approving the final draft of the script before actual production of the video begins.

4.3 Beach Conditions Reporting System

Although modifications have been made over time to the public viewing site, most of the input has come through the "contact us" button, and has been changed with consensus of the

project team members. Changing from Blackberry™ to the Droid™, smartphones proved that utilizing emerging mediums can be finicky and require the assistance of an IT professional. With the use of new technology come a few challenges, like automatic updates or upgrades to the external system (such as the Android™ operating system, or Verizon wireless phone system, or Google Picasa photo albums). More often than not, these external systems might completely immobilize the product. The lesson learned is to expect emerging technologies to have logistical issues over time. It may be working fine on day 2 but not on day 22 and having backup systems and files are a must. Backup systems help quickly identify if the issues are internal or external, and also can save all data in cases when the emerging technology disappears. As mentioned earlier, the most useful feature of emerging technologies (such as Facebook, Twitter and Google) is the integrated usage analytics (evaluation) tools. Use of these tools allows scientists to quantify and qualify site utilization, including data inflow/outflow, user demographics, network traffic, and system response time. The availability of these tools allows scientists to directly interact with the data and does away with the need to request customized reports from the local IT staff.

As new social networking platforms have come to the market, the team members have evaluated their potential value to the FRTRG goal of making information on Florida red tide easily available to a wide range of stakeholders. Some important system characteristics that should be evaluated before placing any products on a new system include: anticipated longevity of the system, ease of loading and updating, amount of information that can be posted through the particular system, and other information that may be available through the particular system (such as content inappropriate for public health messaging).

One of the lessons learned is that flexible outreach and educational systems (such as video production, the beach conditions, FAQ card distribution challenges, and the relationships built in doing this kind of work) can mean that the Florida red tide research and its network can be used as a “platform” for new environmental issues including other harmful algae blooms, microbial pollution and oil spills.

5. Conclusion

The need for improved science education and outreach is a theme in many discussions of public perception, risk analysis, and evaluation of environmental health hazards, including Florida red tide and other HABs (Kirkpatrick et al., 2004b; Fleming et al., 2007; Kuhar et al., 2009; Nierenberg et al., 2010). Scientists tend to be trusted to provide quality unbiased information based on their work; however, they must also accept responsibility for communicating their results to the broader community, both by learning how to communicate to different stakeholders and by engaging communication experts early in the development of research activities (Dean, 2009; Lofstedt, 2006).

There are many gaps in the outreach arena, but also many opportunities to provide quality scientific information in a timely manner and in a way that can be understood. The rapidly evolving social networking technologies provide a potential new way to reach a large number of people with useful messages about environmental and public health that can be used in individual decision-making.

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Figure 1.
Full and abbreviated Logos for the NIEHS PO1 grant

Figure 2.
Examples of Florida Red Tide Epidemiologic Study Recruitment Outreach/Education Materials

Figure 3.
Florida Red Tide Epidemiologic Study Outreach/Education Towel with Logo

Figure 4.
Florida Red Tide Research Team Website (www.mote.org/NIEHSredtidestudy)

**Sneezing? Coughing?
Watery Eyes?**

Your symptoms may be related to Florida Red Tide.
People with asthma or respiratory problems should avoid red tide
areas especially when winds are blowing on shore.

To speak to a health professional anytime,
call the Florida Red Tide Health Hotline

1-888-232-8635 toll free

Breathe Easy During a Red Tide

Solutions To Avoid Red Tide, Inc.
www.redtideonline.com

This informational material was funded by the Florida Department of Health.

Figure 5.
Florida Red Tide information sign for beaches (Florida Dept of Health, START, Mote Marine, University of Miami Oceans & Human Health Center, Florida Poison Information Center, and designed by Ms Wendy Stephan MPH)

Figure 6.
Beach Conditions Reporting Website (www.mote.org/beaches)

Table 1
Florida Red Tide outreach and education items distributed by the organization Solutions To Avoid Red Tide (START).

	Years						
	2005	2006	2007	2008	2009	2010*	Totals
FAQ Cards	43,701	21,580	41,255	18,800	5,518	1,552	132,406
Wallet size info cards	25,851	10,090	13,690	4,310	3,002	751	57,694
Pet FAQ cards	N/A	N/A	N/A	2,100	3,913	1,802	7,815
Bracelets	N/A	N/A	N/A	958	2,633	673	4,264
Student Workbooks	N/A	N/A	N/A	48	3,837	773	4,658
Teacher Workbooks	N/A	N/A	N/A	N/A	300	30	330
Tattoos	N/A	N/A	N/A	62	2,010	903	2,975
Bookmarks	N/A	N/A	N/A	N/A	1,190	200	1,390
Totals	69,552	31,670	54,945	26,278	22,403	6,684	211,532

* through October 1, 2010