Published in final edited form as:

Appl Environ Educ Commun. 2015 ; 14(3): 167–177. doi:10.1080/1533015X.2015.1067579.

Risk in daily newspaper coverage of red tide blooms in Southwest Florida

Zongchao Li^{a,*}, Bruce Garrison^b, Steven G. Ullmann^c, Barbara Kirkpatrick^d, Lora E. Fleming^e, and Porter Hoagland^f

^a College of Mass Communications and Information Studies, University of South Carolina, Columbia, SC 29208. ^b School of Communication, University of Miami, Coral Gables, FL 33124-2105. bruce@miami.edu. ^c Center for Health Sector Management and Policy, School of Business Administration, University of Miami, Coral Gables, FL, 33124-9965. sullmann@bus.miami.edu. ^d Environmental Health Program, Mote Marine Laboratory, Sarasota, FL 34236. bkirkpat@mote.org. ^e European Centre for Environment and Human Health, University of Exeter, Medical School Knowledge Spa Royal Cornwall Hospital Truro, Cornwall, TR1 3HD, UK. l.e.fleming@exeter.ac.uk. ^f Marine Policy Center, Woods Hole Oceanographic Institution, Woods Hole, MA 02543. phoagland@whoi.edu.

Abstract

This study investigated newspaper coverage of Florida red tide blooms in four metropolitan areas of Southwest Florida during a 25-year period, 1987-2012. We focused on how journalists framed red tide stories with respect to environmental risk, health risk, and economic risk. We determined risk to be a key factor in this news coverage, being an aspect of coverage of red tide itself in terms of environmental risk, tourism risk, and public health risk. The study found that red tide news coverage is most often framed as an environmental story.

Keywords

Social amplification of risk; red tide; *Karenia brevis*; news media; newspapers; framing; risk communication; environment communication; content analysis

A single-celled photosynthetic organism in ocean waters causes the “red tide” or a “harmful algal bloom” (HAB). Red tide is the common name for blooms of the dinoflagellate, *Karenia brevis*, which turn ocean waters from turquoise, green, and blue to a brown-orange-red. *Karenia brevis* produces powerful natural neurotoxins that can be quite harmful to humans, causing neurotoxic shellfish poisoning and breathing difficulties with risk and distress significantly elevated for those who are predisposed to respiratory issues. Blooms can be devastating to fishing and seafood industries, tourism, and other aspects of local economies (Hoagland, 2013).

*Corresponding author. zongchao.lee@gmail.com.

Red tide blooms are common in Southwest Florida, but residents and tourists are not very knowledgeable about the phenomenon. Research has indicated “knowledge gaps” and misperceptions exist (Kirkpatrick et al., 2014; Nierenberg et al., 2010). While there has been much controversy in both the scientific community as well as the general public about formation of Florida red tides, past research indicates that finding accurate information has been a challenge for residents and visitors and that efforts are needed to educate the public about Florida red tide (Kirkpatrick et al., 2014; Nierenberg et al., 2010).

Meanwhile, researchers studying the human-nature dynamics of red tide have pinpointed the impact of news media on public knowledge and perception of risk involving the environment, the economy, and public health (Bauer, 2006; Bennett, Calman, Curtis, & Fischbacher-Smith, 2010; Sachsman, Simon, & Valenti, 2006; Sachsman, Simon, & Valenti, 2010). Newspapers, in particular, have been found as one of the primary sources of public information about these environmental risk issues (Wakefield & Elliott, 2003). Negative media coverage about Florida red tide could shape public perceptions and has a significant impact on social, economic, and cultural levels, a process known as the social amplification of risk (Kasperson et al., 1988). From a risk management perspective, the news media's role in the overall human-nature dynamics is evolving and needs much investigation (Bauer, 2006).

This study examines how newspapers have reported severe blooms in Southwest Florida during the past 25 years. Adopting the social amplification of risk framework, we focus on the different forms of risk frames within the coverage of these blooms. There are clear human and environmental stakes in understanding the news frames of red tide blooms. Public misperception of the health risks of blooms can have severe negative impact on local economies. Hoagland et al., (2013) studied the interactions between humans and nature and how they may impact each other using Florida blooms and coastal populations. This study adopts a similar framework, emphasizing the social, economic, and cultural effects of red tide blooms. The news media influence what people know and, sometimes, what they think about an issue. This impact, in turn, determines human actions, reactions, and behaviors regarding the issue (McCombs & Shaw, 1972; Sparks, 2013). While news content is read and acted upon differently by readers, we feel that studying print media content helps us understand what the public learns about risk – in terms of the environment, public health, and the local economy – caused by red tide blooms.

Literature

Social amplification of risk

The social amplification of risk framework posits that risk events interact with social, psychological, institutional, and cultural processes and may heighten or attenuate the public perceptions of the hazard (Kasperson et al., 1988). The amplified risk perception has been demonstrated to shape behaviors because the public tends to self-protect against risk (Haab, Whitehead, & Parsons, 2001; Smith, van Ravenswaay, & Thompson, 1998). Such behavior responses, in turn, may result in secondary sociocultural and economic impacts (Bauer, 2006, p. 35).

The risk amplification process occurs in two stages: (1) the risk communication process and (2) the response mechanisms of society. In the risk communication process, risk signals are transferred by both individual and social stations, such as the news media, scientists, risk-management institutions, activist organizations, and opinion leaders (Kasperson et al., 1988). Research has identified the news media as key amplification agents. Negative media coverage has been shown to be a major cause of adverse consumer reactions (e.g., Griffith, 1999; Haab, Whitehead, & Parsons, 2001; Wessells, Miller, & Brooks, 1995).

Human responses, prevention, and intervention efforts address the response mechanism of the social amplification of risk process. Such responses to red tide blooms include (1) fertilizer ordinances, which have gained scientific attention as a potential cause for the harmful algal growth (Fleming, 2013); (2) dead marine life and fish removal, (3) beach closings and warnings, (4) shellfish beds or fishing closing, (5) reporting red tide symptoms, and (6) and scientific research on the causal process and impact of this harmful algae. Human responses and interventions signal the risk severity and affect perceived confidence and control over the risk situation.

The role of media in environmental, environmental controversy, and public health risk news has received considerable recent scholarly attention (e.g., Russill, 2008; Russill & Nyssa, 2009; Peeples & Depoe, 2014; DeLuca & Peeples, 2002; Campbell, 2014; Shehata & Hopmann, 2012; Morgan, Larkin, & Adams, 2011). For example, past research has examined media and rhetoric involving environmental issues (Peeples, 2005; Peeples, 2011; Peeples et al., 2014). It is clear there is concern among scholars about media coverage of environmental problems, but little empirical evidence has been provided in assessing the social and cultural impact of harmful algae blooms, such as mass media's influence on public health and the economy (Backer, 2009; Bauer, 2006). Adopting the social amplification of risk framework to the HAB context, the spiral process of mutual influence between risk event and human responses suggests many potential social and cultural impacts, including: (1) enduring mental perceptions, images, and attitudes; (2) impact on local business and economic activities; (3) changes in risk monitoring and management; and (4) changes in political and social pressure, among others (Kasperson et al., 1988).

Newspaper reports remain the main source of public knowledge and information source at the local level (Riffe & Reimold, 2008; Steinle & Brown, 2012). Thus, we analyze newspaper content to understand how risk has been communicated via three risk frames of human health risk, environmental risk, and economic risk. The framing theories are explained below.

Framing and the mass media

Framing research studies how journalists place news in context and the processes through which they select, emphasize, exclude, and elaborate upon information (Baldwin, Perry, & Moffitt, 2004; Sparks, 2013). Reporters and others involved in news production select “some aspects of a perceived reality” and this action elevates those elements of a story in the minds of news consumers (Entman, 1993). In this sense, framing is “an unavoidable reality of the communication process, especially as applied to public affairs and policy” (Nisbet, 2009, p. 15). The public relies on news frames to understand and discuss social issues;

communication experts employ frames to create outreach strategies and persuasive messages; policymakers use frames to determine policies and make decisions; social scientists rely on frames to understand public concerns and study how journalists tell stories and create news (Nisbet, 2009). Framing is an extension of another widely used theory, agenda-setting, in that it helps scholars understand how journalists create news stories that ultimately determine topics about which the public thinks and discusses (Littlejohn & Foss, 2008; Stacks, Li, & Spaulding, 2015).

Environmental issues have been investigated in framing research, including global warming, climate change, threat of species extinction, and extreme weather events (Jacobson et al., 2011; Shehata & Hopmann, 2012; Nisbet, 2010; Ungar, 1999). Research on environmental reporting has identified environmental, economic, political, human interest, and technological news frames (Howenstine, 1987; Sachsman et al., 2006; 2010). In particular, Kusek et al. (1999) studied red tide coverage by the *St. Petersburg Times*. Coverage was found to be inaccurate and inconsistent and a positive correlation was found between intensity of the bloom and amount of coverage. While the research by Kusek et al. (1999) did not specifically focus on frames or news framing, their study found that coverage emphasized economic concerns, public health impacts, and red tide effects on policy. It follows, then, that different news frames may impact the public's perception about risk involved in blooms. For example, a fishing and outdoors story may not convey urgency in a bloom affecting public health.

We adopt framing theory and analyze newspaper content to understand how risk has been communicated. We propose three frames and their sub-frames: (1) human health risk, which includes respiratory/breathing irritation, dermal-skin irritation or skin infection, seafood or shellfish poisoning and watery eyes (see Fleming et al., 2011; Kirkpatrick et al., 2004); (2) environmental risk, including fish kills, shellfish contamination, marine mammals, birds, and nutrients pollution (Fleming et al., 2011); (3) economic risk, including costs associated with public health, tourism and recreation industry, commercial fisheries (including harvest losses, farmed fish kills, and other resources affected by long-term contamination), and monitoring and management costs. These four economic risk categories were drawn from the work of Anderson et al. (2000), in which they identified costs associated with HAB impact. Furthermore, we are interested in human behavioral responses and interventions reported by the print media. Thus:

RQ 1: How was risk information related to red tide blooms communicated in news stories in terms of (a) health effects descriptions, (b) environmental risk descriptions, and (c) economic impact descriptions?

RQ 2: Was any public or private intervention against red tide pollution reported during news coverage of red tide blooms?

RQ3: Which frames were used for headlines and story text in news stories covering red tide blooms?

An important part of the storytelling process is identification of informed and authoritative sources, particularly if storytelling involves scientific subjects (Sachsman, Simon, & Valenti, 2010; Wakefield & Elliott, 2003). In examining media reports of environmental health risk,

researchers have raised concerns about potential biases of sources used by journalists (Griffith, 1999). Using non-scientific sources to report the health risk of Florida red tide (e.g., fishermen and tourists) makes for interesting anecdotal accounts, but may heighten the public's fear of adverse health consequences. Media tend to accentuate existing concerns, uncertainties, and conflicts without questioning the legitimacy of the credibility of the source (Bauer, 2006). As a result, information from various sources is presented to the audience on an equal footing without assessing its technical accuracy. To examine whether a source bias from key informants was present in the print news about red tide, we ask the following:

RQ 4: What public and private sources were used in print media coverage about red tide?

Methods

We focus on the print media coverage of *Karenia brevis* blooms in Southwest Florida from 1987 to 2012. The study utilized quantitative content analysis to collect data (see Riffe et al., 2014; Krippendorff, 2013). Four newspapers – the *Naples Daily News* (1996-2012), *Sarasota Herald-Tribune* (1996-2012), *The Tampa Tribune* (1990-2012), and the *Tampa Bay Times*¹ (1987-2012) – were studied because of their location in the Southwest coastal region of Florida, an area historically prone to red tide blooms. The Associated Press Florida wire (1997-2012) was also included to represent coverage distributed from within Florida to publications and other print media. Story content was obtained through the NewsBank database.

Stories were selected for analysis through a multi-stage process. Databases were searched for all stories mentioning “red tide” in either the headline or the story. This yielded a total of 5,046 items. A systematic sample was drawn from this population by selecting every third story from a random starting point. In cases where undesirable content was identified, the next story was selected. The resulting group of 1,682 stories was reviewed more carefully to eliminate items that were only tangential or were not about red tide. Following the culling, the database settled at 811 items.

Each story was analyzed for certain characteristics. Basic descriptive characteristics such as newspaper name, story reporter/writer, story length, section, page, story publication date, were recorded as a means of organizing coverage analysis. Key variables, their operational definitions, and the codebook can be found in the appendix.

Three trained coders were used to collect data. Prior to data collection, extensive coder training and pretesting improved the coding reliability and accuracy. Multiple tests and revisions were made that led to the final versions of the operational definitions and coding instrument used in the study.² Inter-coder reliability was determined using Cohen's *Kappa*. Inter-coder reliability ranged from 1.000 to 0.632, with most variables falling into the middle or upper portion of that range. While a small number of items scored below 0.800,

¹Formerly the *St. Petersburg Times*.

²A list of all operational definitions and a copy of the coding sheet may be requested from the authors.

Krippendorff (2013) advises that any conclusions about variables with reliabilities at 0.667 to 0.800 be viewed as tentative. We have de-emphasized those items in our analysis.

Findings

The sample's mean story length was 527.49 words. The largest number of stories was published in 2007 (n=124, 15.3% of all stories), 2005 (n=102, 12.6%), and 1996 (n=77, 9.5%), corresponding with severe red tide bloom periods. General descriptions of blooms were found throughout the sample, but reporters sometimes used bloom (56.6%), toxic/poison (48.6%) and *Karenia brevis* (12.8%). A total of 28.7% of all stories included images, mostly photographs.

RQ 1: How was risk information related to red tide blooms communicated in news stories in terms of (a) health effects descriptions, (b) environmental risk descriptions, and (c) economic impact descriptions?

As shown in Table 1, the story content was heavily focused on the environmental risk caused by red tide, with 79.9% reporting at least one kind of risk impact on the environment. Within the stories that covered environmental risk, the major emphasis was on fish kills (82.5%), marine mammals (44.6%), and shellfish contamination (26.8%).

Human health impact was also frequently described in stories with nearly half (47.6%) mentioning some sort of health impact, such as respiratory irritation (90.7%). In addition, 29.7% of stories reported on economic impact, such as impact on tourism or recreation (60.6%). The tone of the descriptions was also recorded as seen in Table 1.

RQ 2: Was any public or private interventions against red tide pollution reported during news coverage of red tide blooms?

As shown in Table 1, human interventions in the form of public and private actions were found in 60.5% of stories. Proposals for research or in-progress research about a bloom or its effects were the leading action (50.7%), followed by shellfish bed closings or fishing being banned (16.7%), dead marine life removal (13.7%), and a plea for reporting dead fish or health symptoms (12.2%).

RQ3: Which frames were used for headlines and story text in news stories covering red tide blooms?

Florida red tide stories were most commonly told as environmental stories. This frame is dominant across all publications; it was used in almost two-thirds of stories, in both the story narrative and the story headline, as shown in Table 2. Environment and/or red tide were primary headline subjects in 66.5% of headlines and 61.8% of story content. Wildlife and marine animals, primarily manatees, was the frame used in 13.3% of headlines and 12.6% of story content.

There were some variations of frame use across newspapers. The *Sarasota Herald-Tribune* emphasized environment frame while others used specific frames such as wildlife/marine mammals or fishing, as shown in Table 3.

RQ 4: What public and private sources were used in print media coverage about red tide?

As indicated in Table 4, 38.3% of stories utilized sources from both public and private sectors; 28.9% of stories involved private sector sources, and 27.2% used public sector sources. A few (5.6%) gave no identifiable source. Within the public sector (54.5%), government officials from agencies not directly involved in public health, such as NOAA, were most frequently cited. Within private sector sources (39.1%), business and commercial officials (15.8%), charter boat captains (13.9%), and academic institutions (e.g., Mote Marine Laboratory) and researchers were identified.

Discussion and conclusions

This paper focuses on how risk information has been communicated by newspapers in the red tide bloom areas from 1987 to 2012. Red tide poses threats to the environment, human health, and local economy. In response, humans engage in education and research, prevention, and intervention to help understand the formation and impact of the hazard and how to reduce it. Such efforts further transfer into policymaking and political decisions. Long term, people's behaviors change due to the impact of red tide and there could be a shift in the coastal demographics. Such socio-economic, political, and other human behavior changes will, in turn, impact on nature, forming a loop of mutual influence.

Within this human-nature dynamic, communication is crucial. It influences how information has been transferred and understood by the general publics, stakeholders, and policymakers. This is especially true for a risk situation, because risk-related information tends to be amplified through the communication process, a phenomenon known as the social amplification of risk. Research suggests news media play a leading role as an amplifying agent because people's reliance on mass media for information gathering (Stacks, Li, & Spaulding, 2015). We are not trying to draw conclusions about the media's impact on perceptions of red tide blooms, but rather attempting to understand the scope and depth of information communicated through newspapers. We believe investigating news content helps us understand the dimension of risk and what the public learns about risk related to red tide – in terms of the environment, public health, and the local economy.

Our findings are valuable to the overall understanding of the red tide problem. Our classifications of the risk frames featured in the newspapers complement the science and social science literature on red tide. We found that newspapers emphasized red tide as an environmental hazard. A considerable amount of news attention was also given to the human health impact caused by red tide, such as respiratory and eye irritation and seafood poisoning. Media attention has also focused on red tide's economic impact such as on tourism and recreation. These findings offer a more in-depth understanding of newspaper coverage of red tide, in addition to the broader risk frames. We believe our findings contribute to the science and socioecology research in helping public administrators to manage this environment hazard and to educate local residents about the potential risk.

Southwest Florida newspapers framed red tide blooms as environmental problem stories, but the stories were also told as wildlife, marine life, and fishing concerns. These findings

highlight sensitivity to the marine environment. The stories are simply not translated into public health, policy, travel and tourism, or local economy stories. Policymakers and red tide communication experts should be cautious about elevation of the environmental risk frame. After all, audiences rely on news frames to interpret and react to social issues. Lack of information on other aspects of red tide could bias people's opinions and further influence their reactions to policies. In terms of public policy and public affairs, Nisbet (2009) argued, framing is part of communication about issues. Using the nuclear energy issue as an example (Nisbet, 2009), initial media coverage was about peaceful and safe uses of nuclear technology. But this shifted in several directions, both supporting and opposing nuclear energy and using differing frames, to discuss the issue during the past half century.

Kasperson, et al. (1988) noted that risk amplification occurs in two ways: in the risk communication process and in the actions and reactions/response mechanisms of society. Southwest Florida's newspapers acted as credible as well as influential information sources and likely have functioned as a social amplifier for risk communication. The heightened public risk perception could result in behavior changes such as reduced seafood consumption and a decline in recreational activities (Morgan, Larkin, & Adams, 2011). The increased public risk perception could also produce a "halo effect" (Coombs & Holladay, 2006; Nisbett & Wilson, 1977), a repercussion that could lead to public's aversion to seafood not affected by red tide, or to areas not impacted by the blooms. This could trigger a chain of reactions that may eventually lead to adverse impact on the economy at a larger scale known as the "butterfly effect" (Jaaskela & Kulish, 2010). This chain of reactions could significantly change the social ecological system in the long term. It is also clear that the response process noted by Kasperson, et al. (1988) is described in detail in a majority of the news reports. More than half of the stories about blooms describe some form of intervention actions, especially research activities. Closings of fishing areas were also significant response actions reported, as were efforts to remove deceased marine life.

Several study limitations lead to future research. First, there is a need to analyze the electronic media and online media coverage of red tide. Second, framing is sometimes viewed as theoretically vague because it lacks a commonly shared theoretical model (Scheufele, 1999). Text-based frames are polysemic and may be read and acted upon differently by different readers, and not all readers are central actors. Furthermore, researchers could go beyond framing theory for further study of coverage of environmental risk. Finally, future research can quantify the media data and incorporate into predictive models to help better understand print media's impact on public perception and behavior.

Acknowledgments

This work was funded by National Science Foundation (NSF) Award #1009106 (CNH); the National Institute for Environmental Health Sciences (NIEHS) Award #R21ES017413-01A2; and by European Regional Development Fund and the European Social Fund.

Appendix. Operational Definitions of Key Variables³

Story frames

Frames were operationalized as both headline and story text primary and secondary subjects.⁴

Risk

Stories about situations leading to exposure to the chance of injury or death, or some type of material loss, such as health dangers possible from exposure to harmful algae blooms or red tide. News stories may refer to potential health problems caused by red tide at beaches, for example, leading to skin problems or breathing difficulties. Or stories may refer to risk directly or indirectly in terms of risks for marine life, such as manatees or shellfish. Risk may be discussed in stories in the context of potential losses in fishing and tourism, for example, or potential impact on human health such as skin irritations or lung problems.

Red tide descriptions

This category analyzes how red tide was described in the story focusing on key words. For example, it can be described as simply *red tide* or as another scientific term such as a *bloom* or *algae* that is *toxic* or referred to as the Southwest Florida algae, *Karenia brevis*.⁵

Environmental risk descriptions

Describe the environment as a factor in the red tide bloom. This includes descriptions as possible natural or man-made pollution causes.⁶

Health risk descriptions

Describe the effects of red tide on public health. Descriptions include red tide as a possible cause of respiratory problems, of skin or dermal irritations, or other medical problems.⁷

Economic risk descriptions

Describe how the story summarizes the impact of red tide on the economy. This could occur in several ways, such as associated medical costs with respiratory symptoms, but sometimes includes lost productivity of workers. Or it may refer to recreation and tourism industries that experience economic losses as a result of people choosing to avoid areas experiencing a red tide or even areas that are known to experience frequent blooms. The story may refer to commercial fisheries and harvest losses. And it might include monitoring and management.⁸

⁴Story frame coding categories for headlines and story content included business/economy, tourism/recreation, politics/policy, public health, seafood safety, fishing, environmental quality/red tide, natural disaster, wildlife/marine animals, and other.

⁵Red tide descriptions coding categories included bloom, toxic/poison, *Karenia brevis* or *K. brevis*, red tide, harmful, and other.

⁶Environmental risk coding categories included fish kills, shellfish contamination, marine mammals, birds, nutrients pollution, and other.

⁷Health risk coding categories included respiratory/breathing irritation, dermal-skin irritation or skin infection, seafood or shellfish poisoning, watery eyes, and other.

Interventions

This variable measures human interventions or actions taken in response to a red tide bloom by a government agency or by private individuals such as tourism boards, restaurant and hotel associations, and so forth.⁹

Sources used in reporting

Types of sources used to report. This includes the type of organization represented or role an individual plays at work, or their specialization.¹⁰

References

- Backer LC. Impacts of Florida red tides on coastal communities. *Harmful Algae*. 2009; 8(4):618–622.
- Baldwin, JR.; Perry, SD.; Moffitt, MA. *Communication theories: For everyday life*. Pearson; Boston, MA: 2004.
- Baran, SJ.; Davis, DK. *Mass communication theory: Foundations, ferment, and future*. 6th ed.. Wadsworth; Boston: 2012.
- Bauer, M., editor. *Harmful algal research and response: A human dimensions strategy*. National Office for Marine Biotoxins and Harmful Algal Blooms, Woods Hole Oceanographic Institution; Woods Hole, MA: 2006. p. 54
- Bennett, P.; Calman, K.; Curtis, S.; Fischbacher-Smith, D., editors. *Risk communication and public health*. 2nd ed.. Oxford University Press; New York, NY: 2010.
- Campbell V. Framing environmental risks and natural disasters in factual entertainment television. *Environmental Communication*. 2014; 8(1):58–74.
- Coombs WT, Holladay SJ. Unpacking the halo effect: reputation and crisis management. *Journal of Communication Management*. 2006; 10(2):123–137.
- Entman RM. Framing: toward clarification of a fractured paradigm. *Journal of Communication*. 1993; 43(4):51–58.
- Fleming, L. CHANS: Public perception of fertilizer ordinances and Florida red tides. paper presented to the 7th Symposium on Harmful Algae in the US; Sarasota, FL.. Oct. 2013
- Fleming LE, Kirkpatrick B, Backer LC, Walsh CJ, Nierenberg K, Clark J, Baden DG. Review of Florida red tide and human health effects. *Harmful Algae*. 2011; 10(2):224–233. [PubMed: 21218152]
- Griffith D. Exaggerating environmental health risk: The case of the toxic dinoflagellate pfiesteria. *Human Organization*. 1999; 58(2):119–127.
- Haab, TC.; Whitehead, JC.; Parsons, G.; Hall, P. The Effect of Information Conveyance on Behavioral Changes from Perceived Risks: An Application to Seafood Consumption and Pfiesteria Piscicida. 2001. Retrieved from http://www.aere.org/old/meetings/0106workshop_Haab.pdf
- Hoagland, P. Coupled nature-human (CNH) systems: Generic aspects of Human interactions with blooms of Florida red tide (*Karenia Brevis*) and implications for policy responses.. In: Rossini, GP., editor. *Toxins and biologically active compounds from microalgae*. Vol. 2, Sec. V: Risk Management. Science Publishers; Enfield, NH: 2013.
- Hoagland, P.; Kirkpatrick, B.; Kirkpatrick, G.; Hitchcock, G.; Kohler, K.; Lovko, V.; Ullmann, S.; Reich, A.; Fleming, L. Florida red tides and coastal populations as a coupled nature-human

⁸Economic risk coding categories included public health, tourism and recreation, commercial fisheries, monitoring and management cost, and other.

⁹Intervention coding categories included fertilizer ordinances, dead marine life removal, beach closing, beach notification-warning, shellfish beds closing or fishing closing, report dead fish or red tide symptoms, travel-tourism incentives, research, and other.

¹⁰Sources included public health official, NOAA or other government official, NGO or NGO official, business-commercial official, tourism-convention bureau, private consultant, academic/researcher/Mote, tourists/visitors, local residents, charter boat captains, and other.

system. paper presented to the 7th Symposium on Harmful Algae in the U.S.; Sarasota, FL.. Oct. 2013

- Howenstine E. Environmental reporting: Shift from 1970 to 1982. *Journalism Quarterly*. 1987; 64(4): 842–846. Winter.
- Jaaskela JP, Kulish M. The butterfly effect of small open economies. *Journal of Economic Dynamics and Control*. Jul; 2010 34(7):1295–1304.
- Jacobson SK, Langin C, Carlton S, Kaid LL. Content analysis of newspaper coverage of the Florida panther. *Conservation Biology*. 2011; 26(1):171–179. [PubMed: 21978166]
- Kasperson RE, Renn O, Slovic P, Brown HS, Emel J, Goble R, Kasperson JX, Ratick S. The social amplification of risk: A conceptual framework. *Risk Analysis*. 1988; 8(2):177–187.
- Kirkpatrick B, Fleming LE, Squicciarini D, Backer LC, Clark R, Abraham W, Baden DG. Literature review of Florida red tide: implications for human health effects. *Harmful Algae*. 2004; 3(2):99–115. [PubMed: 20411030]
- Kirkpatrick B, Kohler K, Byrne MM, Studts J. Florida red tide knowledge and risk perception: Is there a need for tailored messaging. *Harmful Algae*. 2014; 32:27–32. [PubMed: 24563634]
- Krippendorff, K. Content analysis: An introduction to its methodology. 3rd ed.. Sage; Thousand Oaks, CA.: 2013.
- Kusek KM, Vargo G, Steidinger K. Villareal TA. *Gymnodinium breve* in the field, in the lab, and in the newspaper --- A scientific and journalistic analysis of Florida red tides. *Contributions in marine science*. 1999; 34:1–230.
- Littlejohn, SW.; Foss, KA. Theories of human communication. 9th ed.. Wadsworth; Belmont, Calif.: 2008.
- McCombs ME, Shaw DL. The agenda-setting function of mass media. *Public Opinion Quarterly*. 1972; 36(2):176–187.
- Morgan KL, Larkin SL, Adams CM. Empirical analysis of media versus environmental impacts on park attendance. *Tourism Management*. 2011; 32:852–859.
- Nierenberg K, Byrne MM, Fleming LE, Stephan W, Reich A, Backer LC, Tanga E, Dalpra DR, Kirkpatrick B. Florida red tide perception: Residents versus tourists. *Harmful Algae*. 2010; 9:600–606. [PubMed: 20824108]
- Nisbet MC. Communicating climate change: Why frames matter for public engagement. *Environment: Science and Policy for Sustainable Development*. 2009; 51(2):12–23.
- Nisbet, MC. Knowledge into action: Framing the debates over climate change and poverty.. In: D'Angelo, P.; Kuypers, JA., editors. *Doing news framing analysis: empirical and theoretical perspectives*. Taylor & Francis; New York, NY: 2010. p. 43-83.
- Nisbett RE, Wilson TD. The halo effect: Evidence for unconscious alteration of judgments. *Journal of Personality and Social Psychology*. 1977; 35(4):250.
- Peeples, J. Aggressive mimicry: Wise use and the environmental movement.. In: Senecah, Susan, editor. *Environmental communication yearbook*. Vol. 2. Lawrence Erlbaum Associates; Mahwah, NJ: 2005. p. 1-18.
- Peeples J. Toxic sublime: Imaging contaminated landscapes. *Environmental Communication*. 2011; 5(4):373–392.
- Peeples J, Bsumek P, Schwarze S, Schneider J. Industrial apocalyptic: Neoliberalism, coal, and the burlesque frame. *Rhetoric & Public Affairs*. 2014; 17(2):227–253.
- Peeples, J.; Depoe, S., editors. *Voice and environmental communication*. Palgrave Macmillan; New York: 2014.
- Peeples J, DeLuca KM. From public sphere to public screen: Democracy, activism, and the “violence” of Seattle. *Critical Studies in Media Communication*. 2002; 19(2):123–151.
- Riffe, D.; Lacy, S.; Fico, F. *Analyzing media messages: Using quantitative content analysis in research*. 3rd Ed.. Rutledge; New York, NY: 2014.
- Riffe D, Reimold D. Newspapers get high marks on environmental report card. *Newspaper Research Journal*. 2008; 29(3):65–79.
- Russill C. Tipping point forewarnings in climate change communication: Some implications of an emerging trend. *Environmental Communication*. 2008; 2(2):133–153.

- Russill C, Nyssa Z. The tipping point trend in climate change communication. *Global Environmental Change*. 2009; 19:336–344.
- Sachsman DB, Simon J, Valenti JM. The environmental reporters of New England. *Science Communication*. 2006; 28(1):93–121.
- Sachsman, DB.; Simon, J.; Valenti, JM. *Environment reporters in the 21st century..* Transaction Publishers; New Brunswick, NJ: 2010.
- Scheufele DA. Framing as a theory of media effects. *Journal of Communication*. 1999; 49(1):103–122.
- Shehata A, Hopmann DN. Framing climate change: A study of US and Swedish press coverage of global warming. *Journalism Studies*. 2012; 13(2):175–192.
- Smith ME, Van Ravenswaay EO, Thompson SR. Sales loss determination in food contamination incidents: An application to milk bans in Hawaii. *American Journal of Agricultural Economics*. 1988; 70(3):513–520.
- Sparks, GG. *Media effects research: A basic overview*. 4th Ed.. Wadsworth; Boston, MA: 2013.
- Stacks, DW.; Li, Z.; Spaulding, C. Media effects.. In: Wright, J., editor. *International Encyclopedia of Social and Behavioral Sciences*. 2nd Ed.. Vol. 15. Elsevier Ltd; Oxford, UK: 2015. p. 29-34.
- Steinle, P.; Brown, S. *The power and purpose of journalism*. Valid Sources Press; Seattle, WA: 2012.
- Ungar S. Is strange weather in the air? A study of U.S. national network news coverage of extreme weather events. *Climate Change*. 1999; 41:133–150.
- Wakefield SEL, Elliott SJ. Constructing the news: The role of local newspapers in environmental risk communication. *The Professional Geographer*. 2003; 55(2):216–226.
- Wessells CR, Miller CJ, Brooks PM. Toxic algae contamination and demand for shellfish: a case study of demand for mussels in Montreal. *Marine Resource Economics*. 1995; 10(2):143–159.

Table 1

Red tide risk content descriptions

Category	Percent	Negative Tone	Neutral Tone	Positive Tone
<u>Human health impact descriptions</u>	47.6%	37	62.2	0.8
Respiratory/breathing irritation	90.7			
Dermal-skin irritation/skin infection	4.4			
Seafood/shellfish poisoning	19.7			
Watery eyes	27.5			
Other	4.1			
<u>Environmental risk descriptions</u>	79.7%	38.6	59	2.4
Fish kills	82.5			
Shellfish contamination	26.8			
Marine mammals	44.6			
Birds	4.6			
Nutrients pollution	6.5			
Other	3.4			
<u>Economic impact descriptions</u>	29.7%	40.9	56.1	3
Public health	16.6			
Tourism and recreation	60.6			
Commercial fisheries	30.7			
Monitoring and management cost	29.5			
Other	2.5			
<u>Intervention</u>	60.5%			
Fertilizer ordinances	1.8			
Dead marine life removal	13.7			
Beach closing	2.2			
Beach notification/warning	4.1			
Shellfish beds/fishing closing	16.7			
Report dead fish/symptoms	12.2			
Research	50.7			
Other	26.5			

Table 2

Primary red tide news frames

Frame	Story content	Headline
Environment	61.8%	66.5%
Wildlife-marine animals	14.8	13.3
Fishing	12.6	5.2
Politics-policy	3.7	3.8
Business-economy	1.8	1.7
Tourism-recreation	1.5	1.6
Seafood safety	1.2	1.1
Public health	1.0	1.0
Natural disaster	0.0	0.4
Other	1.6	5.4
Totals	100.0	100.0

Table 3

Red tide news framing by publication

News organization	Fishing	Environment	Wildlife/marine mammals
<u>News story content</u>			
<i>Sarasota Herald Tribune</i>	16.4%	70.4%	5.3%
<i>Tampa Bay Times</i>	17.4	60.6	13.6
<i>Tampa Tribune</i>	17.8	54.1	17.3
<i>Naples Daily News</i>	4.0	72.8	8.7
Associated Press Florida	2.1	37.9	45.3
Combined media	12.6	61.8	14.8
<u>Headline content</u>			
<i>Sarasota Herald Tribune</i>	4.0%	80.5%	5.3%
<i>Tampa Bay Times</i>	9.8	64.4	12.1
<i>Tampa Tribune</i>	8.1	58.1	15.1
<i>Naples Daily News</i>	2.9	72.3	8.1
Associated Press Florida	0.0	40.0	40.0
Combined media	5.2	66.5	13.3

Table 4

News sources used in stories

News Sources	Percent
Public health official	4.2%
Other government official (e.g., NOAA)	54.5
NGO or NGO official	13.2
Business-commercial official	15.8
Tourism-convention bureau	2.3
Private consultant	1.4
Academic institution / researcher / Mote	39.1
Tourists / visitors	6.3
Local residents	13.1
Charter boat captains	13.9
No source	5.4
Other	8.6
Overall private sector	28.9
Overall public sector	27.2
Both public and private sector	38.3
No source	5.6