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Public Awareness and Knowledge of Red Tide Blooms

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Public Awareness and Knowledge of Red Tide Blooms

Abstract

We measured the knowledge of Southwest Florida residents regarding red tides by surveying 1,006 randomly selected individuals. Although 89% were aware of red tides, 72% erroneously believed that finfish and crustaceans were unsafe to eat and that waters were unsafe for swimming during a red tide. Because respondents primarily rely on newspapers and television (70% and 62%, respectively), these media should be pursued in Extension efforts to correct these misunderstandings and reduce revenue losses to local businesses. Costly brochures, workshops, and Internet sites do not warrant additional educational efforts at this time because only 6% of respondents identified those sources.

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Introduction

Harmful algal blooms (HABs) are naturally occurring events that can cause considerable ecological and economic damage. A recent report by the National Oceanographic and Atmospheric Administration conservatively estimates annual losses at \$75 million per year (Bauer, 2006). These losses represent direct losses in economic activity at the point of first occurrence, which excludes the corresponding subsequent impacts on related industry sectors.

One particular species of algae (*Karenia brevis*) can impart a reddish hue to marine waters and generates a neurotoxin that affects several species, including humans. An HAB of *K. brevis* is referred to as a "red tide" within the Gulf of Mexico.

Red tides have a long history in Florida, where they have had the most impact. The earliest recorded event dates to 1844 (FWRI, 2006). Since formal data collection began in 1954, red tide events have been documented during 50 of those years in Southwest Florida coastal waters, with events lasting from a few weeks to more than a year (FWRI, 2006).

Severe red tides result in finfish kills and temporary closures of local molluscan shellfish harvesting (i.e., hard clams and oysters). Mortalities have also been documented among several threatened and endangered species, such as the West Indian manatee (Landsberg & Steidenger, 1998). Local tourism activities such as boating, recreational fishing, and beach-related activities can be negatively affected by the presence of noxious airborne toxins and the foul odor emanating from large quantities of decomposing marine life on the water surface and beaches. The airborne toxins have also been shown to affect human health (Steidenger & Penta, 1999).

The purpose of our study was to generate information that would provide for a better understanding of the level of public awareness and knowledge of red tide events among Southwest Florida residents. This information could be used by local and statewide agencies, resource

managers, and extension personnel in the development of more effective Extension programs.

Survey Methodology and Response

We contracted with the Florida Survey Research Center (FSRC) at the University of Florida to survey 1,000 randomly selected residents of Manatee and Sarasota Counties in Southwest Florida. These counties were selected due to the relatively high incidence of documented red tide blooms in that region since record keeping began.

The FSRC conducted the telephone survey using random digit dialing during January and February 2001. The share of respondents by county was determined by a weighting of the total populations at the time of the survey. The FSRC was also instructed to randomize the selection of an adult respondent by asking for the household member over the age of 18 whose birthday was closest to the day of the interview. Because a quota sampling approach was used, a call back procedure was employed whereby the selected adult, if not available, was repeatedly contacted until the interview was completed. The FSRC completed a total of 1,006 interviews, which is six more than requested under the stratified random sampling quota-based approach that was used.

Seventy-eight percent of the respondents were full-time residents of Southwest Florida, while 15% lived in the region less than 7 months per year. Twenty-five percent of the respondents had lived in the region for at least 5 years, while 50% indicated they had lived in the region for at least 13 years, and 25% had lived in the two-county region for at least 23 years.

We asked respondents for the zip code of their primary residence in order to determine their proximity to the Gulf of Mexico. We hypothesized that residents living closer to the beach are more knowledgeable of red tides because they would be more likely to be affected. Of the total number of respondents within the combined two-county region who provided local zip codes, 85% resided west of I-75, which is the primary north-south roadway in the region. This roadway provided a distinct line of demarcation between zip codes that contained coastal areas and those that did not.

Results

Demographic Characteristics

The average characteristics of the sample respondents who indicated awareness of the term "red tide" (i.e., n = 894), which is needed to examine red tide related issues, are compared to published estimates of state demographics in Table 1. The respondents were represented by a slightly higher percentage of females (59.1%) than published statistics would have suggested (52.8%) for a representative sample.

Table 1.
Demographic Characteristics of Respondents Compared to the Population of Florida

Characteristic (No. responses)	Respondents (%)	Statewide Population (%)
Gender (n=894):		
Male	40.9	47.2
Female	59.1	52.8
Age (n=854):		
18-24 years	3.3	7.1
25-44 years	24.9	27.2
45-64 years	34.2	29.3
65 years or older	37.6	36.3
Education Level (n=886):		
8th grade or less	0.4	6.7
Some high school	5.3	14.4
High school graduate	25.8	33.0
Technical/vocational training	2.8	NA
Some college	25.3	20.4
College graduate	26.8	18.6
Graduate/professional school	13.6	6.8
Hispanic:	4.5	6.0
Race (n=875):		

African American	3.1	5.5
Caucasian	93.9	93.6
Asian	0.6	<1.0
American Indian	0.4	<1.0
Other	2.0	<1.0
Gross Annual Income (n=644):		
\$20,000 or less	11.3	24.7
\$20,001 - \$35,000	20.9	25.9
\$35,001 - \$50,000	26.4	19.1
At least \$50,001	41.5	30.3
Notes: The statistics on gender, age and race were obtained from the Bureau of Economic and Business Research (2000). The statistics on education were obtained from U.S. Census Bureau (2000). The statistics for income were obtained from the Sales & Marketing Management Magazine (2000). NA indicates that the statistic was not available.		

The survey targeted only respondents 18 years of age or older. Of that population, the respondents to the survey were generally older; 71.8% were at least 45 years old compared to the 65.6% of state residents in that same age category.

Nearly two-thirds of respondents (65.7%) completed at least some college compared to 44.8% of the representative population in Florida. At the other extreme, just 5.7% of respondents received less than 12 years of formal education compared to the population, where 21.1% lack at least a high school diploma.

The racial and cultural composition of the sample was nearly identical to the state population for those indicating they are Caucasian. Both African Americans and Hispanics were slightly under-represented in the survey by 2.4 and 1.5 percentage points, respectively.

Of the respondents who provided information about household income, 32.2% had a gross annual household income level of \$35,000 or less, which is 18.4 percentage points below the statewide average of 50.6%. At the other extreme, 41.5% of respondents reported an annual average household income that exceeds \$50,000 compared to the statewide average of 30.3%. In our study, we were able to further determine that 18.5% had incomes from \$50,001 to \$75,000, and the remaining 23.0% had incomes in excess of \$75,000.

Thus, the respondents to our study are slightly older, more educated, and wealthier than the average Florida resident; however, these characteristics are generally perceived as representative of Southwest Florida.

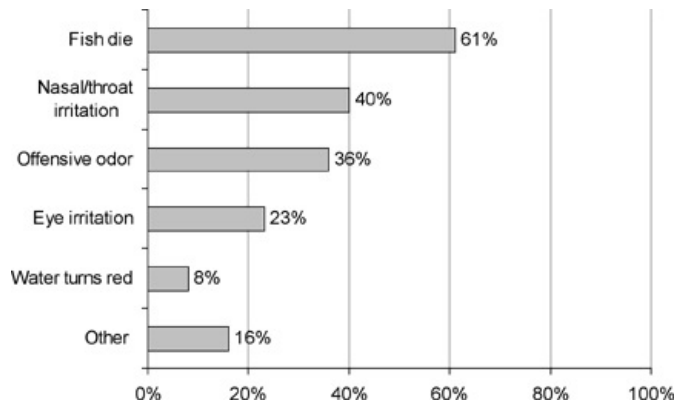
Red Tide Awareness and Effects

Respondents were asked if they were aware of the coastal condition known as red tide. This was the first question we posed to the respondent, without any prior indication that the interview was going to be focused specifically on the topic of red tides. Of the 1,006 households interviewed in the survey, 894 or 89% indicated that they were aware of the term "red tide."

Based on a comparison of response percentages, we found that full-time residents were more likely to be familiar with the term than those only residing in Manatee or Sarasota counties for less than 7 months per year. Those respondents who have resided in the region more than 5 years, have a college degree, or are Caucasian are also more likely to be aware of the term "red tide." Interestingly, there was little difference in awareness levels between respondents who lived nearer to the coast (i.e., west of I-75).

The respondents who indicated an awareness of red tide events were subsequently asked to identify the effects they associate with such events. The respondents were not prompted as to what these effects might be, but rather were asked an open-ended question. Multiple responses were accepted. The incidences of responses are summarized in Figure 1.

Figure 1.
Incidence of Response Regarding Effects of Red Tide



The most frequently cited effect, by 61% of respondents, was that red tides kill fish. However, only 36% of respondents mentioned that an offensive odor was associated with a red tide. Nasal irritation or coughing and watery or burning eyes were mentioned by 40% and 23% of the respondents, respectively. Only 8% of respondents mentioned that water can be discolored during a red tide event.

Red Tide Knowledge

We then asked respondents to evaluate a series of statements about red tide events by indicating whether each is "true" or "false"; "don't know" responses were also allowed. These statements were designed to test each respondent's basic understanding of the biological characteristics of a red tide event and determine each respondent's perception of the human health and environmental issues related to a red tide event. Steidenger and Penta (1999) and Steidenger, Landsberg, Tomas, and Burns (1999) were the primary sources of information used for the selection of the statements. All statements and responses are summarized in Table 2.

Table 2.
Respondent Responses to Statements about Red Tides

Statements	Response	Response (%)		
		Correct	Incorrect	Don't Know
Biological				
Red tides are caused by tiny marine plankton	True	58	18	24
Red tides are naturally occurring	True	74	16	10
The causes of red tide are well known	False	72	20	8
Red tides occur mostly during fall & winter	False	53	23	24
Red tides only occur in Florida	False	66	10	24
Red tides begin in bays, estuaries and near the beach	False	40	43	17
Red tides never occurred until recently	False	79	6	15
Red tides can be predicted with total accuracy	False	80	8	12
Red tides never last longer than 1-2 weeks	False	61	24	15
Human Health and Environmental				
Locally caught oysters and clams are safe to eat during a red tide	Either	NA	NA	10
Locally caught finfish are safe to eat during a red tide	True	13	72	15
Locally caught shrimp and crabs are safe to eat during a red tide	True	10	78	12
Red tide toxin is in the water and in the air	True	76	16	8
Red tide causes lasting health problems for people	False	45	33	22
Red tides can be controlled by	False	59	10	31

chemical treatments				
Red tides only affect people in the water or on the beach	False	66	28	6
It is safe for humans to swim in a red tide	True	18	73	9
Notes: Steidenger and Penta (1999) and Steidenger et al. (1999) were primary sources of information, however, the final selection of statements and their interpretations (and any errors thereof) are the sole responsibility of the authors. NA indicates that the statistic is not applicable due to the ambiguous correct response.				

The percentage of respondents correctly responding to the nine biological statements ranged from a low of 40% regarding where red tides originate (F) to a high of 80% regarding their predictability (H). Thus, the incidence of incorrect or "don't know" responses ranged from 20% to 60% for the biological statements.

The most misunderstood biological statement concerned where red tides originate (F); 43% incorrectly answered that red tides begin in bays, estuaries, or near the beach, while an additional 17% answered that they did not know. Nearly a quarter of all respondents (24%) did not know that red tides are caused by tiny marine plankton (A), that they do not mostly occur during fall and winter (D), and that they occur in other states (E). Overall, as evidenced by the 40% to 80% correct responses, our findings suggest that respondents have a working understanding of the basic biology of red tide events. Only one statement was correctly answered by less than 50% of the respondents.

With the exception of statement (J), whose correct response is contingent upon whether the waters were open for harvesting, the share of correct statements regarding the human health and environmental issues related to red tide events ranged from just 10% to 76%. The most incorrect responses, with less than 20% answering correctly, concerned the safety of eating locally caught seafood and of swimming in the red tide. The share of "don't know" responses ranged from 6% to 31%.

Filter-feeding organisms, such as molluscan shellfish (e.g., oysters and clams), will bio-accumulate the red tide toxin, rendering them unsafe for human consumption. During a red tide event, however, the oyster and hard clam harvesting areas will be closed by the Florida Department of Environmental Protection to commercial and recreational harvest if *K. brevis* cell counts exceed 5,000 cells per liter. Because the statement did not indicate the status of the harvest areas, the results cannot be interpreted except to point out that 10% of the respondents did not know.

Finfish, shrimp, and crabs would be safe to eat (statements K and L) as long as they were caught alive; 72% and 78% of respondents answered incorrectly regarding the safety of consuming finfish and shrimp/crabs, respectively. An additional 15% and 12% did not know that they were safe to eat.

Seventy-three percent of the respondents indicated that it would be unsafe for humans to swim during a red tide (statement Q). In fact, incidental ingestion of red tide organisms while swimming in seawater during a red tide would not make a healthy person sick. However, being in the water during a severe red tide would likely produce symptoms from exposure to the aerosol toxins, such as burning sensations in the eyes and respiratory irritations. It may be "safe" to swim during a red tide, but it would not be very pleasant at higher cell counts.

Respondents overall had a lower level of understanding regarding the human health and environmental impacts of red tide events. In contrast to the level of awareness with biological aspects of red tide, half the statements were correctly answered by less than half the respondents. To further probe the misunderstanding regarding safety of consumption of finfish, shrimp, and crabs and the safety of swimming during a red tide (K, L, and Q, the statements with the highest incidence of incorrect responses in Table 2), the incorrect responses are associated with various demographics in Table 3. Overall, the rate of incorrect response is relatively high among all groups with shares ranging from 62.2% to 96.0% incorrect.

Table 3.

Incidence of Incorrect Responses (%) Regarding Three Key Human Health Consequences During a Red Tide Event by Respondent Demographics

Characteristic	Safe to Eat Finfish	Safe to Eat Shrimp/Crab	Safe to Swim
Average:	72.0	78.0	73.0
Annual Residency			
Less than 7 months	62.2	66.9	69.8
Full time (12 months)	74.7	80.8	74.0

Duration of Residency:			
Less than 5 years	70.1	75.8	76.4
5-10 years	71.8	74.6	73.2
At least 10 years	72.9	79.9	71.9
Age			
18-24 years	80.0	88.0	96.0
25-44 years	81.2	82.6	76.5
45 years or older	69.3	76.8	71.8
Education Level			
Did not complete high school	72.1	76.7	76.7
Completed some college	74.9	81.1	74.9
College graduate or higher	69.0	74.3	71.1
Race			
African American	95.2	95.2	95.2
Caucasian	71.1	77.6	72.1
Other	79.0	73.7	89.5
Gross Annual Income			
Less than \$75,000	74.0	79.0	74.8
At least \$75,000	67.6	74.8	66.9

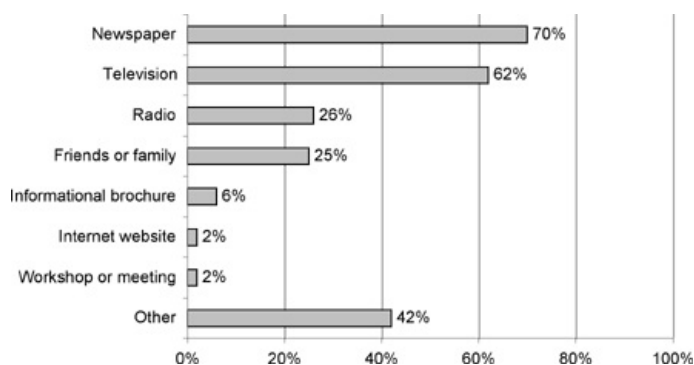
The highest incidence of incorrect response regarding the safety of eating finfish and shrimp or crabs, and the safety of swimming, during a red tide was among annual residents (78% of sample), those aged 18 to 44 years (28.2% of the sample), African Americans (3.1% of the sample), and those with gross annual incomes below \$75,000 (23.0% of the sample).

Over 80% of respondents aged 18 to 44 years incorrectly believe that eating finfish, shrimp, or crabs during a red tide is unsafe. The share of incorrect responses was higher for Caucasians regarding the safety of eating shrimp or crab versus eating finish, but this share was reversed for the "other" demographic. Respondents between the ages of 18 and 24 years had the highest rates of incorrect responses regarding the safety of swimming during a red tide; 96% incorrectly believed that swimming during a red tide is unsafe.

Sources of Information on Red Tide

Last, we asked respondents about their source(s) of information about red tides. We provided several choices and recorded all sources without ranking them in order of importance. Newspapers were the most frequently identified source for information on red tide events, closely followed by television. Seventy percent and 62% of respondents mentioned newspapers and television, respectively (Figure 2).

Figure 2.
Incidence of Response by Sources of Information about Red Tide (n = 894)



Radio and word-of-mouth via friends and family were less frequently identified (for 26% and 25% of respondents, respectively), but considerably more so than informational brochures, Internet Web sites, and workshops or meetings (for which only 6% of respondents indicated as a source of information). A relatively large share of respondents (42%) reported acquiring information about red tides from other sources, of which the primary source was attributed to "personal experience."

Conclusions

Our survey findings provide some insight into the level of awareness and knowledge of red tides by adult residents of Manatee and Sarasota Counties in Southwest Florida. Although the sample consisted of older and more educated individuals from wealthier households than the statewide average, these characteristics are representative of this region of Florida, which is prone to frequent red tide events.

Of the 1,006 respondents, 89% were aware of the term "red tide." Interestingly, there was no difference in awareness between those located in coastal versus inland areas of the two counties. The majority reported receiving information about red tide via the local newspaper and television (70% and 62%, respectively). Less than 6% had obtained red tide information from brochures, the Internet, or workshops.

The respondents, in general, had a good understanding of the basic biological characteristics of red tide; the incidence of correct responses to the nine statements ranged from 40% to 80%. For comparison, the incidence of correct responses to the health and environmental effects of red tide events ranged from 10% to 76% for the seven conclusive statements at the time of the survey. Overall, the incidence of incorrect responses ranged from 20% to 90%. In addition, the incidence of "don't know" responses ranged from 6% to 31%. The relatively wide range of incorrect or uncertain responses could suggest either that previous educational efforts focused on only a few factors, or that some messages that have been produced are confusing.

The majority of respondents (60%) did not know red tide blooms originate in offshore waters. Most respondents erroneously believed that locally caught finfish and crustaceans (shrimp or crabs) were unsafe to eat during a red tide (72% and 78%, respectively). In addition, 15% and 12% of respondents reported that they did not know whether consumption of finfish or shrimp and crabs would be safe to eat, respectively. Only 18% of respondents know that it is safe to swim in waters when a red tide is present.

Implications for Outreach Efforts

Recent red tide events in Southwest Florida have renewed research and outreach efforts at the local, state, and federal level. Within the past year, three comprehensive workshops were conducted to ascertain an overall HAB research agenda (HARNESSESS, 2005), specific research needs regarding the human dimensions (Bauer, 2006), and to direct immediate research needs (*State of the Research on Red Tide in the Gulf of Mexico: A Workshop and Public Forum, 17-20 July 2006*, held in Sarasota, Florida).

With respect to Extension and outreach efforts, sponsors of these workshops (i.e., Mote Marine Laboratory, the Florida Fish and Wildlife Conservation Commission, the National Oceanic and Atmospheric Administration, and the Florida Institute of Oceanography) and the private START organization (Solutions to Avoid Red Tide), continually develop red tide educational programs aimed at local businesses and the public. For example, Red Tide Online <<http://www.redtideonline.com>> is a service to Florida businesses provided by the Red Tide Alliance of Florida Fish and Wildlife Conservation Commission. The stated purpose of the Web site is "to provide information about red tide facts and information pertaining to health and safety issues involved in a red tide event."

Although our study found that 89% of adult residents in areas prone to frequent red tide events were familiar with the term "red tide," Extension and outreach needs are apparent as evidenced by the 20% to 90% of respondents who incorrectly answered 16 biological and ecological impacts of red tide events. The incidence of "don't know" responses ranged from 6% to 31%, which further supports the need for correct information concerning these impacts. Ten specific messages that correctly depict the causes and effects of a red tide (listed in descending order based on the incidence of combined incorrect and "don't know" responses in parentheses) are:

1. Locally caught shrimp and crabs are safe to eat during a red tide (90%)
2. Locally caught finfish are safe to eat during a red tide (87%)
3. It is safe for humans to swim in a red tide (82%)
4. Red tides begin in bays, estuaries and near the beach (60%)
5. Red tide causes lasting health problems for people (55%)
6. Red tides occur mostly during fall and winter (47%)

7. Red tides are caused by tiny marine plankton (42%)
8. Red tides can be controlled by chemical treatments (41%)
9. Red tides never last more than 1 to 2 weeks (39%)
10. Red tides only affect people in the water or on the beach (34%)

The responses to each of these statements suggest an educational opportunity exists to increase the awareness of the science-based knowledge of red tide events of residents of Manatee and Sarasota Counties, where the incidence of these HABs is more frequent than anywhere else in the Southeast.

Our study would further suggest that the information should be conveyed to all county residents in Southwest Florida, including those living near local beachfront areas, via local newspapers and on television. For instance, the use of local cable television stations for public service announcements should be investigated. Aside from reaching residents, particularly year-round residents, this medium would also reach tourists. Collaboration with, or training programs for, local environmental reporters might also be effective. The use of costly print brochures, public workshops, or elaborate Internet sites should be undertaken with caution since our study suggests that residents do not routinely obtain their information from those sources.

Additional educational efforts should pay dividends within business communities that are susceptible to red tide, particularly among the businesses negatively impacted by red tide events. A better informed resident or tourist who may be engaged in local water-related activities, beach-going, and business patronage, may make a more rational decision when responding to an existing red tide event. Hopefully, this rational response will reduce the negative impacts felt by local water-related businesses and the community in general. This is true regardless of the algae species in bloom and the particular communities affected. Thus, for HAB events in other parts of the country, the statements and results described in our study could help to direct future research and Extension efforts.

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