Survey Report

An Assessment of Florida Residents' Communication Preferences for Red Tides: A Statewide and Regional Comparison

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Table of Contents

For More Information i
Suggested Citation i
About the Authors i
Acknowledgements i
List of Figures iii
List of Tables iii
List of Supplemental Tables iv
Background 1
Format of the Report 1
Methods 1
Survey Instrument 1
Sampling Frame 2
Mail Survey Procedures 3
COVID-19 3
Internet Survey Procedures 4
Survey Response and Analysis 4
Results 5
Demographics 5
Knowledge, Awareness & Experience 10
Preferred Methods of Receiving Red Tide Information 14
Usefulness of information 21
Information Sources Used 22
Key Findings & Recommendations 25
Knowledge, Awareness & Experience 25
Preferred Methods of Receiving Red Tide Information 25
Usefulness of information 26
Information Sources Used 27

List of Figures

Figure 1. Census population and survey respondents' race and ethnicity 6
Figure 2. Census population and survey respondents' education 6
Figure 3. Respondent county of residence (percentages) 8
Figure 4. Respondents' characteristics of interest 10
Figure 5. Subjective knowledge about red tide by proximity to coast (a) Statewide, (b) Regional 11
Figure 6. Respondents' familiarity with red tide terms 12
Figure 7. How would you rate your level of concern about red tide in Florida? 13
Figure 8. Percent of individuals who experienced the following occurrences during a red tide event 14
Figure 9. Respondents use of various red tide information formats 16
Figure 10. Percent preferred mobile and social media platforms 18
Figure 11. Perceived usefulness of red tide informational topics 21
Figure 12. Perceived trustworthiness of sources of red tide information by survey's group 24

List of Tables

Table 1. Respondent demographics 7
Table 2. Residential characteristics of respondents 8
Table 3. Frequency in seeking Florida red tide information 15
Table 4. Percent of statewide respondents selecting mobile and social media platforms by characteristics of interest 19
Table 5. Percent of regional respondents selecting mobile and social media platforms by characteristics of interest 20
Table 6. Quality of red tide information 22
Table 7. Most important sources for red tide information 23

List of Supplemental Tables

Table S1. Respondents' county of residence 28
Table S2. Characteristics of interest 29
Table S3. Subjective knowledge by characteristics of interest 30
Table S4. Respondents' familiarity with red tide terms 30
Table S5. Percent of individuals who experienced the following occurrences during a red tide event 30
Table S6. Respondents use of various red tide information formats 31
Table S7. Preferred mobile and social media platforms 32
Table S8. Perceived usefulness of red tide informational topics 33
Table S9. Respondents' perceived trustworthiness of sources of red tide information . 34

Background

Florida Sea Grant, in partnership with the Florida Survey Research Center (FSRC), conducted a survey of Florida citizens to better understand how information about red tide is shared with the public. The research was conducted as part of a Florida Fish and Wildlife Conservation Commission funded project, *Development of a Red Tide Communications Plan for Florida*. The survey collected information about residents' Florida red tide awareness, experiences, and preferences for red tide information content, sources, and formats. The survey was designed to understand both broad statewide communication needs and higher resolution regional needs for those eight Gulf Coast Florida counties that routinely experience red tide.

Format of the Report

This report is divided into several sections. We first present background on the research process and then present the results of the completed surveys. The sections that follow provide the detailed results, including comprehensive information on the findings with tables and figures summarizing responses to each question by survey group. The statewide group includes responses from all Florida counties except for those that make of the southwest regional group. For survey results, each table or figure indicates the total number of respondents who answered the question. Like all self-administered surveys, respondents may not have replied to all questions.

Methods

Survey Instrument

A researcher-developed questionnaire was used as the instrument for this study. Pretesting was conducted to identify potential problems with questionnaire design, including question wording, transitions between sections of the survey, and clarity of language and concepts. Following initial construction of the survey instrument, researchers critically read each of the questions and revised as needed. After this first round of revisions, the questionnaire was shared with colleagues and other appropriate audiences. Their feedback was used to determine how long the questionnaire would take respondents to complete, as well as the clarity of the questionnaire. The survey instrument was also pretested with appropriate audiences and experts to gauge concept validity and make final changes, as needed. The instrument was assessed by a panel of experts that consisted of members of the project team, five members of the project's Scientific Advisory Committee, and four members of the project's Communication Advisory Committee.

The survey instrument included a variety of questions about perceptions and knowledge related to red tide events in Florida with a particular focus on communication preferences. The specific categories of questions are as follows:

- Awareness, Experience & Background Knowledge (with red tide events in Florida)
    - Level of knowledge about red tide
    - Level of concern about red tide in Florida
    - Personal experience with red tide events
    - Familiarity with terms related to red tide
- Red Tide Information
    - Frequency of seeking information about red tide*
    - Frequency of seeking red tide information from various format types
    - Phone-based & social media platform preferences for receiving real-time red tide information
    - Level of agreement about meeting red tide information needs
    - Level of trustworthiness for various sources of red tide information
    - Most important sources for receiving red tide information
    - Most important types of red tide information
- Demographic questions
    - Total length of residence in Florida
    - Months of the year residing in Florida
    - Distance of Florida residence from the coast
    - Zip code of Florida residence
    - Highest level of education
    - Gender
    - Race/Ethnicity
    - Personal characteristics/descriptors (related to red tide experiences)
    - Interest in focus group participation (with contact information)
- Open-ended Comments

As per best practices, print and online questionnaires were designed to match as closely as possible. Only Question 5*, regarding frequency of seeking information about red tide, varied in wording as presented to the two sampled groups (residents of Gulf Coast counties, residents of the rest of Florida). Language in the second response option varied slightly between the two groups, though both referenced information for areas where red tide is a typical occurrence (refer to Appendix X for the full survey instrument).

Sampling Frame

The population of interest was Florida residents (fulltime and part-time “snowbirds”) age 18 or older. The survey instrument was stratified by county of residence and the sampling frame for the state of Florida was divided into two regions. The geographic areas of interest were a group of eight Gulf Coast counties (Pasco, Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, and Collier) that frequently experience red tide events and the remaining 59 Florida counties. The Gulf Coast region was surveyed separately to identify any geographic differences in

communication needs and preferences. This research project used a multi-modal plan for survey dissemination and data collection, including both mail and online surveys, as well as online panel surveying.

Mail Survey Procedures

A paper survey in English and Spanish was mailed to 8,000 Florida residents, 4,000 surveys each to the statewide and regional populations beginning February 2021. Survey participants were determined via a public opinion survey research company, Marketing Systems Group (MSG). Address-Based Sampling (ABS) provides sampling frames with good coverage of US addresses that are easily adapted to geographies of interest, such as the Gulf Coast region, for mail surveys. However, as achieving an acceptable number of returned completions can often require quite large mailings, we also endeavored to decrease costs and increase participation by offering access to the survey online. This "push-to-web" survey mode reaches out through offline contact modes to encourage sample members to go online and complete the questionnaire[1]. Online administration also more easily facilitates options to complete the survey in languages other than English (which are often hard to print within the same spatial boundaries as instruments originally constructed in English); links to Spanish surveys were offered concurrently in all mailings for this project.

Substantial efforts were made by FSRC to improve response rates and reduce error from non-responses when conducting mail surveys[2,3]. Non-response error may result in a bias because those individuals who either refuse to participate or cannot be reached to participate may be systematically different from those individuals who do complete the survey.

Survey packets (containing a cover letter with push-to-web instructions in both English and Spanish, a printed survey questionnaire in English, and a postage-paid return mail envelope) were mailed to potential respondents (4,000 in each region) by the UF Mailing and Printing Office during the second week of February 2021.To encourage participation, a follow-up letter with push-to-web instructions in both English and Spanish was sent to the sample in the second week of April 2021, and a final reminder letter with push-to-web instructions in English and Spanish was sent in the final week of May 2021.

COVID-19

Of special note, this research project took place during the COVID-19 pandemic and during a transition of leadership at the US Postal Service, which caused unique issues in reaching the study populations by mail. According to USPS data, the agency delivered as little as 62 percent of first-class mail on time in December

[1] Olson, et al. (2020). Transitions from telephone surveys to self-administered and mixed-mode surveys: AAPOR task force report. *Journal of Survey Statistics and Methodology,* 1-31.
[2] Dillman, D. (2000). *Mail and internet surveys: The tailored design method*. John Wiley & Sons, Inc.
[3] Gideon, L. (2012). *Handbook of survey methodology for the social sciences*. Springer.

2020; this recovered to 84 percent by the first week of March 2021 but remained below the target of 96 percent[4]. Mirroring delays from late 2020 and early 2021, in mid-2021 the USPS expected to deliver less than 69 percent of pieces slated for a three-to-five-day delivery window on time. One reporter noted: "USPS has never recovered from nationwide mail delays resulting from operational changes DeJoy put into place shortly after taking office last year. While USPS worked to correct those issues and court orders eventually blocked their full implementation, delays persisted due to employee absenteeism stemming from the pandemic, unprecedented upticks in more labor-intensive package delivery and longstanding issues with the postal network."[5] While a return rate of 10 percent is typical for mail surveys, combined responses from mail (print and push to web) in this case were closer to 1 percent.

Internet Survey Procedures

To increase the survey response rate, an online survey was distributed via MSG to an additional 1,000 individuals in each geographic population. Probability-based samples are ideal for this type of survey design, but the vast majority of online panels are compiled through various methods of intercept or targeted recruitments. MSG accesses dozens of panel providers to secure the most representative samples possible with an opt-in panel method. Panel members were screened first to insure they were at least 18 years old and a Florida resident, and then screened into two groups – those who resided in the eight-county Gulf Coast region of Florida and those who resided in other Florida counties.

Survey Response and Analysis

Returned mail surveys were opened, reviewed by a supervisor for accuracy and completeness, coded appropriately, and then data reduced into an Excel file. Online survey data were downloaded from the FSRC secure servers and reviewed by a supervisor for accuracy. These two files were then merged with online panel data responses to form an overall database of responses to the survey. Since unique identifiers were assigned to each respondent, survey responses were checked to ensure that no participant replied more than once (by mail and online).

A total of 614 surveys were submitted from the statewide population. Of these, 595 were usable responses with 74 individuals responding to the mail survey and 521 responding to the online panel survey. A total of 330 surveys were completed from the regional population. Of these, 324 were usable responses with 138 individuals

[4] Fuchs, H. (2021, March 21). Postal service struggles to speed up delivery, compounding its troubles. *New York Times*. https://www.nytimes.com/2021/03/21/us/politics/postal-service-mail-delivery.html

[5] Katz, E. (2021, June 3). USPS projects continuing mail delays, setting targets well below historical standards. *Government Executive*. https://www.govexec.com/management/2021/06/usps-projects-continuing-mail-delays-setting-targets-well-below-historical-standards/174490/

responding to the mail survey and 186 individuals responding to the online panel survey.

Data analyses consisted of descriptive statistics (e.g. frequencies, percentages, means, and standard deviations). Within and between group analyses were conducted and the statistical tests are described in the text where appropriate. Statistical significance was inferred at $\alpha = 0.05$. All tests were performed using SPPS Statistics 27. Detailed results of these analyses are presented in the remainder of this report. Additional data tables are provided in supplementary materials.

Results

Demographics

Compared to the 2019 Florida Census[6], our survey sample is not representative of the state population in several demographic areas. Females comprised 62.5% of survey respondents yet account for 51% of the population based on Census data. Likewise for race, the percentage of people selecting “white” was greater in both the statewide (71%) and regional (80%) survey populations compared to the 2019 Florida Census, which reported 38% and 43% of the population, respectively. Unlike gender and race, we had fewer Hispanic participants (10% of statewide and 9% of regional respondents) compared to the 49% state and 48% regional populations reported in the Census (Figure 1). Finally, our statewide and regional survey samples under-represent the number of individuals who graduated from high school or received their GED (17% vs. 33% for statewide census; 14% vs 34% for regional census) and over-represent the number of individuals with higher education degrees (Figure 2). Comprehensive survey demographics are found in Table 1.

[6] U.S. Census Bureau (2021). Selected Florida population characteristics, 2019 American Community Survey 5-year estimates. https://data.census.gov/cedsci/all

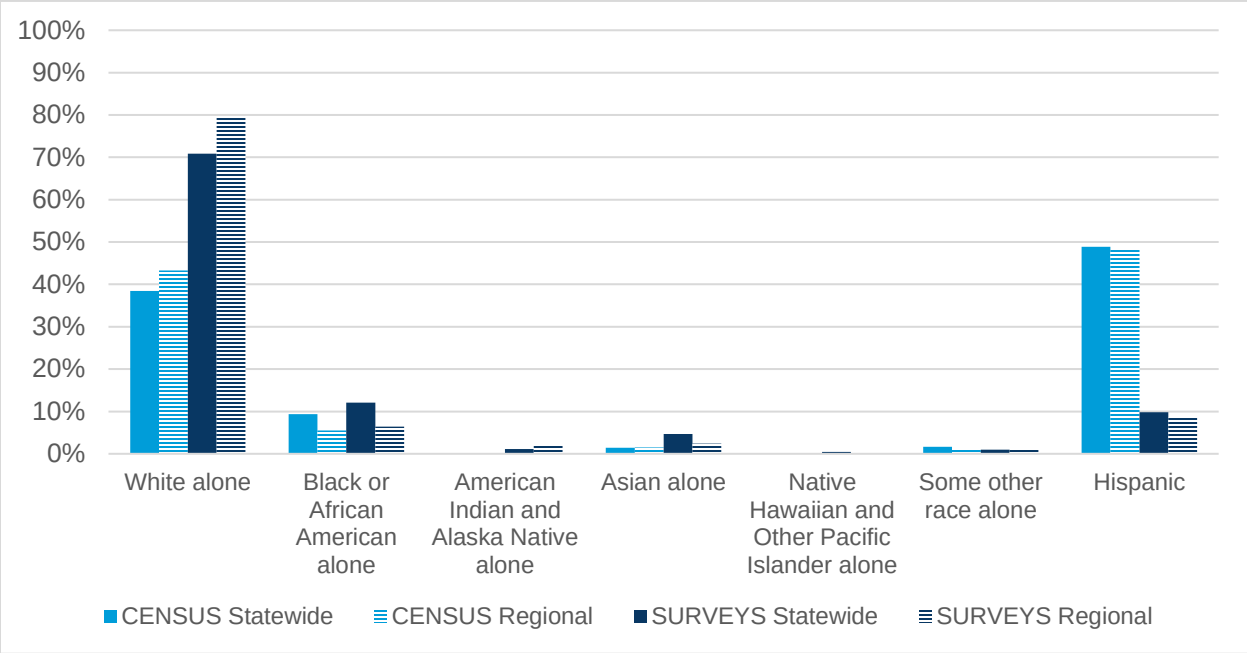

Figure 1. Census population and survey respondents' race and ethnicity

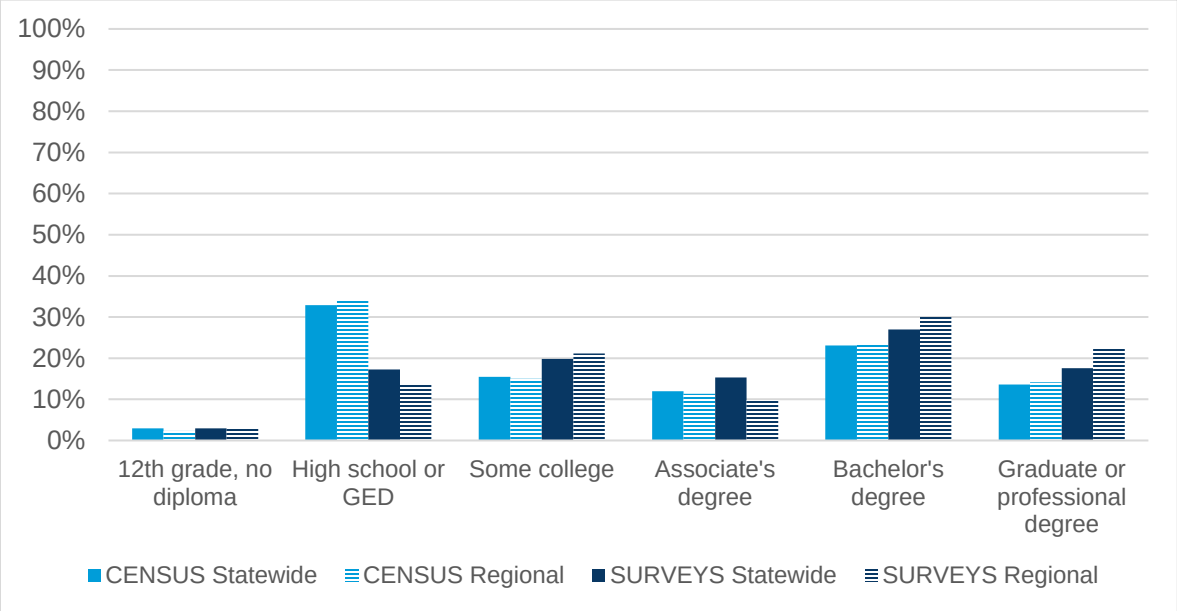

Figure 2. Census population and survey respondents' education

Table 1. Respondent demographics

	Statewide		Regional	
Variable	Frequency *f*	Percentage %	Frequency *f*	Percentage %
Gender Identity				
Man	208	35.9	117	36.6
Woman	362	62.5	200	62.5
Non-binary	4	0.7	0	0
Prefer not to answer	5	0.9	3	0.9
Race and Ethnicity				
American Indian or Alaska Native	7	1.1	7	2.2
Asian	29	4.4	8	2.5
Black or African American	75	11.4	21	6.5
Native Hawaiian or Other Pacific Islander	3	0.5	0	0
White	440	66.9	261	80.6
Hispanic/Latino(a)	61	9.3	28	8.6
Other	6	0.9	3	0.9
Prefer not to answer	26	4.0	0	0
Education				
12th grade or less	17	2.9	9	2.8
High school graduate or GED	99	17.1	43	13.4
Some college	114	19.7	67	20.9
Associate's or technical degree	88	15.2	31	9.7
Bachelor's degree	155	26.8	95	29.7
Graduate or professional degree	101	17.5	72	22.5
Prefer not to answer	4	0.7	3	0.9

Information about respondents' county of residence (Figure 3; Table S1) and residential characteristics were collected. Respondents from both populations were primarily full-time Florida residents and more than half have lived in Florida for more than 15 years. Respondents' geographic proximity to the coast is distributed across coastal to inland locations. Residents in the southwest regional population reside closer to the coast than the statewide population. Full residential characteristics of respondents are displayed in Table 2.

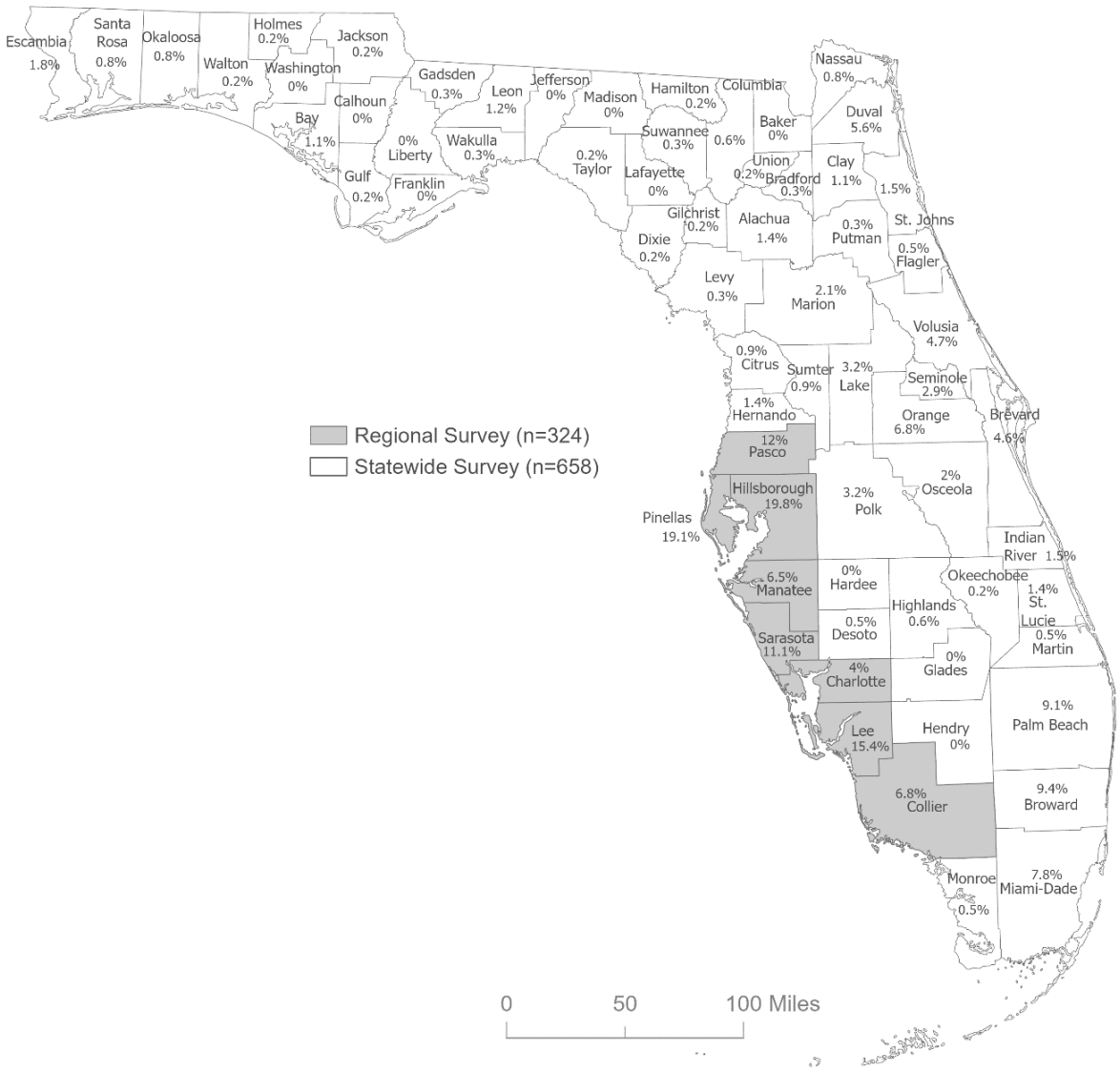

Figure 3. Respondent county of residence (percentages)

Table 2. Residential characteristics of respondents

	Statewide		Regional	
Variable	*f*	%	*f*	%
Florida Residency				
Full-time Florida resident	448	80.6	264	86.3
Part-time Florida resident (< 6 months)	40	7.2	15	4.9
Part-time Florida resident (> 6 months)	29	5.2	23	7.5
Do not know/Prefer not to answer	39	7.0	4	1.3
Years Lived in Florida				
Less than 1	17	3.1	8	2.5

	Statewide		Regional	
Variable	*f*	%	*f*	%
1 to 5	81	14.6	51	15.9
6 to 14	74	13.3	53	16.6
15 to 24	145	26.1	71	22.2
25 to 49	172	30.9	100	31.3
50+	45	8.1	25	7.8
Do not know/Prefer not to answer	22	4.0	12	3.8
Miles from Coast				
Less than 1	49	8.8	47	14.8
1 to 5	93	16.7	85	26.8
6 to 15	96	17.3	94	29.7
16 to 25	49	8.8	20	6.3
25+	141	25.4	25	7.9
Do not know/Prefer not to answer	128	23.0	46	14.5

Characteristics of interest to red tide-related behaviors and decisions were also collected. Respondents were asked to select all that apply. The majority of statewide and regional respondents are seafood consumers (65.7% and 72.8%, respectively). About half of statewide participants are beachgoers that participate in activities including swimming, beach combing, walking, and running. Nearly two-thirds of regional participants are beachgoers. Statewide, approximately one-fifth are recreational fishers including angling, crabbing, and shellfish harvesting and 30% of regional participants are recreational fishers. 13.1% of statewide participants and 17.3% of regional participants indicated they have asthma or similar respiratory issues. Full respondent characteristics are displayed in Figure 4 (Table S2).

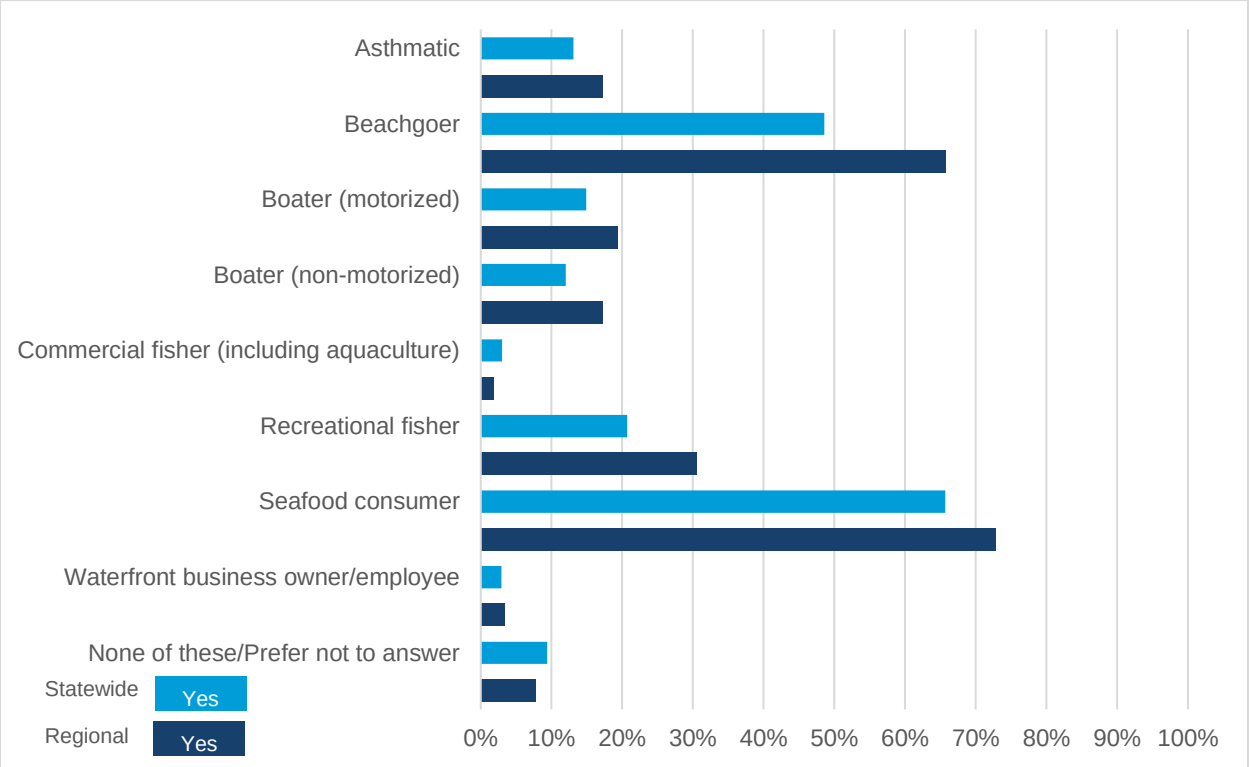

Figure 4. Respondents' characteristics of interest

Knowledge, Awareness & Experience

Respondents' subjective knowledge about red tide was measured using a 3-point Likert-type scale of knowledge (1 = *not at all knowledgeable;* 3 = *very knowledgeable*). Overall, respondents considered themselves to be somewhat knowledgeable about red tides in Florida. Self-assessment of red tide knowledge was higher in regional respondents (M = 2.00; SD = 0.53; n = 324) than in statewide participants (M = 1.79; SD = 0.62; n = 595) (Ordinary Chi-Square= 23.9; $p \leq 0.01$).

Respondents' knowledge was compared to other demographic variables. There is no evidence that years of residency influences perceived knowledge for either statewide or regional respondents. Within the regional sample, respondents living closer to the coast perceived themselves to be more knowledgeable than those living further away (Ordinal Chi-Square = 11.4; $p \leq 0.01$). However, this was not the case for the statewide sample (Ordinal Chi-Square = 2.1; $p = 0.144$) (Figure 5).

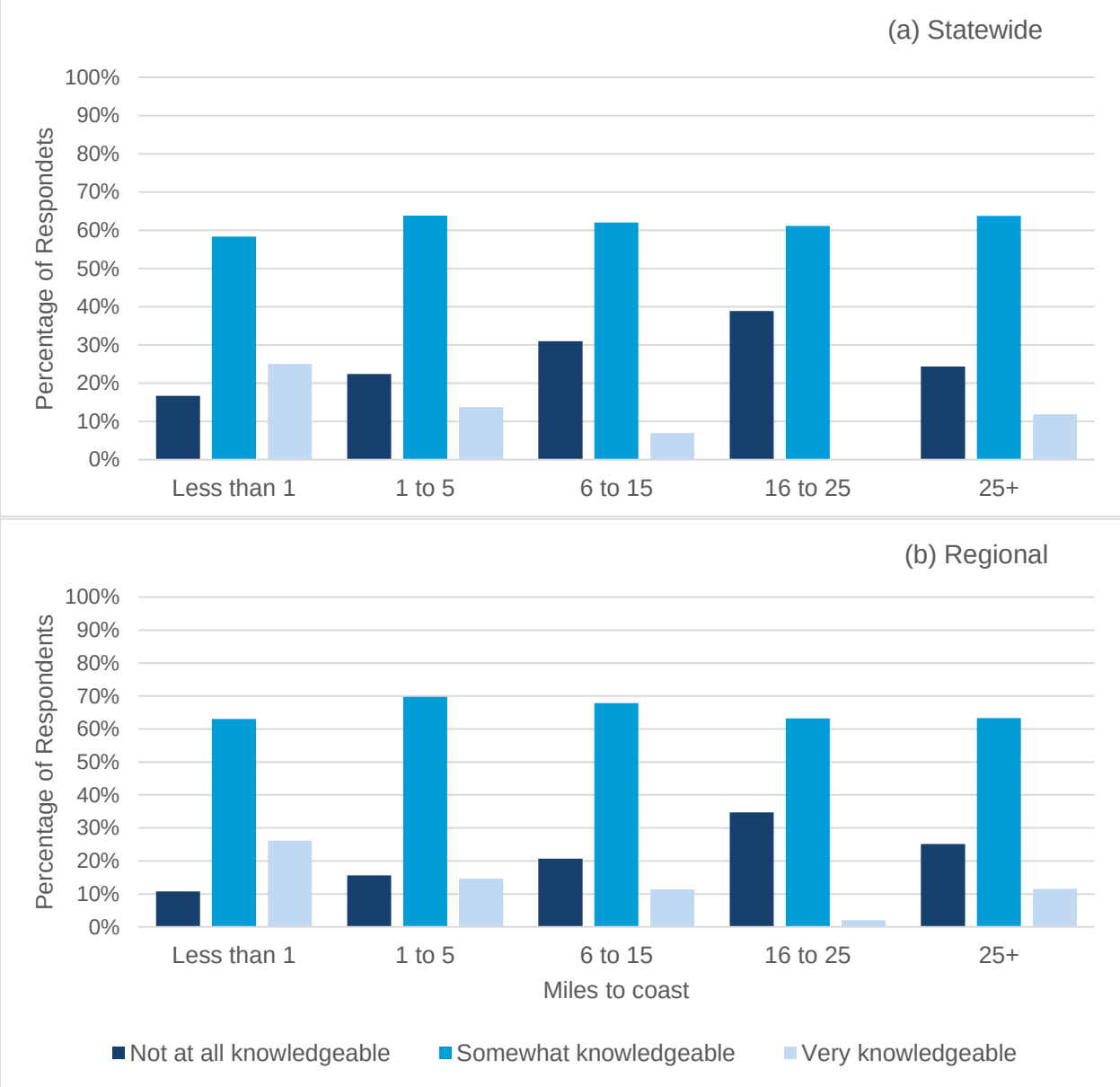

Figure 5. Subjective knowledge about red tide by proximity to coast (a) Statewide, (b) Regional

For our statewide sample, respondents with more education perceived themselves to be more knowledgeable about red tide than respondents with lesser education (Ordinal Chi-square = 4.1; p = 0.04). There was no significant difference for the regional group (Ordinal Chi-square = 0.2; p = 0.63).

When characteristics of interest were compared with subjective knowledge, recreational fishers and boaters perceived themselves to be more knowledgeable than those who are not. There was no association with knowledge for either asthmatics or seafood consumers for both population samples (Table S3 shows the Ordinal Chi-square and p-values).

Respondents' subjective familiarity with commonly used red tide terms was evaluated using a 5-point Likert-type scale (1 = *not at all familiar;* 5 = *very familiar*). A construct mean was computed to represent respondents' overall degree of familiarity with red tide terms (Statewide *n* = 595; Regional n = 323). Overall, statewide respondents were not familiar with red tide terminology and regional respondents were neutral in their understanding of red tide terminology (Statewide: *M* = 2.37; *SD* = 1.26 and Regional: *M* = 2.54; *SD* = 1.28). Respondents were moderately familiar with the term "algae" and were less familiar with the more technical terms commonly used to discuss red tide. Regional respondents (*M* = 3.23; *SD* = 1.43) were more familiar with the term "harmful algal bloom" than the statewide audience (*M* = 2.74; *SD* = 1.47) (Ordinal Chi-square = 22.1, $p \leq 0.01$). Figure 6 (Table S4) displays the full results for each term.

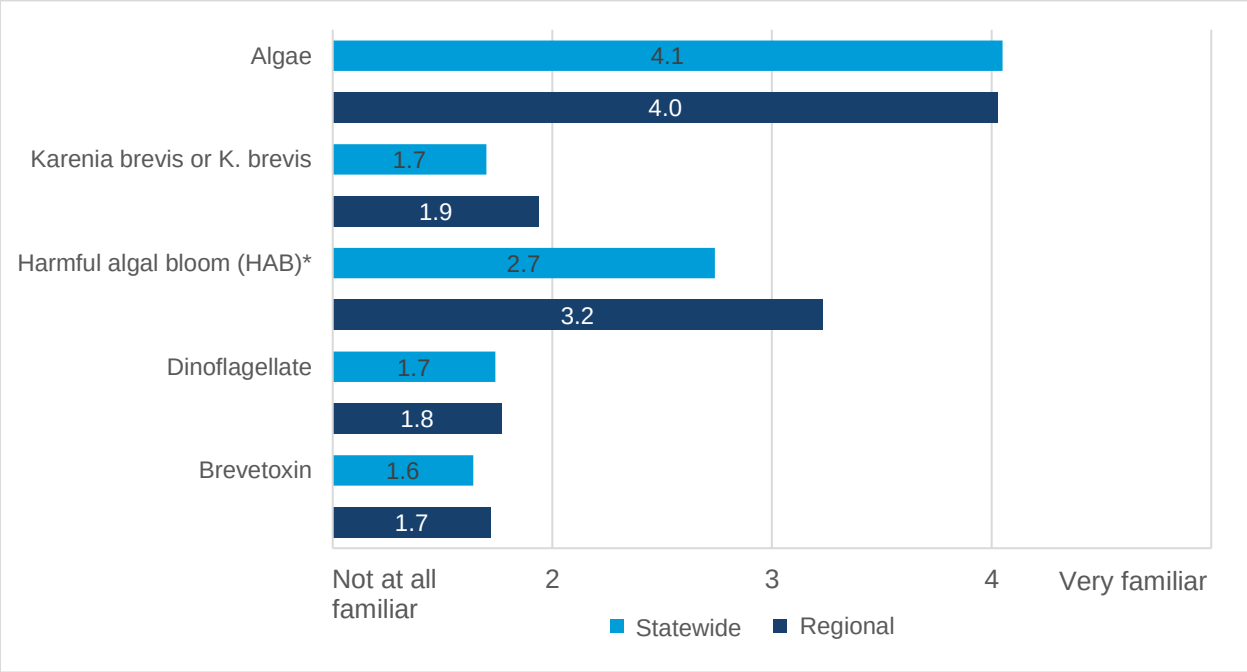

Figure 6. Respondents' familiarity with red tide terms
Values represent mean.
** indicates between group significance at p ≤ 0.05; Chi-square*

Respondents familiar with the term "algae" perceived themselves more knowledgeable than other survey participants. Respondents that identified themselves as "*not at all knowledgeable*" were not familiar with the other evaluated terms (*Karenia brevis*, HAB, dinoflagellates, and brevetoxin). This was the case for both statewide and regional respondents.

Respondents' level of concern about red tide in Florida was measured using a 5-point Likert-type scale (1 = *not at all concerned*; 5 = *very concerned*). Overall, respondents were moderately concerned about red tides in Florida and regional

respondents (*M* = 4.19; *SD* = 0.94; *n* = 324) were more concerned than statewide participants (*M* = 3.77; *SD* = 1.22; *n* = 595) (Ordinal Chi-Square = 27.8; p ≤ 0.01). Figure 7 displays the full results.

As survey respondents' concern about red tide increased so did their knowledge (from *not at all* to *somewhat knowledgeable*) for both groups (Statewide Ordinal Chi-Square = 81.1; p ≤ 0.01; Regional Ordinal Chi-Square = 32.2; p ≤ 0.01).

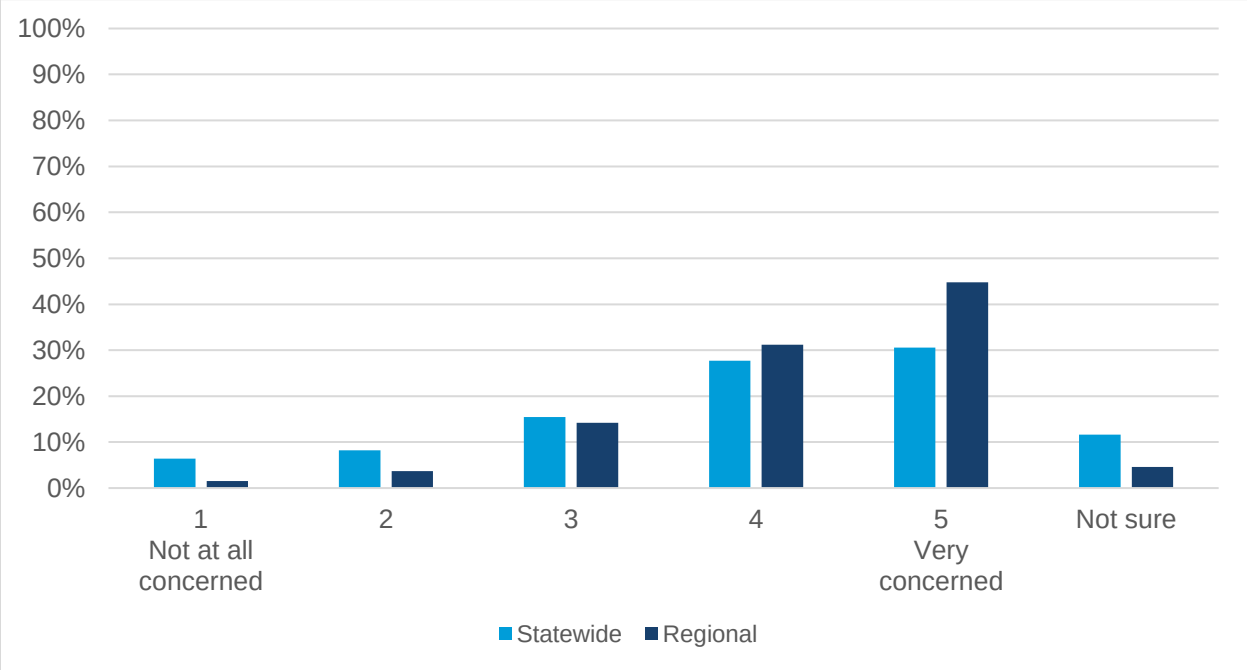

Figure 7. How would you rate your level of concern about red tide in Florida?

Respondents' personal experience with various red tide related impacts was assessed using a series of binary Yes/No questions. The percentage of statewide respondents answering "Yes" ranged from 18 - 49%. The percentage of regional respondents answering "Yes" ranged from 29 – 73%. The percent response to each item is displayed in Figure 8 (Table S5).

Respondents that personally experienced issues during a red tide event tended to be more concerned than other survey participants. All of them were significant at p ≤ 0.01. Asthmatic respondents in the regional group were statistically more concerned about red tide (Ordinal Chi-square = 13.8; p ≤ 0.01) than people that did not selected this option.

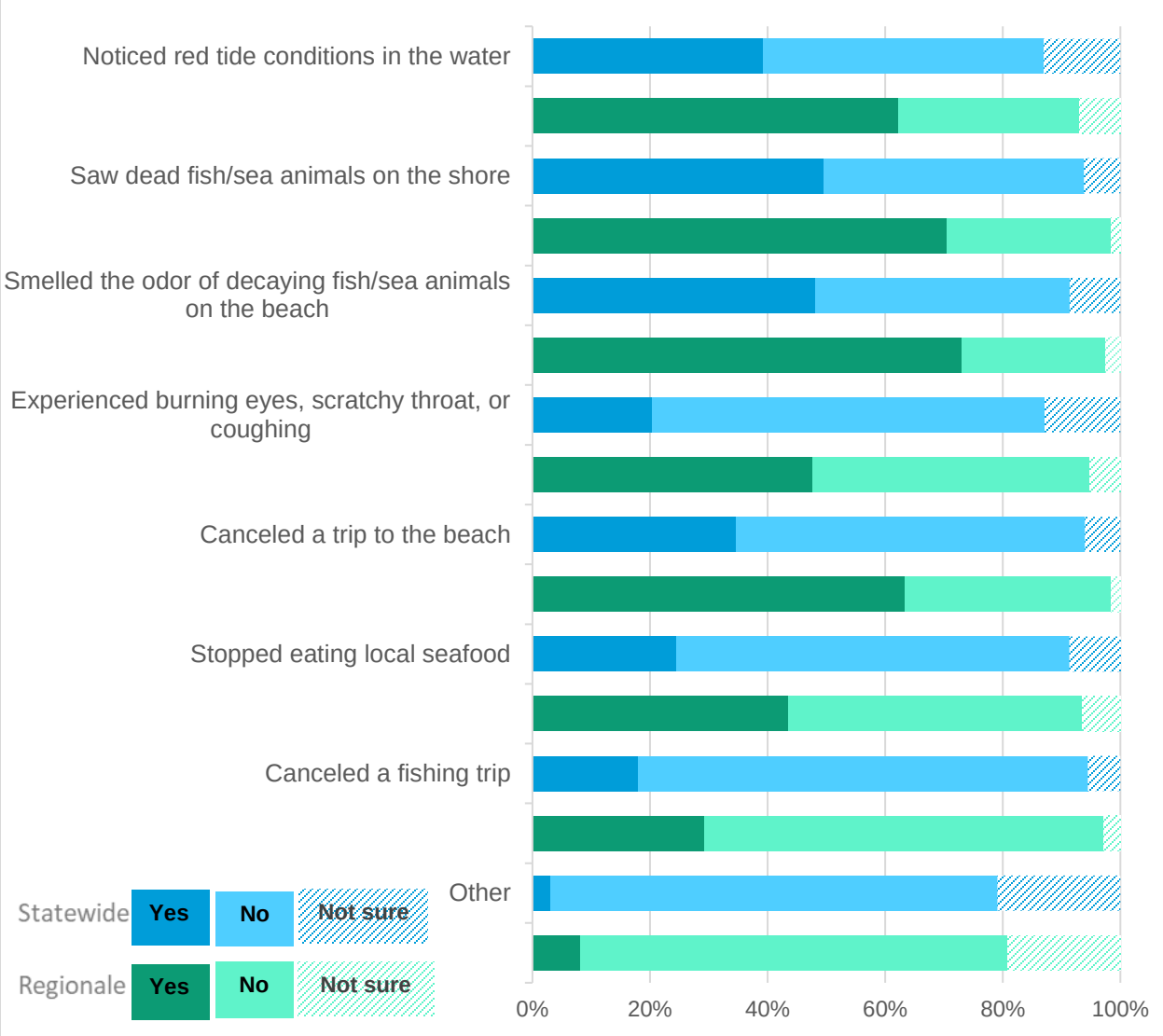

Figure 8. Percent of individuals who experienced the following occurrences during a red tide event
Statewide n=595; Regional n=324

Preferred Methods of Receiving Red Tide Information

Respondents were asked to select the statement that best describes how frequently they seek information about red tides in Florida (Table 3). Statewide, most respondents indicated that they never look for information about red tide (39%) and few individuals regularly look for information about red tide (5.6%). Regionally, most respondents look for information when a red tide event is near their home or work and few individuals (11.5%) look for red tide information regularly. Respondents that seek information on a regular basis tended to be more knowledgeable (Statewide Ordinal Chi-Square=139.3, $p \leq 0.01$; Regional Ordinal Chi-Square=39.7, $p \leq 0.01$).

Table 3. Frequency in seeking Florida red tide information

	Statewide (*n* = 587)		Regional (*n* = 324)	
Variable	*f*	%	*f*	%
I never look for information about red tide events in Florida	229	39.0	58	18.0
I only look for information when I am planning a trip to a red tide area (Statewide survey response)	155	26.4	119	37.0
I only look for information when a red tide event happens near my home/work (Regional survey response)				
I only look for additional information when something new is reported about red tides	170	29.0	108	33.5
I look for information about red tides on a regular basis	33	5.6	37	11.5

Preferred formats for receiving red tide information were assessed using a 5-point Likert scale (1 = *never;* 5 = *always*) and an average score was calculated for each item. Overall, internet news sources were the most frequently used. Television news sources, posted signs at the beach, word of mouth and internet websites were also identified. Respondents indicated that newspapers, radio news, and email notifications were rarely used (Table S6). Regional respondents used almost all sources of information more frequently than statewide respondents. Figure 9 displays the full results for each format.

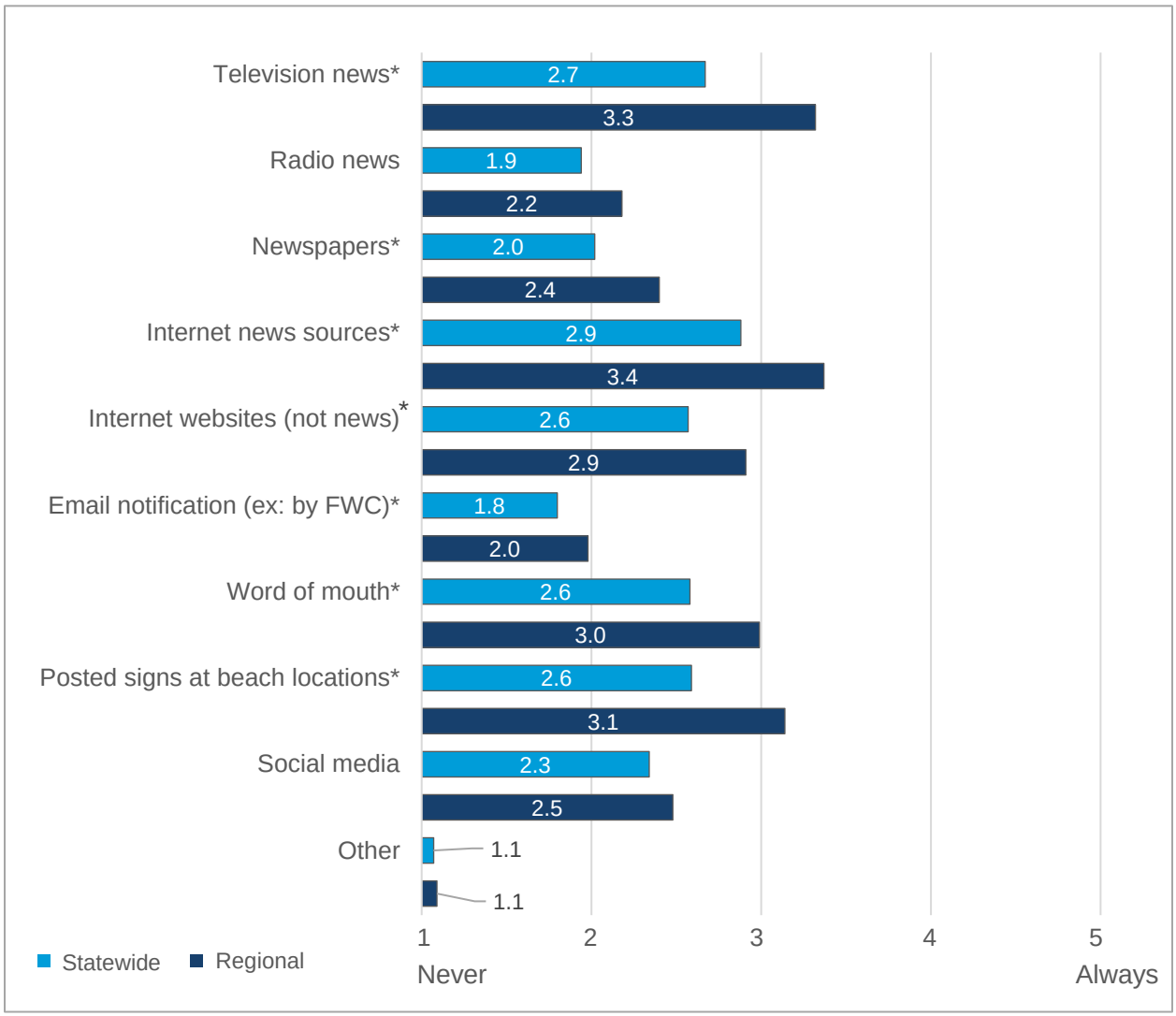

Figure 9. Respondents use of various red tide information formats
Values represent mean
** Indicates between survey group significance at p ≤ 0.05; Chi-square*

New and existing social media platforms and mobile applications were ranked based on respondents' preference to receive real-time or location specific information about red tides. Respondents were prompted to choose all that apply. Statewide participants identified Facebook as the preferred method (*f* = 251; 38.1%) followed by SMS (Short Message Service) text message (*f* = 195; 29.6%). Statewide respondents were least likely to use telephone hotlines (*f* = 56; 8.5%) and Snapchat (*f* = 52; 7.9%). Regional participants identified SMS text messaging service as the preferred method (*f* =145; 44.8%). Facebook (*f* =123; 38%) and a mobile phone application (*f* =118; 36.4%) were also identified as preferred mobile and social media platforms. Regional participants were least likely to use Snapchat

(*f* =16; 4.9%), telephone hotlines (*f* =37; 11.4%), and twitter (*f* =38; 11.7%). The percent response to each item is displayed in Figure 10 (Table S7).

Responses were further assessed by characteristics of interest (Tables 4 & 5). Statewide, Facebook was the preferred method for all segments of the population except for non-motorized boaters who preferred SMS messages. For all statewide populations but commercial fishers, SMS messaging was the second most preferred outreach method. Commercial fishers preferred Instagram and mobile phone applications. Across statewide populations, Snapchat and telephone hotlines were the least preferred methods except for waterfront businesses who preferred Snapchat over QR codes and YouTube. Regionally, SMS text messaging was the preferred platform for most segments. However, recreational fishers and boaters preferred mobile phone applications. Commercial fishers preferred Facebook over other methods, although it is important to note the small sample size (*n* = 6).

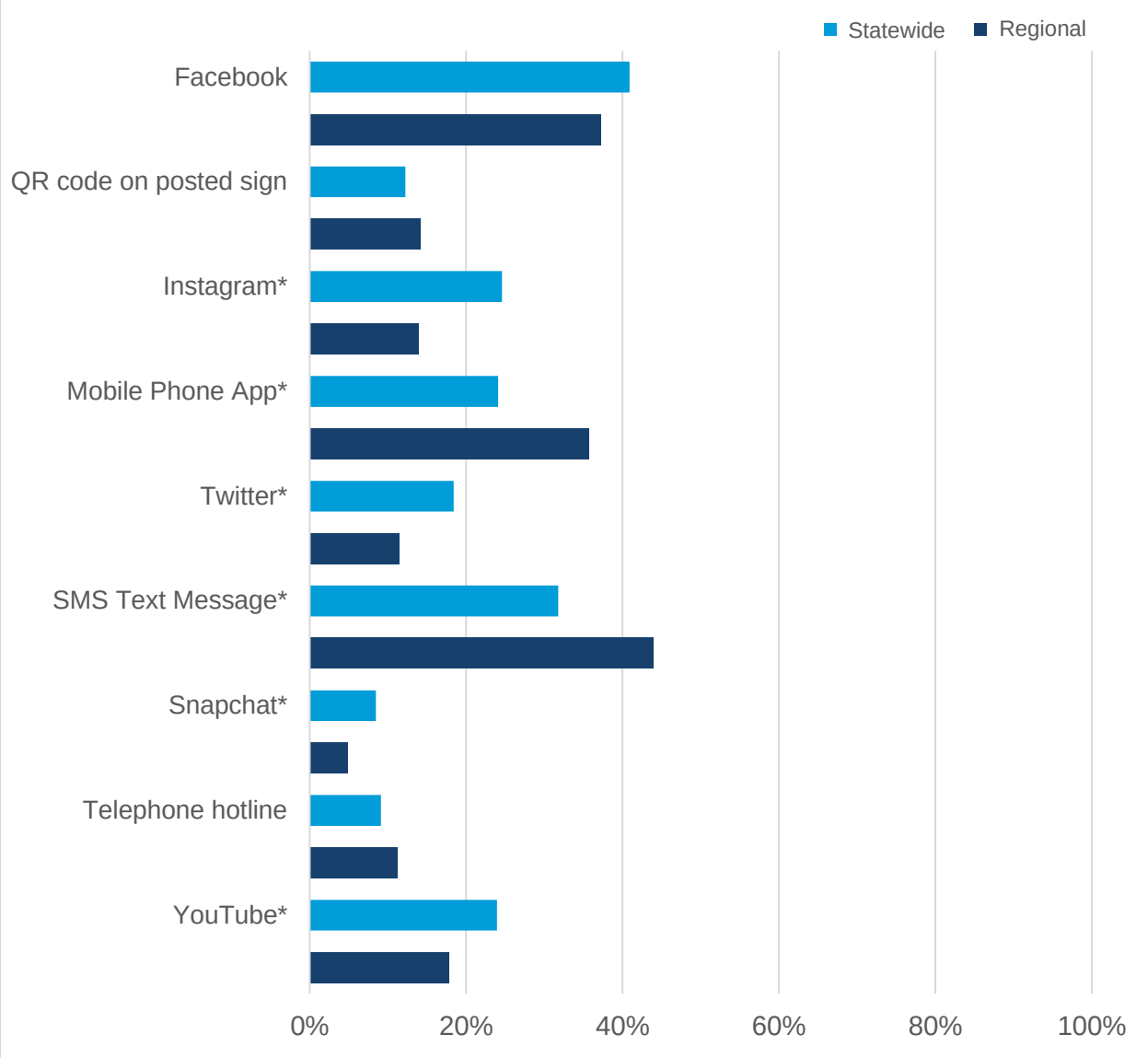

Figure 10. Percent preferred mobile and social media platforms
Statewide n=614; Regional n=330
** Indicates between survey group significance at p ≤ 0.05; Chi-square*

Table 4. Percent of statewide respondents selecting mobile and social media platforms by characteristics of interest

	Asthmatic (or similar respiratory issue) (*n* = 86)	Beachgoer (*n* = 320)	Boater (motorized) (*n* = 98)	Boater (non-motorized) (*n* = 79)	Commercial fisher (*n* = 20)	Recreational fisher (*n* = 136)	Seafood consumer (*n* = 432)	Waterfront business owner/ employee (*n* = 19)
Facebook	**47.7**	**46.6**	**46.9**	48.1	**60.0**	**59.6**	**42.4**	**68.4**
Instagram	22.1	26.3	24.5	38.0	55.0	28.7	23.8	57.9
Mobile phone app	26.7	28.7	34.7	45.6	50.0	32.4	24.5	47.4
QR code on posted sign	17.4	15.9	16.3	26.6	35.0	17.6	13.0	31.6
SMS Message	41.9	38.8	34.7	**49.4**	45.0	34.6	35.6	52.6
Snapchat	8.1	8.4	8.2	8.9	30.0	8.1	6.9	36.8
Telephone hotline	10.5	9.4	11.2	16.5	25.0	8.1	8.6	26.3
Twitter	23.3	21.3	24.5	26.6	40.0	21.3	17.8	36.8
YouTube	29.1	25.0	24.5	20.3	40.0	27.9	23.1	31.6
Not sure	7.0	3.4	5.1	2.5	10.0	3.7	5.6	10.5
None of these	14.0	12.5	10.2	8.9	5.0	11.8	15.7	0.0

Notes: Highest ranked choice is bolded for each characteristic. Populations are not independent.

Table 5. Percent of regional respondents selecting mobile and social media platforms by characteristics of interest

	Asthmatic (or similar respiratory issue) (*n* = 56)	Beachgoer (*n* = 213)	Boater (motorized) (*n* = 63)	Boater (non-motorized) (*n* = 56)	Commercial fisher (*n* = 6)	Recreational fisher (*n* = 99)	Seafood consumer (*n* = 236)	Waterfront business owner/ employee (*n* = 19)
Facebook	42.9	39.9	46.0	42.9	**83.3**	42.4	40.7	45.5
Instagram	10.7	12.2	9.5	23.2	33.3	14.1	14.0	9.1
Mobile phone app	39.3	40.8	**47.6**	**51.8**	50.0	**46.5**	36.9	54.5
QR code on posted sign	10.7	16.9	12.7	19.6	33.3	14.1	14.0	9.1
SMS Message	**50.0**	**48.4**	44.4	**51.8**	33.3	44.4	**43.6**	**63.6**
Snapchat	1.8	3.3	3.2	3.6	0	5.1	5.1	0
Telephone hotline	14.3	12.7	12.7	10.7	16.7	11.1	13.1	18.2
Twitter	8.9	9.9	4.8	12.5	16.7	14.1	10.6	18.2
YouTube	17.9	16.4	20.6	21.4	16.7	18.2	17.8	9.1
Not sure	12.5	6.6	3.2	1.8	0	7.1	8.5	9.1
None of these	8.9	13.1	14.3	5.4	16.7	12.1	13.6	9.1

Notes: Highest ranked choice is bolded for each characteristic. Populations are not independent.

Usefulness of information

To assess usefulness of information, respondents were asked to select red tide informational topics that they perceived to be useful. Respondents were prompted to select all that apply. Informational topics were ranked based on respondents' preferences (Figure 11, Table S8). Overall, survey participants think that the most important information about red tide is "where a red tide event is currently occurring by location" and "the severity of a current red tide event by location". Regional respondents showed significant greater percentages for each of the "most important types of information" questions (except for "none of these" option). The causes of red tide and control and mitigation efforts were identified as the least important items by both groups when compared to the other choices in this question.

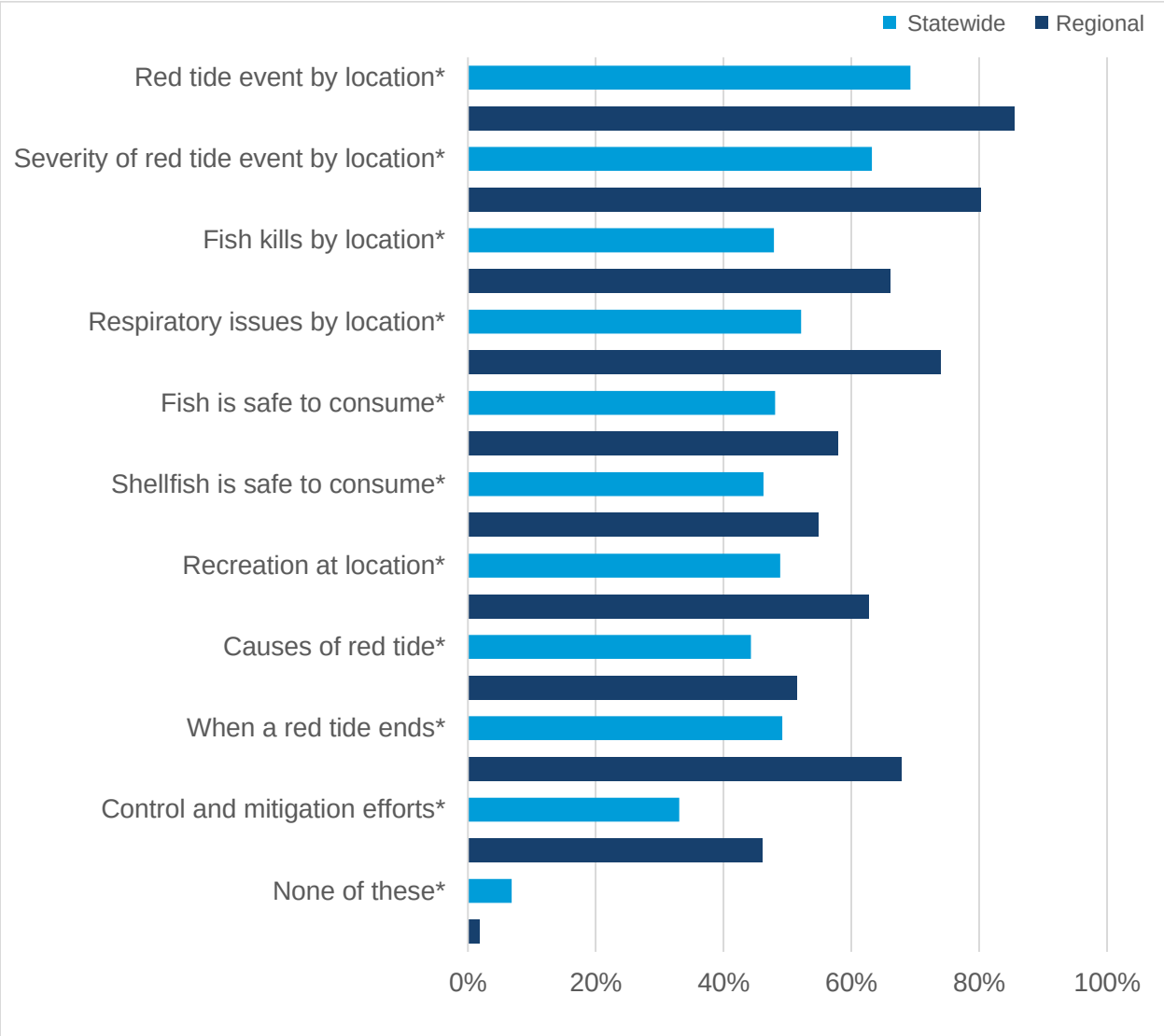

Figure 11. Perceived usefulness of red tide informational topics
Statewide n=614; Regional n=330
** Indicates between survey group significance at p ≤ 0.05; Chi-square*

The quality of current red tide information was evaluated using a 5-point Likert-type scale (1 = *strongly disagree;* 5 = *strongly agree*) (Table 6). A construct mean was computed to represent overall quality of red tide information. Overall, respondents agreed that red tide information is meeting their various needs (Statewide: *M* = 4.05*; SD* = 1.14; Regional: *M* = 4.23; *SD* = 1.05).

Table 6. Quality of red tide information

I can find red tide information…	*M*	*SD*	Interpretation	*M*	*SD*	Interpretation
...in the format I prefer (for example: in print, online, on social media, etc.)	3.95	1.19	Agree	4.12	1.10	Agree
...in the language I prefer (for example: in English, Spanish, Haitian Creole, etc.)	4.29	1.14	Agree	4.51	0.98	Strongly agree
...that is clear and understandable	3.96	1.10	Agree	4.13	1.07	Agree
...that is relevant to my needs / questions	3.98	1.11	Agree	4.15	1.03	Agree

Construct Mean = Statewide 4.05 (*SD* = 1.14; n = 588); Regional 4.23 (*SD* = 1.05; *n* = 324)
Note. Real limits: 1.00 to 1.49 = *strongly disagree;* 1.50 to 2.49 = *disagree*; 2.50 to 3.49 = *neither agree nor disagree;* 3.50 to 4.49 = *agree;* 4.50 to 5.00 = *strongly agree*

Information Sources Used

Use and trust of various red tide information disseminators was assessed. A list of fourteen sources of red tide information were provided. Respondents were asked to select all the most important sources from which they receive red tide information (Table 7). Overall, participants identified Florida Fish and Wildlife Conservation Commission (FWC) (Statewide: *f* = 292; 16.5%; Regional: *f* = 178; 16.2%) and local news media (Statewide: *f* = 252; 14.3%; Regional: *f* = 196; 17.8%) as the most important sources for information. Mote Marine Laboratory and local governments were more important to regional respondents than statewide respondents. Statewide respondents considered the Florida Department of Agriculture and Consumer Services to be more important than regional respondents. A greater number of statewide respondents selected the “none of these” category when compare with regional ones (5% and 1%, respectively).

Table 7. Most important sources for red tide information

	Statewide (*n* = 658)		Regional (*n* = 322)	
Variable	*f*	% of total	*f*	% of total
Florida Fish and Wildlife Conservation Commission (FWC)	292	16.5	178	16.2
Local news media	252	14.3	196	17.8
Florida Department of Health (FDOH)	179	10.1	123	11.2
Florida Department of Environmental Protection (FDEP)	175	9.9	92	8.4
National Oceanic and Atmospheric Administration (NOAA)	133	7.4	71	6.4
Local (County or City) government	110	6.2	96	8.7
National news media	92	5.2	54	4.9
Florida Department of Agriculture and Consumer Services (FDACS)	92	5.2	42	3.8
Universities and Colleges	66	3.7	42	3.8
Mote Marine Laboratory	61	3.5	85	7.7
Visit Florida	53	3.0	33	3.0
Local businesses	49	2.8	22	2.0
Non-profits and community organizations	38	2.1	23	2.1
Florida Sea Grant	36	2.0	14	1.3
Not sure/Prefer not to answer	60	3.4	19	1.7
None of these	80	4.5	11	1.0
TOTAL	1768	100	1101	100

The trustworthiness of primary sources of red tide information was evaluated using a 5-point Likert-type scale (1 = *not trustworthy at all;* 5 = *very trustworthy*). With the exception of local news media (M = 3.48; SD = 1.18), all sources of red tide information were identified as trustworthy by respondents ($H(5) = 301.2$; $p < 0.01$). On average, respondents perceived FWC to be the most trustworthy of red tide information sources (M = 4.44; SD = 0.96) (Table S9). Figure 12 displays a further breakdown of the distribution of respondents' answers to this section.

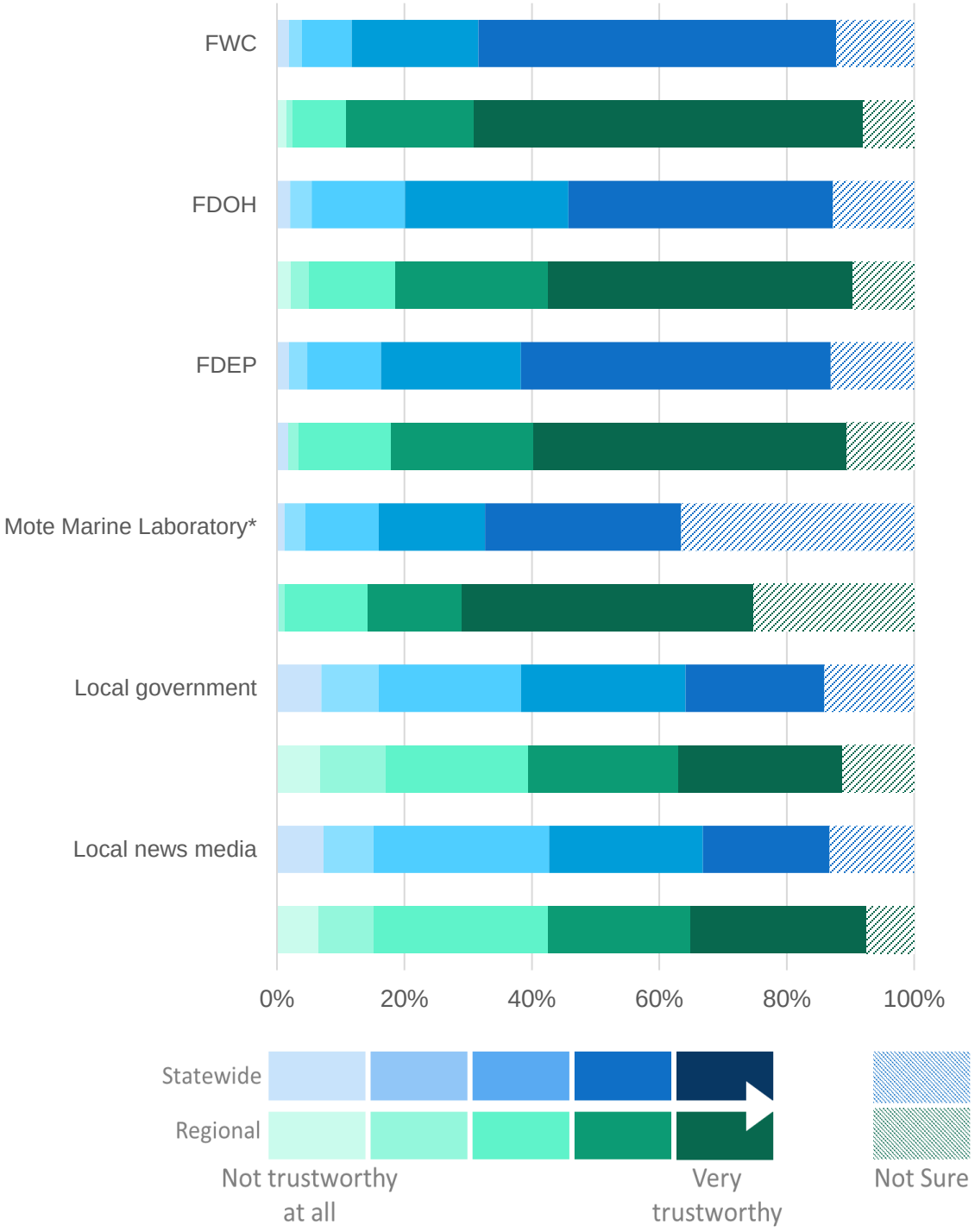

Figure 12. Perceived trustworthiness of sources of red tide information by survey's group
**indicates between group significance at p ≤ 0.001; Chi-square test*
Statewide n = 588; Regional n = 321-323

Key Findings & Recommendations

This study surveyed the opinions, knowledge, experiences, and communication preferences of Florida residents regarding *Karenia brevis* red tide events. To explore differences and similarities we targeted residents of the eight counties that historically experience more red tide events (regional group) and compared their responses with the remaining 59 Florida counties (statewide group).

Although every effort was made to have a representative sample, one of the limitations of this study is that our response rates showed that there is a greater percentage of women, highly educated respondents, and a lower percentage of Hispanic ethnicity than the one found in Florida. We believe this disparity is likely to have the greatest influence on the quality of red tide information responses.

- Future efforts should be made to ensure that red tide information is meeting the needs of diverse and multi-lingual audiences.

Knowledge, Awareness & Experience

Overall, survey participants perceived themselves to be "*somewhat knowledgeable*" regarding red tide events. Knowledge was associated with several variables including education, experience with, and concern about red tides. Overall, familiarity with red tide related terminology was low. Respondents were most familiar with the term "algae" and regional respondents were more familiar with "harmful algal bloom" than statewide participants. There was a correlation between perception of knowledge and familiarity with red tide terms indicating that perceived knowledge may be indicative of actual knowledge about red tides.

Unsurprisingly, more regional respondents had experience with red tide than statewide respondents. Regional respondents were also more concerned about red tide than statewide respondents and a relationship exists between experience and concern about red tides.

Preferred Methods of Receiving Red Tide Information

The majority of respondents only look for red tide information when they are either planning a trip (statewide respondents), when it is near their home or work (regional respondents), or when something new is reported.

- Since very few individuals are regularly looking for red tide related information, educational efforts should occur during a bloom event to have the greatest reach.

Internet news sources were identified as the primary source for red tide information, but television news, posted signs at beach locations, word of mouth, and internet websites were all identified as other important sources for both statewide and regional audiences.

- Due to the importance of posted beach signs as a source of information, efforts should be made to make these signs applicable to non-English speaking residents and visitors.
- Considering the importance of “word of mouth” as a communication method, red tide communication training or, at a minimum, resources should be made available for individuals who have regular interaction with residents and visitors (e.g. park rangers and attendants, lifeguards, recreational authorities, hotel concierge, etc.).

Although social media was not identified as a primary source for red tide information respondents identified Facebook as a preferred social media and mobile application platform; almost all statewide sectors identified it as their preferred choice. Commercial fishers in both surveys identified Facebook as their preferred source for red tide information.

- Although the sample size was low, we recommend that FDACS and FWC consider co-hosting a private Facebook page for individuals who have a commercial harvesting license to share red tide and shellfish harvesting area information in an easily accessible and safe space.
- Based on the regional preference for SMS text messaging service, we recommend that an opt-in service be developed for localized red tide beach conditions.
- A mobile phone app was also ranked highly by both statewide and regional respondents and was especially favored by regional recreational boaters and fishers. These audiences often rely on mobile apps for weather, winds, and tidal information. Integrating red tide conditions into an already existing weather app would be an opportunity for reaching a target audience.
- An additional opportunity is the integration of public input platforms into a single mobile-friendly app. This product could increase the citizen driven data to improve locally relevant information (i.e., fish kill locations, respiratory irritation, and beach conditions).
- Finally, FWC should strategically use their Instagram page to reach a broader audience.

These results highlight the need for continued delivery of information about red tide using different sources and platforms, including the development of new outreach modes and methods.

Usefulness of information

The most important information for regional and statewide respondents was the presence and severity of red tide by location, and information about respiratory issues. All topics were deemed important by at least 30% of the statewide and 47% of regional respondents.

- Messaging about red tide should be diverse but prioritize location specific information.

Most of the participants agreed that current red tide information is in the format and language they prefer, that it is clear and relevant to their needs/questions. Nevertheless, we believe that there is always room for improvement.

- Due to the limitations of this survey, we recommend continued evaluation for this variable (specially the prefer language question).

Information Sources Used

For both groups, local news media and FWC were identified as the most important sources for red tide information. However, whereas FWC was rated the most trustworthy source of red tide information, local news media were perceived to be the least trusted, although their rating was still positive (*trustworthy*) by regional respondents.

- Due to the importance of internet and television news sources as a preferred format and source for information, we suggest that FWC formalize a relationship with local news media during bloom events to ensure accurate dissemination of information to the public.

FDOH and FDEP were also recognized as important and trustworthy sources of information. Regional respondents also identified local governments and Mote Marine Laboratory as sources for information. While Mote Marine Laboratory was ranked more trustworthy than local governments an important discovery is that a substantial portion of both populations were unfamiliar with them (37% statewide and 25% regional). This will limit their ability to disseminate information to a wider audience.

Supplementary Tables

Demographics

Table S1. Respondents' county of residence

Variable	Statewide		Regional	
	Frequency	Percentage	Frequency	Percentage
	f	%	*f*	%
County of Residence				
Alachua	9	1.4	--	--
Bay	7	1.1	--	--
Bradford	2	0.3	--	--
Brevard	30	4.6	--	--
Broward	62	9.4	--	--
Charlotte	--	--	13	4.0
Citrus	6	0.9	--	--
Clay	7	1.1	--	--
Collier	--	--	22	6.8
Columbia	4	0.6	--	--
De Soto	3	0.5	--	--
Dixie	1	0.2	--	--
Duval	37	5.6	--	--
Escambia	12	1.8	--	--
Flagler	3	0.5	--	--
Gadsden	2	0.3	--	--
Gilchrist	1	0.2	--	--
Gulf	1	0.2	--	--
Hamilton	1	0.2	--	--
Hernando	9	1.4	--	--
Highlands	4	0.6	--	--
Hillsborough	--	--	64	19.8
Holmes	1	0.2	--	--
Indian River	10	1.5	--	--
Jackson	1	0.2	--	--
Lake	21	3.2	--	--
Lee	--	--	50	15.4
Leon	8	1.2	--	--
Levy	2	0.3	--	--
Manatee	--	--	21	6.5
Marion	14	2.1	--	--
Martin	3	0.5	--	--
Miami-Dade	51	7.8	--	--
Monroe	3	0.5	--	--
Nassau	5	0.8	--	--

	Statewide		Regional	
Variable	Frequency	Percentage	Frequency	Percentage
	f	%	*f*	%
Okaloosa	5	0.8	--	--
Okeechobee	1	0.2	--	--
Orange	45	6.8	--	--
Osceola	13	2.0	--	--
Palm Beach	60	9.1	--	--
Pasco	--	--	39	12
Pinellas	--	--	62	19.1
Polk	21	3.2	--	--
Putnam	2	0.3	--	--
St. Johns	10	1.5	--	--
St. Lucie	9	1.4	--	--
Santa Rosa	5	0.8	--	--
Sarasota	--	--	36	11.1
Seminole	19	2.9	--	--
Sumter	6	0.9	--	--
Suwannee	2	0.3	--	--
Taylor	1	0.2	--	--
Union	1	0.2	--	--
Volusia	31	4.7	--	--
Wakulla	2	0.3	--	--
Walton	1	0.2	--	--
Out of State	2	0.3	--	--
Prefer not to answer	102	15.5	17	5.2

Table S2. Characteristics of interest

	Statewide		Regional	
Variable	*f*	% Yes	*f*	% Yes
Asthmatic	86	13.1	56	17.3
Beachgoer	320	48.6	213	65.7
Boater (motorized)	98	14.9	63	19.4
Boater (non-motorized)	79	12.0	56	17.3
Commercial fisher (including aquaculture)	20	3.0	6	1.9
Recreational fisher	136	20.7	99	30.6
Seafood consumer	432	65.7	236	72.8
Waterfront business owner/employee	19	2.9	11	3.4
None of these/Prefer not to answer	62	9.4	25	7.7

Knowledge, Awareness & Experience

Table S3. Subjective knowledge by characteristics of interest

	Statewide	Regional
Knowledge* rec fishers	31.4; p ≤ 0.01	14.2; p ≤ 0.01
Knowledge * boaters (motorized)	23.8; p ≤ 0.01	15.3; p ≤ 0.01
Knowledge * boaters (non-motorized)	11.8; p ≤ 0.01	10.7; p ≤ 0.01
Seafood consumers	0.79; p=0.37	2.1; p=0.15
Asthmatic	2.83; p=0.09	3.3; p=0.07

Ordinal Chi-square and significance values for the statewide and regional surveys

Table S4. Respondents' familiarity with red tide terms

	Statewide			Regional		
Item	*M*	*SD*	Interpretation	*M*	*SD*	Interpretation
Algae	4.05	1.20	Moderately familiar	4.03	1.21	Moderately familiar
Karenia brevis or *K. brevis*	1.70	1.19	Not familiar	1.94	1.36	Not familiar
Harmful algal bloom (HAB)*	2.74	1.47	Neutral	3.23	1.43	Neutral
Dinoflagellate	1.74	1.25	Not familiar	1.77	1.21	Not familiar
Brevetoxin	1.64	1.18	Not familiar	1.72	1.18	Not familiar

Construct Mean = Statewide 2.74 (*SD* = 1.47); Regional 3.23 (*SD* = 1.43)
Note. Real limits: 1.00 to 1.49 = *not familiar at all;* 1.50 to 2.49 = *not familiar*; 2.50 to 3.49 = *neutral;* 3.50 to 4.49 = *moderately familiar;* 4.50 to 5.00 = *very familiar*
*indicates between survey group significance at *p* ≤ 0.05

Table S5. Percent of individuals who experienced the following occurrences during a red tide event

	Statewide (*n* = 595)			Regional (*n* = 324)		
Item	Yes	No	Not sure	Yes	No	Not sure
Saw dead fish/sea animals on the shore	49.2	44.6	6.2	70.3	28.2	1.5
Smelled the odor of decaying fish/sea animals on the beach	47.8	43.8	8.4	72.6	24.9	2.5
Noticed red tide conditions in the water (red or brown/discolored water)	39.7	47.5	12.8	61.5	31.4	7.1
Canceled a trip to the beach	34.8	59.3	5.9	63.0	35.4	1.6
Stopped eating local seafood	24.5	66.8	8.8	43.5	50.0	6.5
Experienced burning eyes, scratchy throat, or coughing that could have been from the event	19.9	67.0	13.1	47.2	47.2	5.3
Canceled a fishing trip	17.9	76.4	5.7	29.3	67.9	2.8

Preferred Methods of Receiving Red Tide Information

Table S6. Respondents use of various red tide information formats

	Statewide			Regional			
How frequently do you currently seek out red tide information in each of these formats?	*M*	*SD*	Interpretation	*M*	*SD*	Interpretation	Significance ($p < 0.05$)
Internet news sources	2.88	1.57	Neutral	3.34	1.44	Neutral	14.35, p ≤ 0.01
Television news	2.67	1.57	Neutral	3.25	1.51	Neutral	24.5, p ≤ 0.01
Posted signs at beach locations	2.59	1.57	Neutral	3.10	1.45	Neutral	16.7, p ≤ 0.01
Word of mouth	2.58	1.51	Neutral	2.96	1.41	Neutral	12.5, p ≤ 0.01
Internet websites (not news)	2.57	1.56	Neutral	2.87	1.52	Neutral	8.88, p ≤ 0.01
Social media	2.34	1.50	Rarely	2.47	1.48	Rarely	0.50, p = 0.48
Newspapers	2.02	1.33	Rarely	2.37	1.53	Rarely	4.62, p = 0.03
Radio news	1.94	1.27	Rarely	2.14	1.36	Rarely	1.7, p = 0.19
Email notification (ex: by FWC)	1.80	1.26	Rarely	1.99	1.34	Rarely	4.07, p = 0.04
Other	1.07	0.47	Never	1.09	0.51	Never	0.06, p = 0.80

Note. Real limits: 1.00 to 1.49 = *never;* 1.50 to 2.49 = *rarely*; 2.50 to 3.49 = *neutral;* 3.50 to 4.49 = *often;* 4.50 to 5.00 = *always*
Between survey group significance at $p \leq 0.05$, Ordinal chi-square.

Table S7. Preferred mobile and social media platforms

	Statewide		Regional	
Variable	*f*	% (*n* = 658)	*f*	% (*n* = 324)
Facebook	251	38.1	123	38.0
Instagram	151	22.9	46	14.2
Mobile phone app	148	22.5	118	36.4
QR code on posted sign	75	11.4	47	14.5
SMS (Short Message Service) Text	195	29.6	145	44.8
Snapchat	52	7.9	16	4.9
Telephone hotline	56	8.5	37	11.4
Twitter	113	17.2	38	11.7
YouTube	147	22.3	59	18.2
Not sure	35	5.3	24	7.4
None of these	98	14.9	48	14.8
Other	13	2.0	11	3.3
News	4	--	2	--
Email notification	2	--	3	--
Google	2	--	--	--
TikTok	2	--	--	--
Weather app/news	1	--	2	--
A Florida beach website	1	--	--	--
Friends (word of mouth)	1	--	1	--
Nextdoor	--	--	1	--
Mail	--	--	1	--

Usefulness of information

Table S8. Perceived usefulness of red tide informational topics

	Statewide (*n* = 658)		Regional (*n* = 324)	
Variable	*f*	%	*f*	%
Red tide event occurrence by location	425	64.6	282	87.0
The severity of a current red tide event by location	388	59.0	265	81.8
Whether respiratory (breathing) issues like coughing/wheezing might occur by location	320	48.6	244	75.3
When a red tide ends	302	45.9	224	69.1
Whether I should recreate (swim, walk, fish, boat, etc.) at a location	300	45.6	207	63.9
Whether finfish is safe to consume	295	44.8	191	59.0
Whether fish/marine animal kills are present by location	294	44.7	218	67.3
Whether shellfish is safe to consume	284	43.2	181	55.9
Causes of red tide	272	41.3	170	52.5
Control and mitigation efforts	203	30.9	152	46.9
Not sure/Prefer not to answer	44	6.7	10	3.1
None of these	42	6.4	6	1.9

Information Sources Used

Table S9. Respondents' perceived trustworthiness of sources of red tide information

	Statewide				Regional			
Variable	*M*	*SD*	Interpretation	Significance	*M*	*SD*	Interpretation	Significance
Florida Fish and Wildlife Conservation Commission (FWC)	4.44	0.91	Trustworthy	a	4.50	0.84	Very Trustworthy	a
Florida Department of Health (FDOH)	4.16	0.99	Trustworthy	b	4.24	0.98	Trustworthy	b
Florida Department of Environmental Protection (FDEP)	4.30	0.97	Trustworthy	a,b	4.29	0.94	Trustworthy	b
Mote Marine Laboratory*	4.14	1.01	Trustworthy	c	4.40	0.85	Trustworthy	a,b
Local government	3.54	1.21	Trustworthy	d,e	3.58	1.23	Trustworthy	c
Local news	3.48	1.18	Neutral	e	3.60	1.21	Trustworthy	c

Note. Real limits: 1.00 to 1.49 = *not trustworthy at all;* 1.50 to 2.49 = *not trustworthy*; 2.50 to 3.49 = *neutral;* 3.50 to 4.49 = *trustworthy;* 4.50 to 5.00 = *very trustworthy*

Letters indicate within survey group significance at $p \leq 0.05$; Kruskall-Wallis test with Dunn's post-hoc

*indicates between group significance at $p \leq 0.001$; independent-samples t-test