Public Awareness and Attitudes toward Invasive Lionfish: Preliminary Results from Baseline Survey

Interim Report to the Florida Fish and Wildlife Conservation Commission

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Report Objectives

Nonnative Indo-Pacific lionfish (*Pterois volitans and P. miles)* are established in Florida's marine waters where they are negatively impacting native fish populations, altering reef habitats, and competing with economically important species. Control of lionfish populations is a high priority for the Florida Fish and Wildlife Conservation Commission (FWC), and recent regulatory changes facilitate public participation in lionfish removal efforts. However, public unawareness, misperceptions, and safety concerns remain. FWC is launching a statewide outreach campaign in 2015 with the goals of raising awareness and influencing behaviors toward lionfish. University of Florida (UF) is conducting pre- and post-campaign surveys to help FWC develop and evaluate the lionfish outreach campaign.

This Interim Report summarizes preliminary results of the pre-campaign survey, which was conducted in January–February 2015. The purpose of the pre-campaign survey is to provide baseline data on perceptions and experiences of three Florida populations: the general public, recreational saltwater anglers, and recreational SCUBA divers. Objectives of this report are as follows:

1. Describe awareness and knowledge of lionfish among Florida anglers, divers, and the general population
2. Assess how involved these groups are in lionfish control efforts (e.g., removing lionfish, using reporting tools, cooking and eating lionfish)
3. Describe public attitudes toward lionfish and other invasive species in Florida (e.g., beliefs about severity of lionfish impacts, support of invasive species control and management)
4. Make recommendations based on survey results to help FWC modify outreach goals and messages

After post-campaign data are collected in the fall of 2015, we will present a Final Report to FWC describing effects of the outreach campaign on public awareness, attitudes, and behaviors.

Key Findings

Group Profiles

- **Florida General Public:** an Internet sample (*N* = 422) that reflects the actual population of Florida in terms of age, sex, and geographic location in the state, but slightly underrepresents minority groups such as Hispanics, African-Americans, people with less than a Bachelor's degree, and those with household incomes greater than $100,000. This sample includes 207 people (49%) with some saltwater fishing experience and 24 (6%) with some SCUBA diving experience, but these recreationists are less experienced than those in the two target groups.

- **Saltwater Anglers:** a sample of 508 respondents from FWC's list of 2013 saltwater fishing licensees, who are not certified SCUBA divers. This group is 82% male, 95% white, 9% Hispanic/Latino, and 18% out-of-state residents. Education and income levels are relatively high compared to the general public. They have many years of saltwater angling experience and have almost all been fishing within the past two years. A relatively low survey response rate suggests that the sample may be biased toward people with greater interest in the issue.

- **SCUBA Divers**: 284 divers from a database of divers who received a PADI certification in Florida within the past three years, plus 309 SCUBA divers from FWC's list of 2013 saltwater fishing licensees. This group is similar to the saltwater anglers in terms of sex ratio (79% male) and ethnic makeup (94% white, 11% Hispanic), and contains slightly more out-of-state residents (22%). The SCUBA divers are younger than the other two groups, have the highest education and income levels, and are most likely to be members of conservation organizations. This group contains more experienced divers (61% Advanced Open Water or higher certification levels) than the actual population of SCUBA divers. Again, these respondents are likely more interested in the issue of lionfish than divers who did not reply to the survey.

Lionfish Awareness and Knowledge

- Most SCUBA divers (96%) and saltwater anglers (87%), and more than half of the general public (52%) knew that there were invasive lionfish in Florida's waters prior to taking the survey (Figure 2).
- Majorities of SCUBA divers (73%) and saltwater anglers (65%) knew that aquarium releases were *the most likely explanation* for how lionfish were first introduced to Florida. Forty-seven percent of the general public knew (Figure 7).
- Only 17% of the general public, 38% of anglers, and 58% of SCUBA divers knew that a recreational fishing license is *not required* to remove lionfish in Florida using a spear or handheld net (Figure 8).
- Only 12% of the general public, 17% of anglers, and 31% of SCUBA divers knew that there have been no confirmed deaths in the United States from lionfish stings. Approximately one-third of each group thought that people have died (Figure 9).

Information Sources

- The Internet/social media, friends/family/acquaintances, and television were important sources of information about lionfish for all groups. SCUBA divers, and to a lesser extent saltwater anglers, learned about lionfish from their own personal outdoor experiences. Newspapers were the next most effective information source.
- All groups expressed interest in learning more, saying they would be likely to pay attention to a news story dealing with invasive lionfish.

Lionfish Sighting and Reporting

- Seventy-five percent of SCUBA divers, 24% of saltwater anglers, and 12% of the general public *who had participated in saltwater recreation activities* reported that they had seen a lionfish in the wild (Figure 10).
- Most sightings were in the Florida Keys, followed by Florida Atlantic coast, Caribbean Islands, and Florida Gulf Coast (Figure 11).
- South Florida residents were most likely to have seen lionfish on Florida's Atlantic Coast. Northwest Florida residents were most likely to have seen them on Florida's Gulf Coast. Non-Florida residents were most likely to have seen them in the Caribbean Islands and Mexico/Central America (Table 8).
- Only 12% of those who had seen lionfish in Florida said they had reported their lionfish sightings to the FWC.
- Eighteen percent of SCUBA divers, 12% of saltwater anglers, and 4% of the general public had heard about FWC's Report Lionfish App. Only 4% of SCUBA divers and 1% of each other group had downloaded it (Table 10).

- The most common reason (73%) for not reporting sightings was a lack of knowledge that the FWC wanted people to report. However, under "other reasons," 21 respondents wrote that lionfish are too common to report, and locations are (or should be) already known to authorities.
- Most respondents said they would be likely to report future sightings, but those who did not report them in the past were less likely to say they would report them in the future.

Lionfish Removal

- Approximately one-third of the SCUBA divers group, 10% of the saltwater anglers, and 3% of the general public had removed a lionfish while diving or snorkeling (Figure 14). (Of respondents who had *ever seen lionfish,* these percentages are 45% of SCUBA divers, 36% of saltwater anglers, and 9% of the general public.)
- Of those who had removed lionfish, 20% (N = 38) did so without possessing a Florida saltwater fishing license.
- People who removed lionfish were more likely than others (68% vs. 38%) to be aware of FWC's license exemption for lionfish removal (Figure 15). However, even among the 38 people who removed lionfish without possessing a saltwater fishing license, some (N = 11) did not know about the license exemption.
- Most removals took place in the Florida Keys (70%), on Florida's Atlantic coast 44%, on Florida's Gulf Coast (22%) and in the Caribbean Islands (22%; Figure 16).
- Pole spears were much more frequently used than other lionfish removal gear, followed by Hawaiian sling, handheld net, and other spearing devices. Some respondents wrote in that they used spear guns and dive knifes.
- Ecological reasons were cited by almost everyone who removed lionfish (94%), followed by "They are good to eat" (51%), "They are an easy target" (35%), "I might as well spear them since I'm already hunting" (35%), and "It is fun to spear them" (34%; Figure 17).
- People who had seen but never removed lionfish said their reasons were they did not have appropriate gear (69%), they did not spearfish (38%), they were afraid of getting stung (22%), or lionfish were not their target species (16%). Some wrote in other reasons, (e.g., they didn't know about lionfish or that it was legal to remove them, they don't feel comfortable killing animals, the dive master removed them, or they have killed but not removed lionfish).
- 74 total respondents (6% of those who had saltwater fished) had caught lionfish on hook and line. Only 3 respondents had purposely targeted lionfish while fishing on hook and line.
- 30% of SCUBA divers (7% of anglers) had eaten a lionfish. 17-18% of divers (4% of anglers) had fileted/cooked a lionfish. 11% of divers (3% of anglers) had ordered lionfish in a restaurant. (Percentages were all marginal in general public.)

Attitudes toward Lionfish and Other Invasive Species

- Overall, all groups tended to believe that there are large numbers of lionfish, that they are impacting native fish populations, and that they pose a threat to Florida's coastal ecosystems and fisheries (Table 12, Component 3). SCUBA divers endorsed these beliefs most strongly, followed by saltwater anglers. The general public tended to agree that lionfish are having impacts, but less strongly than the other groups.
- SCUBA divers and saltwater anglers expressed highly supportive attitudes toward control and prevention of invasive species in Florida (Table 12, Component 4). Members of the general public also rarely disagreed with these statements, although they were more likely to have no opinion.

- In general, people *do not* think that the problem of lionfish is a "non-issue" that will resolve itself (Table 12, Component 1). For example, only 15% of the general public, 7% of anglers, and 5% of SCUBA divers agreed that "If we leave lionfish alone, Florida's coastal ecosystems will balance themselves naturally." Twenty-seven percent of the general public vs. only 6% of anglers and 3% of divers felt that "it is wrong to kill wildlife, even if it is an invasive species."
- SCUBA divers expressed little fear about encountering and eating lionfish. Anglers expressed some uncertainty about whether eating lionfish posed dangers from toxins and venom. Members of the general public were quite fearful about both eating lionfish and encountering them while snorkeling or diving (Table 12, Component 2).
- Majorities of all groups said they thought it was "probably not" possible to eradicate (completely remove) lionfish from Florida's waters.
- SCUBA divers were more likely than the other two groups to think that state agencies are not doing enough to control the lionfish population in Florida. Many respondents in all groups were uncertain about whether state agencies were doing enough to control lionfish.

Summary and Recommendations

➔ Large majorities of divers and anglers (96% and 87% respectively) and about 50% of the general public know that "there are invasive lionfish in Florida's coastal waters." By comparison, the general public seems to be somewhat more aware of Burmese pythons than they are of lionfish. Divers and anglers seem to be equally aware of the two invasive species. However, future research using identical measures is needed to confirm this comparison.

➔ Although many people know that lionfish exist, they are less informed about specific issues. More outreach is needed to raise awareness that a license is not required for hunting lionfish, and that FWC wants people to report lionfish sightings.

➔ Outreach is also needed to allay safety concerns about encountering and consuming lionfish. Fears are particularly strong among the general public. Divers and anglers are also uncertain about the potential fatality of lionfish stings, and some anglers are uncertain about whether lionfish meat contains toxins or venom.

➔ Lionfish outreach campaigns will be likely to reach many segments of the public via websites, social media, television, and newspapers. Working with the dive industry (dive shops, charters, instructors) may be an effective way to inform SCUBA divers. Increasing FWC's direct communications (e.g., emails, flyers) can also be effective.

➔ People are largely unaware that FWC wants lionfish sightings to be reported, and largely unaware that there is an app for this. There seems to be some skepticism that reporting lionfish is important or useful, given how abundant lionfish are perceived to be. (The fact that 21 respondents wrote this comment suggests that many more may think the same.) These findings suggest a need for FWC to more clearly communicate the purpose of reporting lionfish, and maybe to provide more specific reporting instructions (e.g., only report new locations rather than all sightings).

- ➔ About a third of SCUBA divers in our survey are actively removing lionfish (which is likely higher than among the general population of FL SCUBA divers). For many who did not remove, the reason was just that they didn't have appropriate gear, so actively guiding people on what gear to use may help increase removal efforts. Education on safe removal techniques is needed to calm the fears of the 22% who are afraid of getting stung.

- ➔ 38% said their reason for not removing lionfish was that they do not spearfish. Maybe offering an "introduction to spearfishing" class/training could prompt some of them to try this new activity. Although only a few wrote in that they are not comfortable killing animals, more people may feel this way. If possible, outreach messages that convey respect for this view may be more favorably received.

- ➔ Even among those who are actively removing lionfish, not everyone knows that a fishing license is not required when using certain spearing gear or a handheld net. More outreach is needed to inform divers and anglers of the license exemption and specific gear it applies to (for example, does it apply to spear guns or dive knives?).

- ➔ Survey respondents who have thus far removed lionfish (we may think of them as "early adopters") are highly motivated by ecological reasons. This finding suggests that ecological motivations are likely to resonate with many divers and anglers. However, some of the "later adopters" may be less ecologically minded and require additional motivations to remove lionfish. The fact that many respondents indicated other reasons (they are good to eat, an easy target, and fun to hunt) suggests that outreach messages focusing on multiple benefits of removing lionfish are likely to be successful.

- ➔ Although half of those who removed lionfish acknowledge that they are good to eat, the rest of the populations may be less aware of lionfish as a food source. Additional outreach about fileting, cooking, and eating lionfish may help motivate more people to consume them. Currently, few have had the opportunity to eat lionfish in restaurants, so providing more opportunities to taste lionfish may increase people's interest in eating them.

- ➔ Catching lionfish on hook and line occurs infrequently, but anglers need to be informed that it may happen and how to safely handle the lionfish if they catch one. Targeting lionfish by hook and line is so rare that it does not seem necessary to promote this as a deliberate method of removing lionfish.

- ➔ Among the general public, and even more so among target groups of divers and anglers, beliefs about lionfish impacts and attitudes toward lionfish control tend to align with management views and objectives. Further, most respondents have realistic understandings of the unlikeliness of eradicating lionfish, which suggests that the public will accept and support FWC's objectives of controlling lionfish populations. Outreach messages that continue to focus on ecological and economic impacts of lionfish, and the necessity of controlling populations, are likely to be effective.

- ➔ Most people think that agencies are not doing enough to control lionfish, or they are undecided on this point. This presents an opportunity for FWC to ramp up efforts and be met with agreement from the public.

- ➔ The fact that many recreational divers and anglers learned about lionfish through their own direct experiences and social interactions indicates that they likely have strong attitudes about the issue. For these involved groups, outreach goals should focus on providing specific information and instructions (about reporting, removing, fileting and cooking lionfish) rather than on attempting to influence beliefs and attitudes.

- ➔ General public attitudes about lionfish are weaker and may be more malleable through education and outreach. Outreach goals should focus on increasing knowledge and awareness of lionfish. Data from the post-campaign survey, to be collected in late 2015, will allow us to examine relationships between awareness/knowledge and attitudes toward lionfish.

Methods

We developed the pre-campaign questionnaire to address FWC's specific research questions about public awareness, beliefs, and involvement, as well as broader questions about invasive species knowledge and attitudes raised in the literature (e.g., Bremner and Park 2007, Garciá-Llorente et al. 2008, Harvey et al. in press, Odera and Lamm 2014 , Sharp et al. 2011). Questionnaire drafts were reviewed by FWC staff, an executive at the Professional Association of Diving Instructors (PADI), and members of the Everglades Cooperative Invasive Species Management Area (ECISMA) Steering Committee. We pre-tested the survey on a convenience sample of 36 students and 12 colleagues, and revised questions based on results of preliminary data analyses. Final questions were approved by FWC staff. The University of Florida Institutional Review Board exempted this study from human subjects review because its primary purpose involves program evaluation rather than contributing to generalizable knowledge.

We administered the survey online via Qualtrics software to samples of three populations: the general population of Florida, Florida saltwater anglers, and Florida SCUBA divers. Details of sampling and administration for each group are described below. The questionnaire was slightly modified for the different samples (for example, we deleted the question "Are you a certified SCUBA diver?" for the diver sample); otherwise, all groups were asked the same set of questions. The online survey took an average of about 15 minutes to complete (about half of respondents completed it in less than 12 minutes). Upon completion of data collection, we downloaded and merged all data into IBM SPSS Statistics 22 for analyses.

Qualtrics General Population Sample

We purchased an "opt-in" Internet sample of the general Florida population from Qualtrics, LLC. Use of opt-in Internet panels is a non-probability sampling method that is increasingly used in public opinion research (Baker et al. 2013). If attention is paid to sample quality, opt-in samples can provide minimally biased results that sometimes outperform traditional probability samples (Vavrek and Rivers 2008). To estimate true population values within plus or minus five percentage points (i.e., +/- 5% sampling error), at a 95% confidence level, we aimed for a completed sample size of 400 (Dillman 2007). Qualtrics collected survey responses using quotas to attempt to represent the Florida population according to three attributes: gender, age category, and geographical location within the state.

Qualtrics works with private Internet panel providers to recruit survey respondents using two methods. They recruit people who are immediately incentive-driven, such as someone playing an online game who can take a survey instead of paying to continue their game. They also recruit through advertisement via online banner ads or email campaigns, where respondents are incentivized with "E-points" to spend in an online marketplace. Potential respondents are asked screening questions to determine if they meet the survey and quota criteria. To reduce bias, the survey topic is concealed from respondents until they have chosen to participate.

Qualtrics provided a sample of 422 "good completes," i.e., respondents who were at least 18 years old, Florida residents, and fit the quotas for gender, age, and geographic location. They had to slightly relax the geographic and age quotas in order to complete the sample, but the resulting sample still closely resembles the Florida population (Table 1). Qualtrics required respondents to answer all survey questions, so there are no missing data in this sample.

Table 1. Demographic attributes of Florida population and the general population survey sample provided by Qualtrics.

	Florida population[a]	Sample
Gender		
Female	51.1%	51.2%
Male	48.9%	48.8%
Age Group		
18 to 29	19.7%	20.9%
30 to 39	15.5%	15.6%
40 to 49	17.9%	18.2%
50 to 59	17.2%	18.0%
60 to 69	14.2%	14.7%
70 or Older	15.5%	12.6%
Geographic Region of Florida		
Northwest	7.0%	6.2%
North Central	9.5%	9.5%
Northeast	22.0%	22.0%
Southwest	26.9%	25.4%
South	34.5%	28.9%

[a] Statistics for the state of Florida based on 2010 U.S. Census (www.census.gov)

PADI SCUBA Diver Sample

PADI drew a random sample of 2100 names from their database of 54,544 divers who received a PADI certification in Florida within the past three years. This sample included 700 divers who were certified in each of the three years (which had approximately even numbers of certifications). To ensure representation of both new and experienced divers, the sample was stratified based on certification level (74% Open Water, 21% Advanced Open Water, 5% Rescue Diver). After removing opt-outs, PADI sent the survey directly to 2087 divers.

To attempt to maximize response, respondents were contacted four times using a modified version of Dillman's (2007) tailored design method. A brief prenotice email was followed after two days with a survey invitation email describing the research purpose, assurance of confidentiality, and a link to the online survey. A reminder email was sent after seven days and a second reminder 11 days later. The emails came from PADI's Industry & Governmental Relations Executive and included PADI's logo as well as those of UF and FWC.

A total of 284 divers from this sample filled out at least part of the survey, representing a 14% response rate. However, we have no way of knowing the number of people who opened the email versus those who did not even see it if it went into their spam folder (see description of angler sample response rate below). Item nonresponse was up to 16% (46 respondents) on some of the questions, but we kept all respondents in the sample to maximize data. Because of these missing values, sample size (*N)* varies among the data analyses in this report.

FWC Saltwater Angler Sample

We downloaded FWC's list of 2013 saltwater fishing licensees, removed 250,187 duplicate entries and 720,288 entries that did not have email addresses, resulting in a dataset of 471,844 saltwater anglers with email addresses. From this, we drew a random sample of 6000 anglers and emailed the survey using the Qualtrics email distribution system. (We decided to survey a larger sample of 6000 anglers based on the diver sample response rates, which were lower than expected). Again, we made four contacts to attempt to increase response rate. The initial invitation email (from the UF research coordinator) was followed two days later by a reminder from FWC, a second reminder from UF after five more days, and a third reminder one week later. To stimulate response, the second reminder included an incentive for the next 200 anglers to complete the survey: either a waterproof cell phone holder or a T-shirt with the "lionfish: be the predator" logo. These gifts were mailed to respondents after data collection was complete.

One hundred ten emails bounced. Of the 5890 emails that went through, 820 people (14%) completed the survey. Qualtrics' system tells us that only 2163 (37%) of the emails were opened. Based on number of anglers who opened the email, our response rate is 38%[1]. Unfortunately, we cannot know why 3727 people did not open the email; it is possible that many of those emails went into people's spam folders. Item nonresponse was less than 1% (12 respondents) on all questions except sensitive questions about income and race. Three respondents who reported that they "have never been saltwater fishing for recreation" were removed from the sample, bringing the sample size to 817.

Group Categorization

All analyses in this report are presented as comparisons among three groups of respondents: the Florida general public, saltwater anglers, and SCUBA divers. The first step in data analysis was to construct these three categories. Our Qualtrics and FWC samples each included a combination of SCUBA divers, saltwater anglers, and people who participated in neither activity (Table 2). We conducted preliminary analyses to compare groups of divers and anglers across samples, to examine similarities and differences and determine placement in one of the three categories for analyses.

Table 2. Numbers of SCUBA divers, saltwater anglers, and others in each of three survey samples.

	Qualtrics General Population Sample	**FWC Saltwater Anglers Sample**	**PADI SCUBA Divers Sample**
SCUBA divers (%)	24 (6%)	309 (38%)	284 (100%)
Saltwater anglers who are not SCUBA divers (%)	190 (45%)	508 (62%)	--
Non-Divers/Anglers (%)	208 (49%)	3 (0.4%)	--
Total *N*	422 (100%)	820 (100%)	284 (100%)

[1] We will conduct a non-response bias check to examine how non-respondents differ from respondents and better understand any bias that might be present in our survey results. In final analyses, we may weight the data to better represent the populations.

Based on preliminary analyses, SCUBA divers within the FWC Saltwater Anglers sample ("FWC divers," *N* = 309) were more similar to the "PADI divers" than they were to other FWC anglers on nearly all measures of experience and knowledge of lionfish. These similarities were striking given that FWC divers had lower average certification levels and less recent diving experience than PADI divers, and were more likely than PADI divers to be older and Florida residents. For this reason, we categorized all "FWC divers" into our "SCUBA Divers" group for comparative analyses (Figure 1).

On the other hand, the 24 SCUBA divers within the Qualtrics General Population sample ("GenPop divers") more closely resembled the other members of that sample than they did the PADI divers on many measures. For example, the GenPop divers were significantly less likely than the PADI divers to have seen, removed, eaten or cooked lionfish, to be aware of the lionfish invasion (prior to taking the survey), and to know FWC's license requirements. The GenPop divers did resemble the PADI divers in their knowledge of the source of lionfish release, their self-assessed knowledge of lionfish, and frequency of talking to others about lionfish. The same pattern held for the 190 "GenPop anglers." They had less Florida fishing experience and had fished less recently than the FWC anglers (see Table 4). They more closely resembled other GenPop respondents than they did the FWC anglers in most measures of knowledge and experience of lionfish.

Because of these significant and consistent differences between divers and anglers who were *incidentally included in the Qualtrics GenPop sample* and those who were *purposely targeted in the FWC and PADI samples*, we decided to categorize all 422 GenPop respondents as "Florida General Public" (Figure 1). Therefore, this group provides an approximate representation of the actual Florida general public (which does contain segments of anglers and divers). From here on, we will refer to three groups in our analyses: Florida General Public (*N* = 422), Saltwater Anglers (*N* = 508), and SCUBA Divers (*N* = 593; Figure 1).

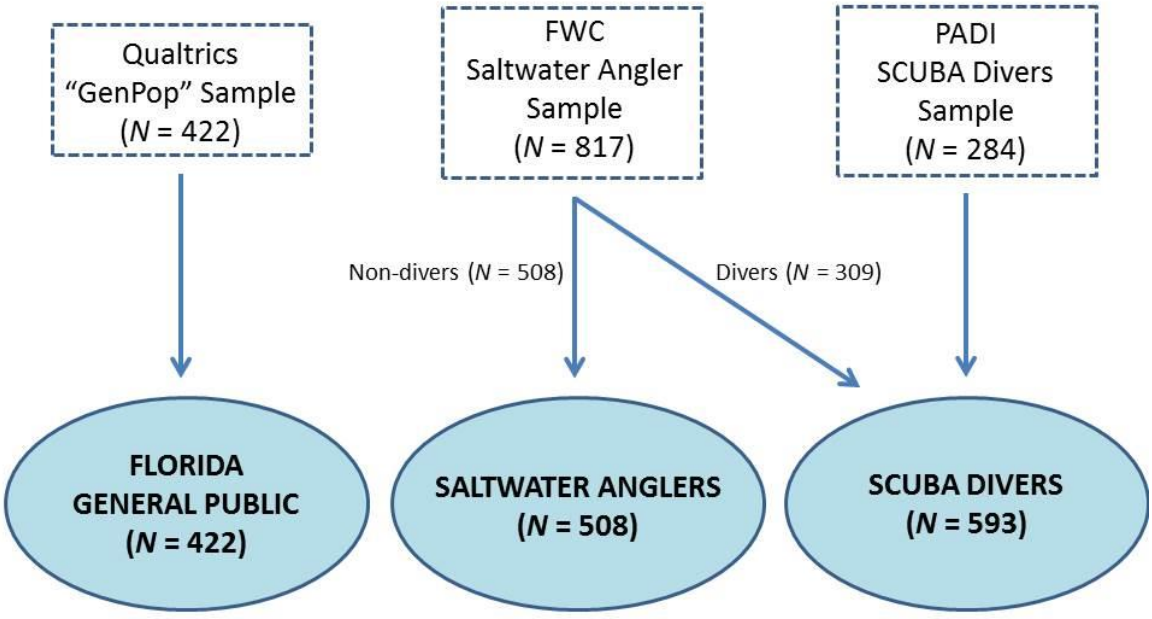

Figure 1. Three groups used for comparative analyses, and how they were formed from the three survey samples.

Detailed Results

Respondent Characteristics

Table 3 describes socio-demographic characteristics of the three survey groups. As noted previously, the Florida general public sample reflected the actual population in terms of age, sex, and geographic location in the state. However, the sample underrepresented minority groups such as Hispanics (13% in sample vs. 24% in the population, according to U.S. Census data), African-Americans (9% vs. 17%), people with less than a Bachelor's degree (66% vs. 74%), and people with household incomes greater than $100,000 (12% vs. 18%).

SCUBA divers were a few years younger, on average, than the other two groups (Table 3). Both the saltwater angler and SCUBA diver groups had large male majorities (82% and 79%, respectively) and sizeable proportions of out-of-state residents (18% and 22%). The angler and diver groups had significantly higher proportions of whites (95% and 94%) than the general public group (86%), but the groups did not differ significantly in percentage of Hispanics. Educational attainment and household incomes were highest among the divers and lowest among the general public. Divers (24%) were more likely than the other groups to be members of conservation or wildlife organizations, followed by anglers (16%). More than 50% of the general public, and much larger majorities of the other two groups, had been snorkeling or skin diving.

The saltwater angler and SCUBA diver groups exhibited many years of saltwater angling experience, and large majorities (94% and 80%) had been angling very recently (2014–2015; Table 4). All of the saltwater angler group and 76% of the SCUBA diver group had been saltwater fishing in Florida. By comparison, the 207 anglers in the general public sample had less fishing experience overall and in Florida, and were much less likely to be fishing recently (2014–2015).

Our SCUBA diver group was almost evenly split among divers with Open Water certification (39%), Advanced Open Water (31%), and higher levels such as Rescue Diver or Instructor (30%; Table 5). By comparison, 71% of the 24 SCUBA divers in the general public sample were at the Open Water level. Although total years of diving experience did not differ significantly between the groups, divers in the general public sample were much less likely to have been diving recently (2014–2015).

Table 3. Socio-demographic characteristics of the three survey groups.

	Florida General Public (*N* = 422)	**Saltwater Anglers (*N* = 508)**	**SCUBA Divers (*N* = 593)**	**Comparative Statistic**
Average Age (SD)	48.0 (17.3)	47.0 (13.7)	44.4 (13.8)	F = 7.4**
Sex				
Female	51%	18%	21%	χ^2 = 152.8***
Male	49%	82%	79%	
Florida Residency				
Full-time FL resident	97%	75%	72%	χ^2 = 116.0***
Part-time FL resident	3%	7%	6%	
Not a FL resident	0%	18%	22%	
Ethnicity				
Hispanic/Latino	13%	9%	11%	χ^2 = 4.9
Not Hispanic/Latino	87%	91%	89%	
Race				
White	86%	95%	94%	χ^2 = 74.9***
Black/African-American	9%	2%	0.4%	
Other/More than one race	5%	3%	6%	
Education Level				
Less than Bachelor's	66%	54%	43%	χ^2 = 75.7***
Bachelor's degree	25%	30%	35%	
Advanced degree	10%	16%	23%	
Household Income				
Less than $50,000	50%	24%	21%	χ^2 = 185.9***
$50,000 to $100,000	37%	37%	33%	
$100,000 or More	12%	39%	46%	
Conservation Organization Membership				
Member	7%	16%	24%	χ^2 = 51.7***
Not a member	93%	84%	76%	
Ever Been Snorkeling or Skin Diving				
Yes	53%	87%	98%	χ^2 = 340.4***
No	47%	13%	2%	

** p <.01, *** p <.001

Table 4. Recreational saltwater fishing experience of anglers in the three survey groups.

	Florida General Public (*N* = 207)	**Saltwater Anglers (*N* = 508)**	**SCUBA Divers (*N* = 472)**	**χ^2**
Total Years of Saltwater Fishing Experience				
Less than 2 years	29%	6%	9%	115.1***
2 to 20 years	46%	47%	38%	
More than 20 years	25%	47%	52%	
Most Recent Saltwater Fishing Experience				
2015	6%	42%	38%	393.7***
2014	26%	52%	42%	
Pre-2014	68%	6%	20%	
Ever Saltwater Fished in Florida				
Yes	33%	100%	76%	524.3***
No	67%	0%	24%	

* p <.05, ** p <.01, *** p <.001

Table 5. SCUBA diving experience of divers in two survey groups.

	Florida General Public (*N* = 24)	**SCUBA Divers (*N* = 472)**	χ^2
SCUBA Certification Level			
Open Water	71%	39%	13.2*
Advanced Open Water	29%	31%	
Higher Levels	0%	30%	
Total Years of SCUBA Diving Experience			
Less than 2 years	25%	11%	5.3
2 to 20 years	54%	64%	
More than 20 years	21%	25%	
Most Recent SCUBA Diving Experience			
2015	8%	19%	125.2***
2014	25%	49%	
Pre-2014	67%	32%	

* p <.05, ** p <.01, *** p <.001

Lionfish Awareness and Knowledge

We measured overall awareness of lionfish by asking "Before taking this survey, did you know that there are invasive lionfish in Florida's coastal waters?" By this measure, 52% of the general public, 87% of Saltwater Anglers, and 96% of SCUBA divers were aware of lionfish (χ^2 = 320.1, p < .001; Figure 2).

As a point of comparison, we also gauged awareness of invasive Burmese pythons. (However, the question was asked differently than the question about lionfish awareness, so it only provides a rough comparison[2]). Response categories were "I do not know what this is," "I know what this is but I did not know it was an invasive species," and "I know what this is and I know it is an invasive species." Among the general public, 87% at least knew what Burmese pythons were, and 56% said they knew that they were an invasive species (Figure 2). Thus, the general public seems to be somewhat more aware of Burmese pythons than they are of lionfish, but future research using identical measures is needed to confirm this comparison.

Among anglers, 94% knew what Burmese pythons were and 88% knew they were invasive (Figure 2). Among SCUBA divers, 96% knew what Burmese pythons were and 87% knew they were invasive. Thus, by both measures, divers and anglers seem to be about equally aware of lionfish as they are of Burmese pythons.

The same question was asked for five other invasive species in Florida. Table 6 shows percentages of each group who answered "I know what this is and I know it is an invasive species." Overall, awareness of these species was much lower than awareness of Burmese pythons or lionfish. For all but one species, the general public was significantly less knowledgeable than the other two groups.

[2] Future surveys will use the same wording to measure awareness of lionfish and Burmese pythons in order to make direct comparisons between the two species.

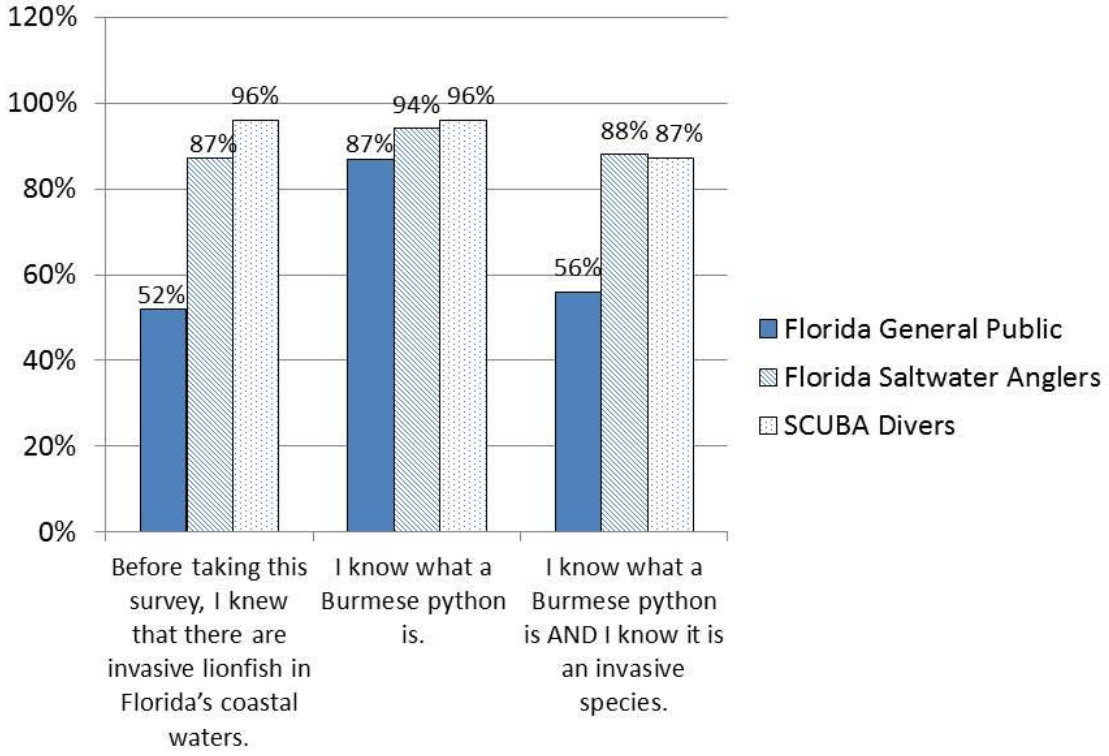

Figure 2. Awareness of invasive lionfish compared to awareness of Burmese pythons in Florida.

Table 6. "Please indicate what you know about the following invasive animals and plants that are found in Florida."

Plant or animal species	**Florida General Public (*N* = 422)**	**Saltwater Anglers (*N* = 508)**	**SCUBA Divers (*N* = 593)**	χ^2
	% who said "I know what this is and I know it is an invasive species."			
Argentine black & white tegu	8%	12%	15%	29.1***
Channeled apple snail	11%	21%	22%	32.3***
Old world climbing fern	10%	10%	13%	7.2
Melaleuca	15%	26%	26%	24.5***
Water hyacinth	19%	37%	34%	37.1***

*** p <.001

SCUBA divers were most likely to learn about lionfish from personal outdoor experiences, Internet/social media, and friends/family (Figure 3). Anglers were most likely to learn about lionfish from Internet/social media, friends/family, and television. The general public was most likely to learn about lionfish from television, Internet/social media, and friends/family. Chi-square tests revealed significant differences among groups in all categories except zoos/nature centers/museums, radio, and other sources. Specific newspapers and television shows/channels from which people received information on lionfish are listed in the Appendix.

Relatively few respondents said they had seen anything about lionfish in the news *in the last month* (18% of general public, 21% of anglers, and 26% of SCUBA divers; $\chi^2 = 22.4$, $p < .001$).

Majorities of all groups reported being *very likely* or *likely* to pay attention to a news story dealing with invasive lionfish (Figure 4). SCUBA divers were significantly more likely to pay attention than were anglers, who were significantly more likely than the general public ($F = 24.2$, $p < .001$).

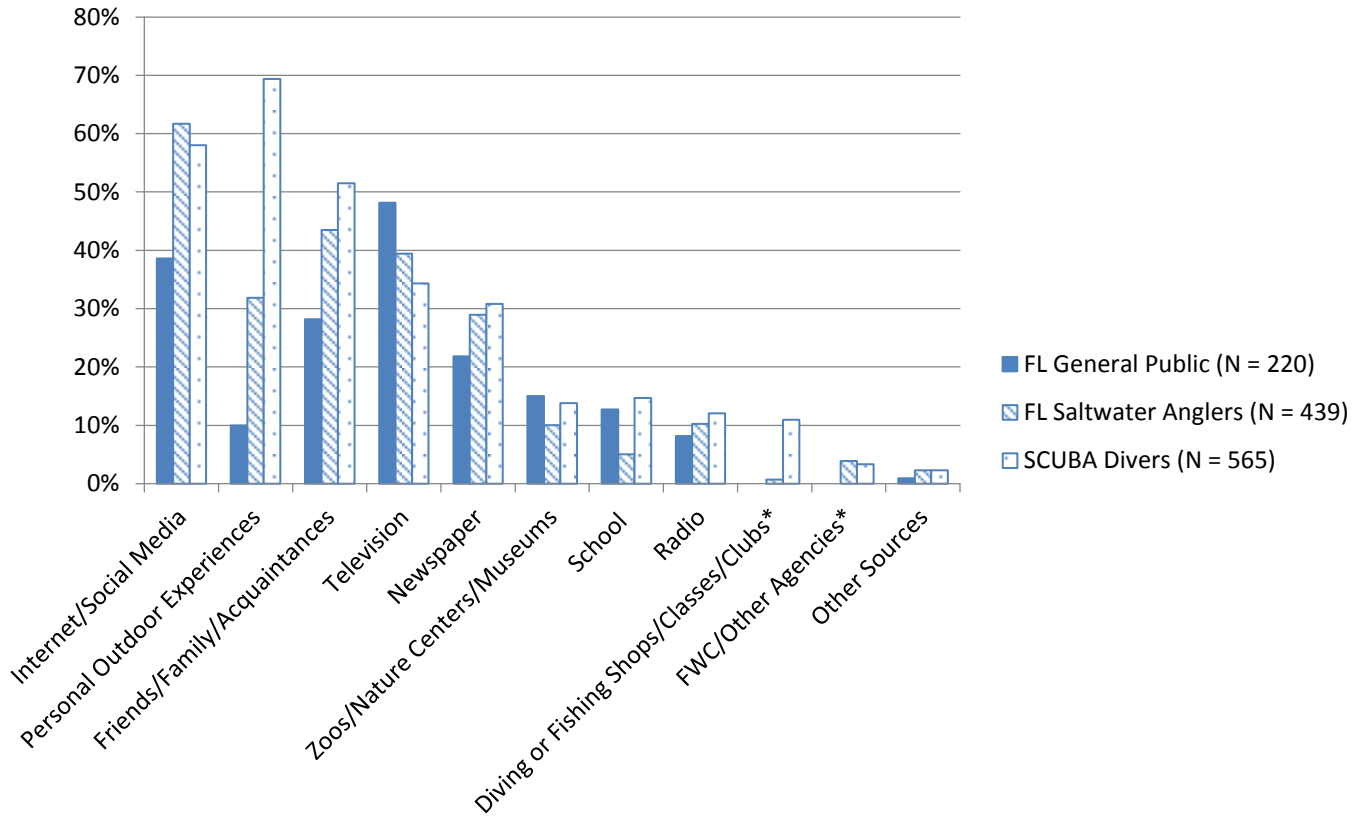

Figure 3. Where did you learn about lionfish? *(Check all that apply)*

** These were write-in responses. Actual percentages may be higher.*

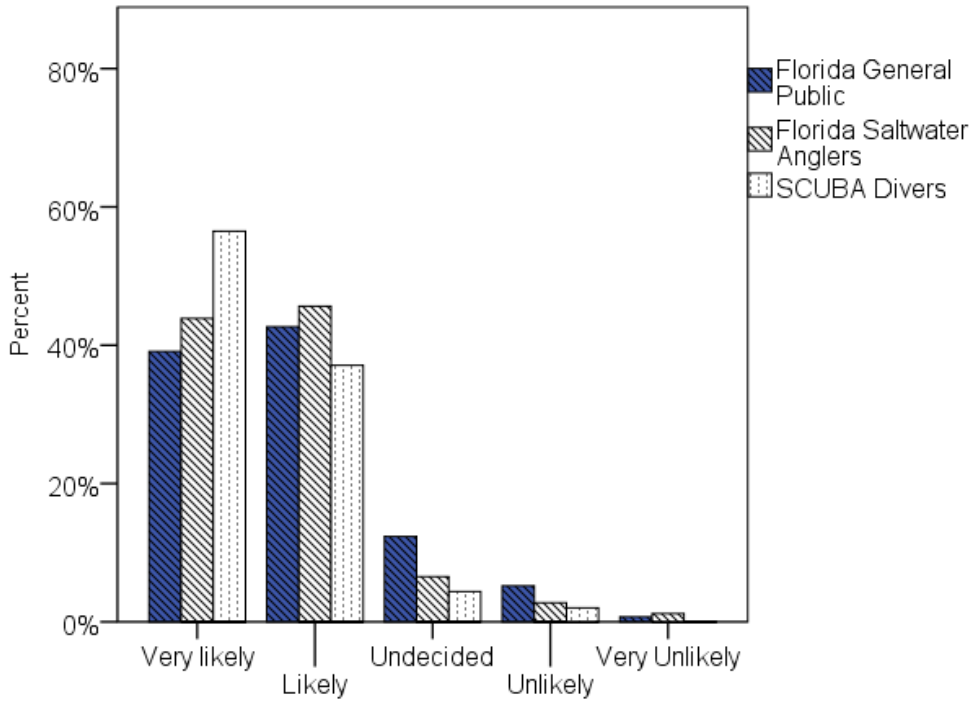

Figure 4. How likely are you to pay attention to a news story dealing with issues related to invasive lionfish?

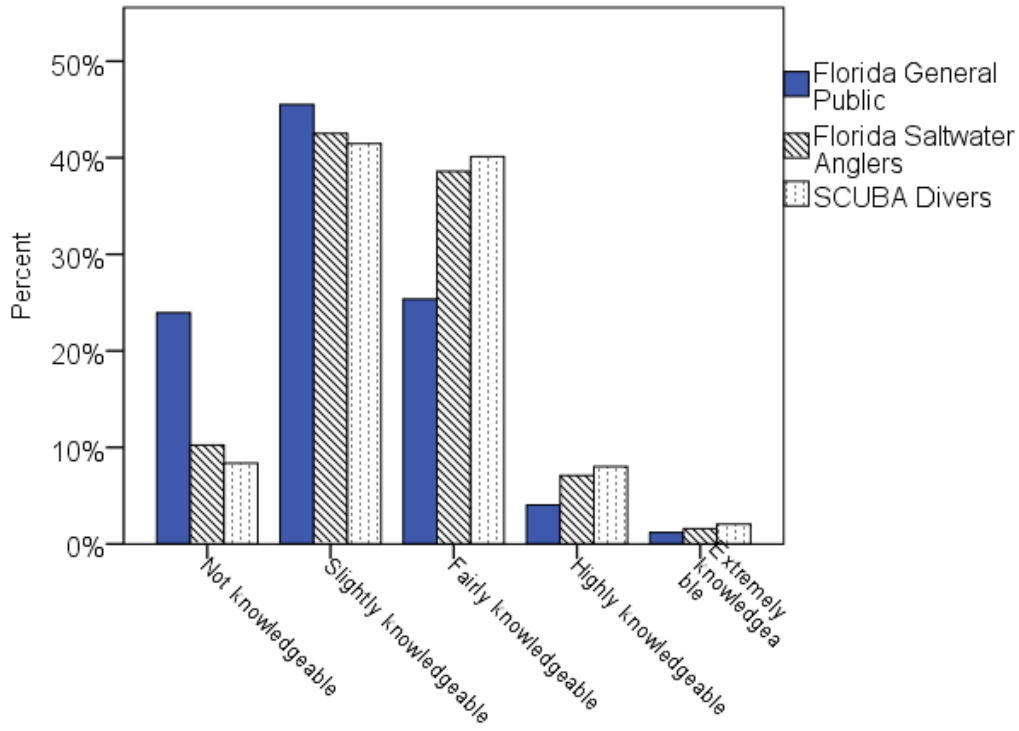

Figure 5. How knowledgeable do you feel you are about invasive species in general?

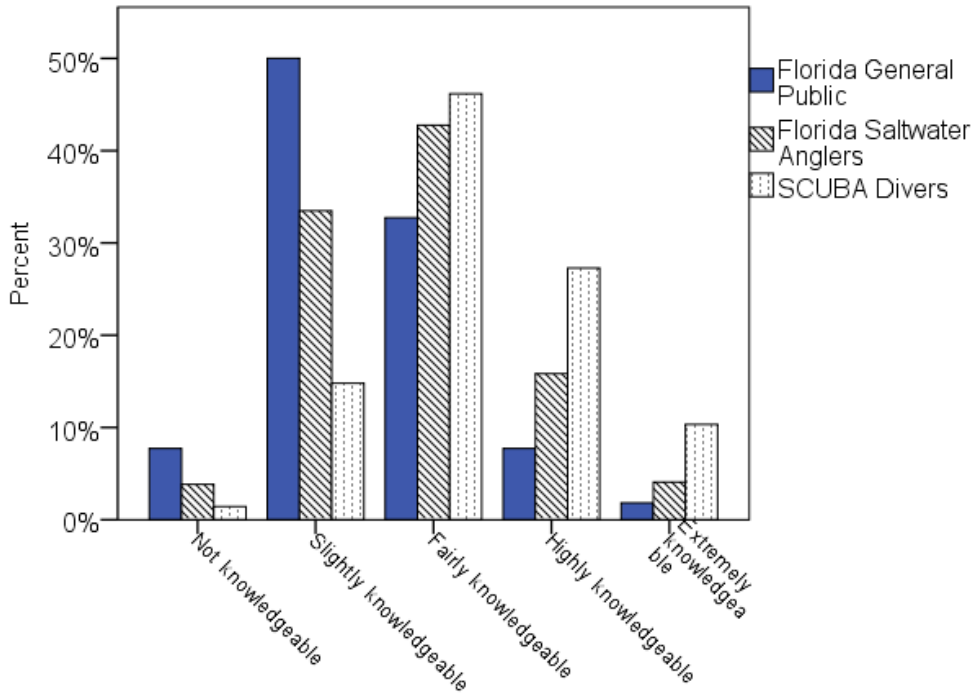

Figure 6. How knowledgeable do you feel you are about invasive lionfish?

We asked respondents "How knowledgeable do you feel you are about invasive species in general?" on a five-point scale from "not knowledgeable" to "extremely knowledgeable." Pluralities of all three groups (46%, 43%, and 42%, respectively) considered themselves only "slightly knowledgeable" (Figure 5). However, SCUBA divers and saltwater anglers were significantly higher than the general public in their self-assessed knowledge of invasive species ($F = 31.5$, $p < .001$).

There were greater intergroup differences in self-assessed knowledge of invasive lionfish. Eighty-four percent of SCUBA divers considered themselves *at least* fairly knowledgeable, whereas 90% of the general public considered themselves *no more than* fairly knowledgeable (Figure 6). Anglers were in between, with significant differences between each group ($F = 83.3$, $p < .001$).

Finally, the survey included three "quiz questions" to assess knowledge of lionfish. Regarding *the most likely explanation* for how lionfish were first introduced to Florida, 47% of the general public, 65% of anglers, and 73% of SCUBA divers knew that they were most likely introduced through aquarium releases ($\chi^2 = 106.5$, $p < .001$; Figure 7). SCUBA divers (58%) were also significantly more likely than anglers (38%) or the general public (17%) to know that a recreational fishing license is not required to remove lionfish in Florida using a spear or handheld net ($\chi^2 = 178.8$, $p < .001$; Figure 8). Fewer respondents (31% SCUBA divers, 17% anglers, 12% general public) knew that people have not died from lionfish stings ($\chi^2 = 74.7$, $p < .001$; Figure 9). It is notable that large percentages of respondents said they did not know the answers to these questions.

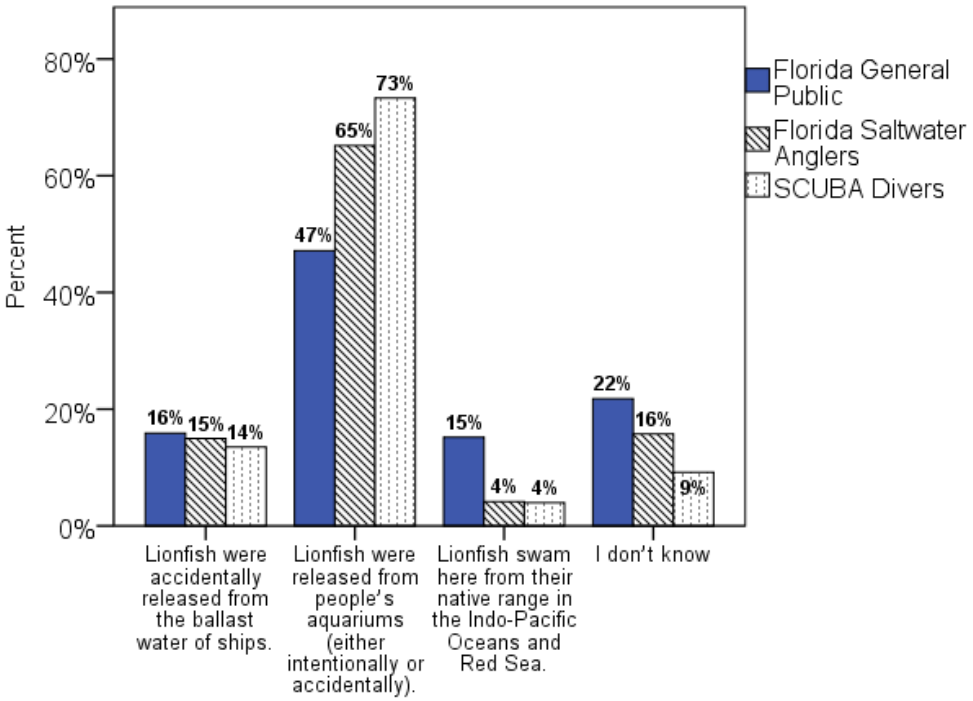

Figure 7. What do you think is the most likely explanation for how lionfish first arrived in Florida's coastal waters?

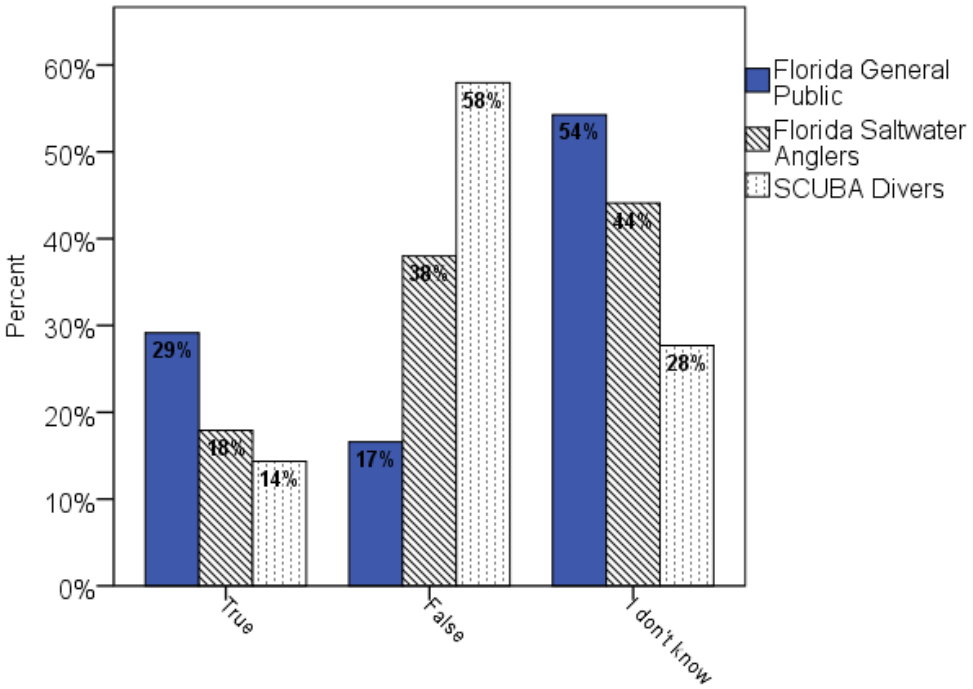

Figure 8. True or False? You must have a recreational fishing license to legally remove lionfish in Florida using a spear or handheld net.

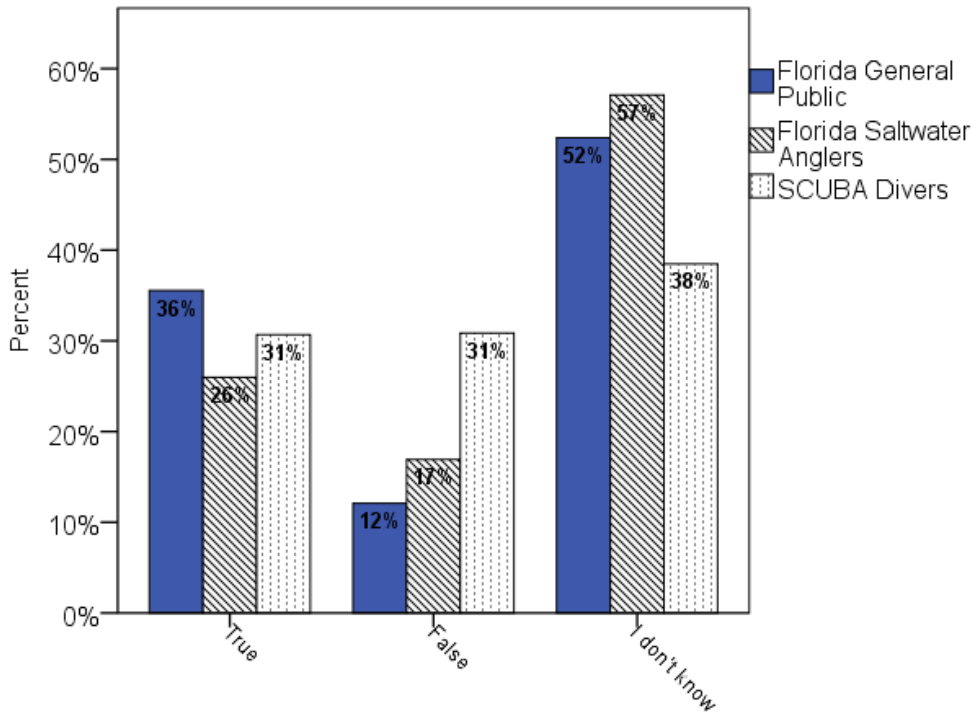

Figure 9. True or False? People have died from lionfish stings.

Lionfish Sightings

Three quarters of SCUBA divers, one quarter of saltwater anglers, and 12% of the general public *who had participated in saltwater recreation activities (diving, snorkeling or saltwater fishing)* reported that they had seen a lionfish (Figure 10). Out of the entire general public sample, 8% had seen a lionfish.

Table 7 details the experience of seeing lionfish while participating in each of the three saltwater recreation activities. Twenty-nine percent of SCUBA divers within the general public sample versus 71% of those in the SCUBA divers group had seen a lionfish while diving. SCUBA divers were also more likely than the other two groups to have seen lionfish while snorkeling. Very small numbers of respondents in all groups had caught a lionfish on hook and line (only 7 members of the general public, 33 saltwater anglers, and 34 SCUBA divers). Of those who had caught lionfish on hook and line, 52% (*N* = 37) reported that they used baitfish, 50% (*N* = 35) reported using shrimp, 47% (*N* = 33) reported using squid, and 3% (*N* = 2) reported using artificial lures. Most of those catches were incidental. Only 3 respondents in the entire survey reported that they had *purposely targeted lionfish* while fishing on hook and line.

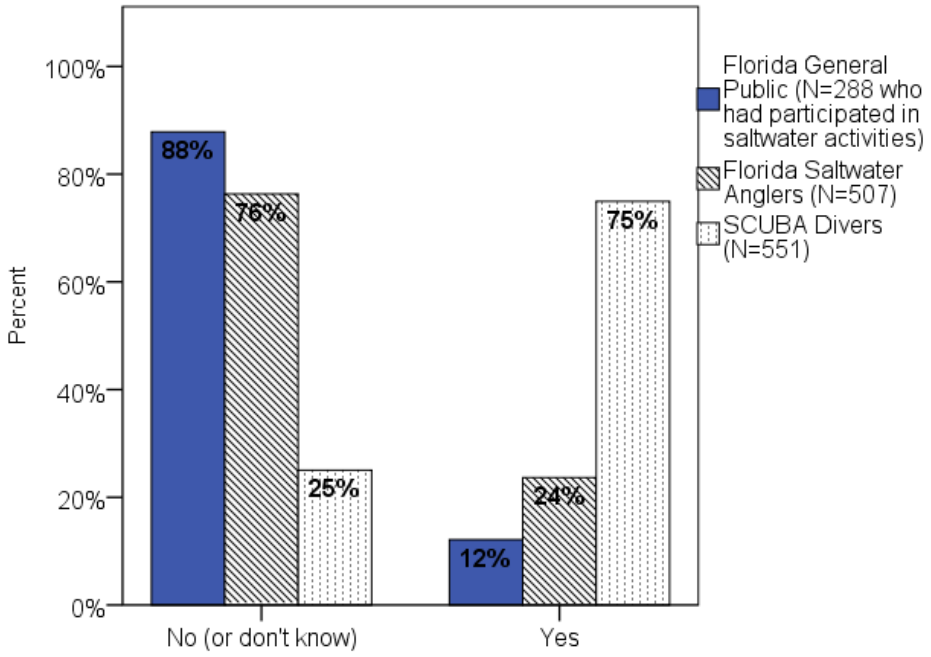

Figure 10. Ever seen a lionfish while SCUBA diving, snorkeling, and/or saltwater fishing (anywhere in the world)

Table 7. Experience of seeing lionfish while participating in saltwater recreational activities.

Action	**Florida General Public**	**Saltwater Anglers**	**SCUBA Divers**	χ^2
Number who have ever SCUBA dived	*N = 24*	--	*N = 552*	
% who have seen lionfish while SCUBA diving	29%	--	71%	21.6***
Number who have ever snorkeled or skin dived	*N = 222*	*N = 439*	*N = 541*	
% who have seen lionfish while snorkeling or skin diving	15%	24%	49%	112.0***
Number who have ever saltwater fished	*N = 207*	*N = 508*	*N = 470*	
% who have caught lionfish on hook & line while saltwater fishing	3%	7%	7%	38.0***
% who have purposely targeted lionfish while fishing on hook & line	0.4%	0.2%	0.2%	2.1

*** p <.001

We asked respondents to indicate all geographic regions where they had seen lionfish while diving, snorkeling, or saltwater fishing. Of 570 total respondents who had seen lionfish, 66% saw them in the Florida Keys. Next common locations were Florida Atlantic coast, Caribbean Islands, and Florida Gulf coast (Figure 11).

We examined lionfish sightings based on respondents' geographic region of residence (Table 8). (See Appendix 2 for a map of Florida regions.) Location of residence was not significantly related to lionfish sightings in the Florida Keys. South Florida residents were most likely to have seen lionfish on Florida's Atlantic Coast. Northwest Florida residents were most likely to have seen them on Florida's Gulf Coast. Non-Florida residents were most likely to have seen them in the Caribbean Islands and Mexico/Central America. There were no significant differences in lionfish sightings in lionfish native range, other U.S. Atlantic and Gulf Coasts, and South America.

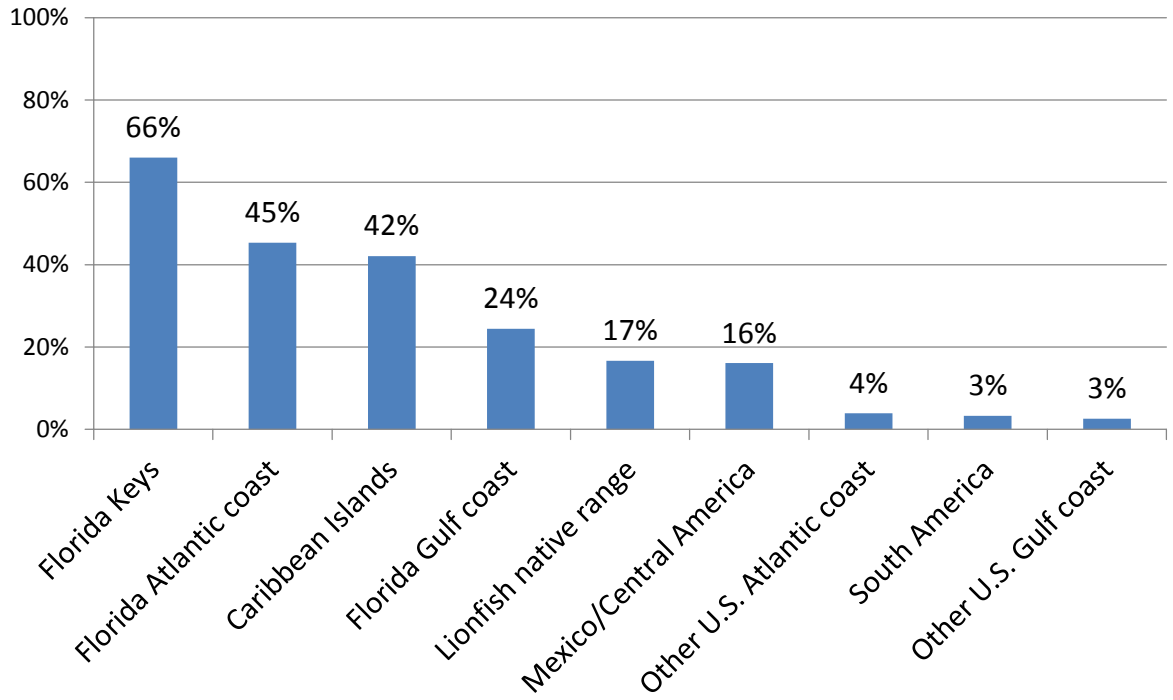

Figure 11. Locations where respondents reported seeing lionfish while SCUBA diving, snorkeling, or saltwater fishing (*N* = 570).

Table 8. Locations where respondents reported seeing lionfish while SCUBA diving, snorkeling, or saltwater fishing based on region of residence.

	Geographic Region of Residence						χ^2
Lionfish Sighting Locations	**Northwest FL**	**North Central FL**	**Northeast FL**	**Southwest FL**	**South FL**	**Outside of FL**	
Florida Keys	52%	62%	70%	67%	68%	64%	4.6
Florida Atlantic Coast	13%	39%	52%	22%	69%	29%	92.7***
Caribbean Islands	26%	21%	48%	37%	43%	51%	16.9**
Florida Gulf Coast	71%	23%	12%	43%	14%	22%	75.0***
Lionfish native range	13%	18%	15%	18%	16%	19%	1.1
Mexico/Central America	26%	18%	7%	18%	10%	28%	24.1***
Other U.S. Atlantic Coast	0%	8%	3%	5%	3%	5%	3.7
South America	0%	3%	5%	3%	3%	3%	2.5
Other U.S. Gulf Coast	7%	0%	2%	4%	1%	5%	7.3

** p <.01, *** p <.001

Lionfish Reporting

Of 499 respondents who indicated they had seen lionfish in Florida, only 12% said they had reported their lionfish sightings to the FWC. *Among those who had seen lionfish in Florida*, members of the general public were more likely than members of the other two groups to report their sightings (χ^2 = 10.1, p < .01; Figure 12).

Respondents who had seen lionfish but had not reported their sightings gave the following reasons for not reporting.

- 73% -- Did not know that the FWC wanted people to report lionfish sightings
- 13% -- Knew the FWC wanted reports, but they did not know how to make a report.
- 5%* -- lionfish are too common to report all sightings; locations are already known
- 3%* -- reported to someone other than FWC (such as dive charter)
- 2%* -- killed them instead of reporting
- 1%* -- Forgot
- 1%* -- It was a long time ago
- 3%* -- other reasons:
    - By the time I started to see them, FWC no longer requested them to be reported.
    - FWC act like *** when interacting with the public
    - I feel they have more important thing to do like keeping people safe from other boaters
    - The app was not convenient to use
    - The problem is not the lionfish, its humans. I've seen a boatful of hunters take out more wildlife in one trip than the entire nonnative lionfish population will consume in six months.
    - This is not an activity I would take part in. Extra step to alert authorities I have no proof are doing anything with the information in a state I only visit once per decade.

** Indicates write-in responses.*

The survey included the following statement: "The FWC wants people to report all lionfish sightings on the Report Florida Lionfish App or on their website MyFWC.com/Fishing." After reading this, a majority of respondents said they would be "very likely" (45%) or "likely" (35%) to report future lionfish sightings to the FWC. However, people who had not reported past sightings were less likely to say they would report them in the future ($\chi^2 = 20.7$, $p < .001$; Figure 13).

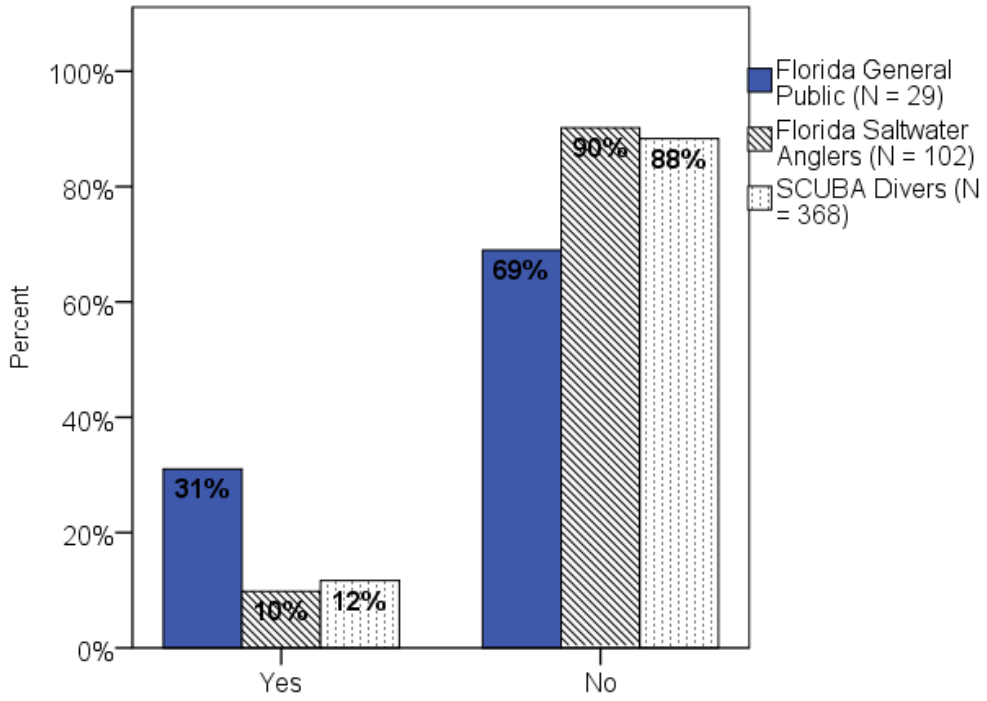

Figure 12. If you have seen lionfish in Florida, have you ever reported your sighting(s) to the Florida Fish and Wildlife Conservation Commission?

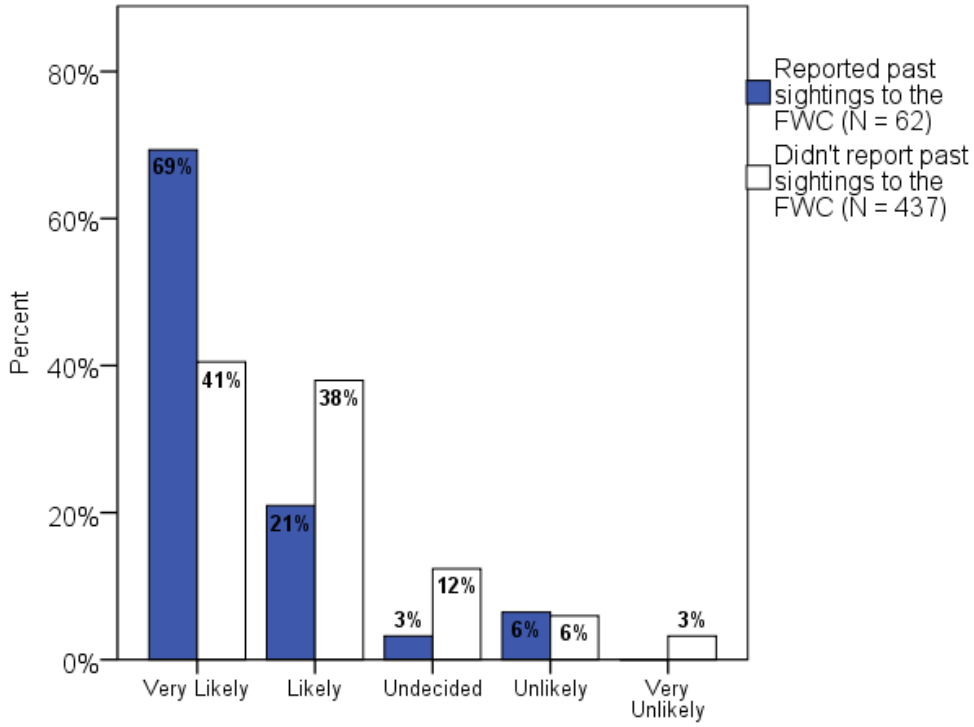

Figure 13. If you see a lionfish in Florida in the future, how likely will you be to report it to FWC?

Lionfish Removal

Forty-one percent of all respondents who had *ever seen lionfish* while SCUBA diving or snorkeling reported that they had *removed a lionfish* (45% of SCUBA divers, 36% of saltwater anglers, and 9% of the general public who had seen lionfish; $\chi^2 = 19.6$, $p < .001$; Figure 14). This represents 34% of the entire SCUBA diver group, 10% of the saltwater anglers, and 3% of the general public group.

Excluding the saltwater anglers group (all of whom had a Florida fishing license), 80% of those who had removed a lionfish (N = 156) had a Florida saltwater fishing license and 20% (N = 38) did not.

Sixty-eight percent of respondents who had removed a lionfish knew that a recreational fishing license is not required to remove lionfish in Florida using a spear or handheld net, compared to only 38% of other respondents ($\chi^2 = 73.3$, $p < .001$; Figure 15). Knowledge of the license exemption was not significantly different between those who removed lionfish with and without a license ($\chi^2 = 2.7$, $p = .26$).

Seventy percent of removals took place in the Florida Keys, 44% on Florida's Atlantic coast, and 22% each on Florida's Gulf Coast and in the Caribbean Islands (Figure 16).

Pole spears were the preferred method of removing lionfish, followed by Hawaiian sling, handheld net, and other spearing devices (Table 9). Some respondents wrote in that they used spear guns and dive knifes. "Other" gear listed included the following:

- Clove oil
- Fishing poles
- Long clamp, like a grabber
- Scissors
- Spire of a conch shell used to spear Pterois volitans (lionfish) underwater
- Tote
- ZooKeeper Containment Tube

As noted in the section on Lionfish Sightings above, only 74 total respondents (6% of those who had saltwater fished) had caught lionfish on hook and line. Nearly all of those catches were incidental while anglers were targeting other species.

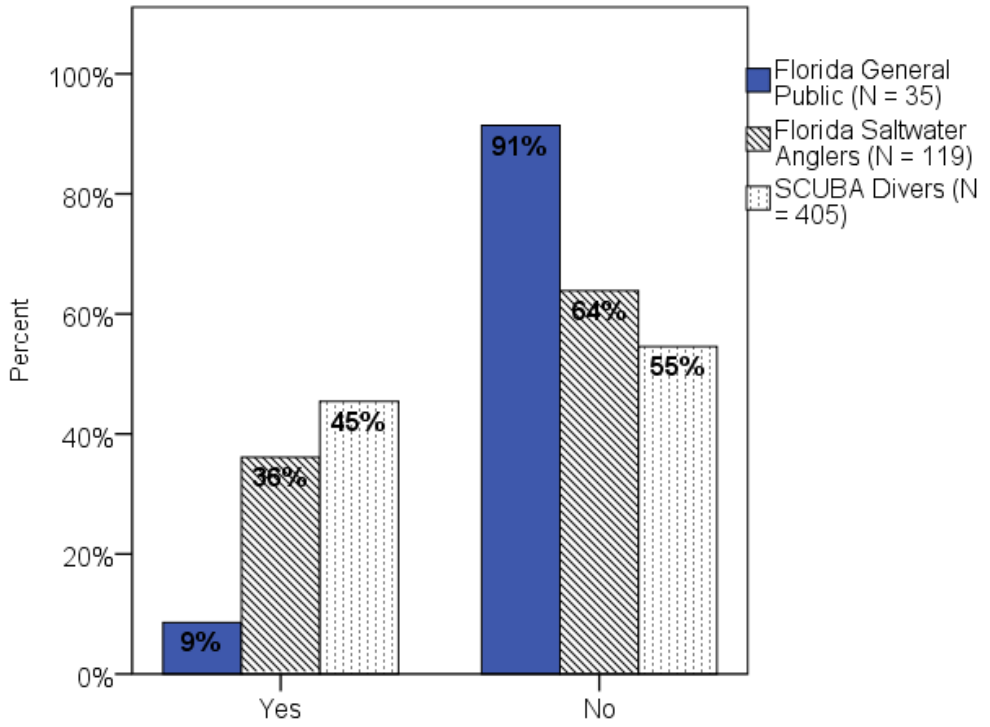

Figure 14. If you have ever seen lionfish while diving or snorkeling, have you ever removed a lionfish?

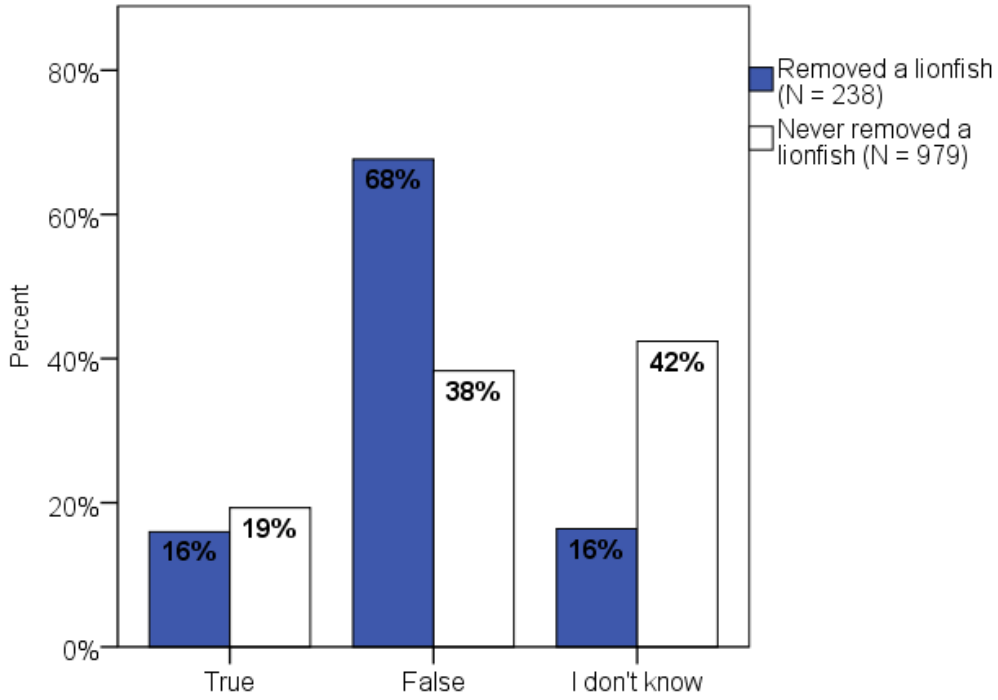

Figure 15. True or False? You must have a recreational fishing license to legally remove lionfish in Florida using a spear or handheld net.

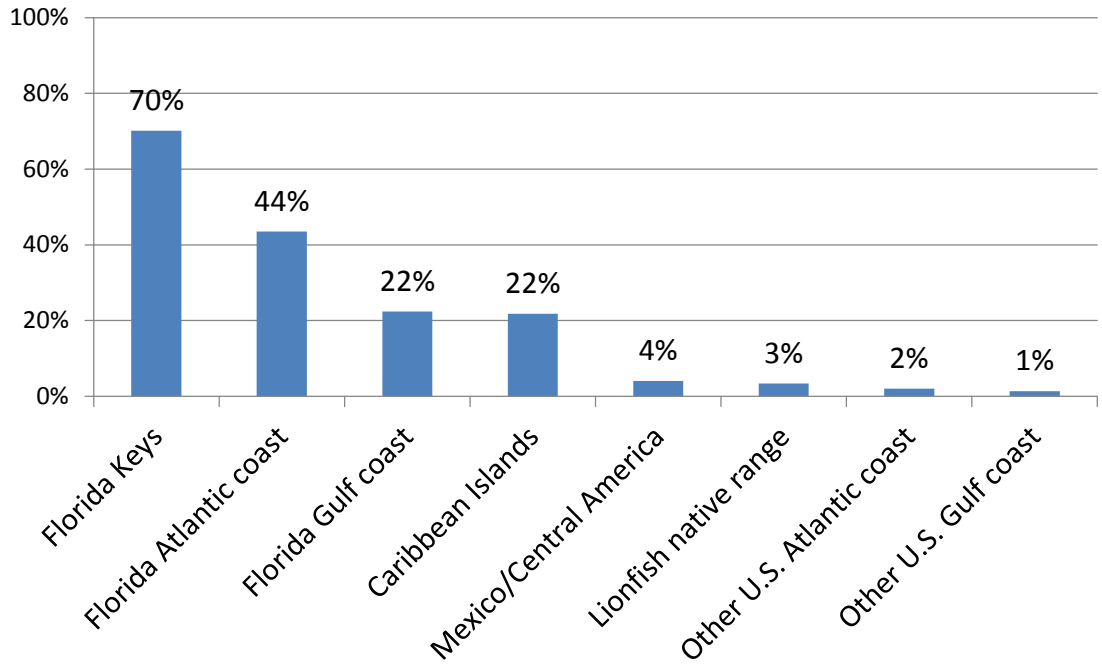

Figure 16. Locations where respondents reported removing lionfish while SCUBA diving or snorkeling (*N* = 147).

Table 9. Gear used to remove lionfish (n = 235)

Type of Gear	**Percent who report using it**	**Percent who report it as only or preferred method**
Pole spear	68%	55%
Hawaiian sling	31%	17%
Handheld net	23%	10%
Other spearing device designed for lionfish	19%	10%
Spear gun*	9%	6%
Dive knife*	2%	0.4%
Other gear	5%	2%

** These were write-in responses. Actual percentages may be higher.*

Nearly all respondents (94%) who had removed lionfish said that one of their reasons was "To remove an invasive species from the reef ecosystem." In addition, more than 50% said that eating lionfish was one of their reasons for removing them. Approximately a third of respondents gave each of the three other reasons listed on the survey (Figure 17). "Other" reasons people gave for removing lionfish included the following:

- At the time I had aquarium set up and I put them in the aquariums.
- Education purposes of locals around us
- I feel other divers aren't hunting them enough to control their spread.
- I was turning a blind eye to the act I was committing.
- It was hurt.
- Lionfish prey upon ornamental fish which I collect.
- Lionfish tournaments

- They get in lobster holes in the Keys, not only a danger to human hands but they run the lobster and grouper out of the hole.

Respondents who indicated they *had seen a lionfish* while diving or snorkeling but *had never removed one* (*N* = 318) were asked their reasons for *not removing lionfish* (Figure 18). Overall, 69% said it was because they did not have appropriate gear, 38% said they did not spearfish, 22% said they were afraid of getting stung, 16% said that lionfish was not their target species, 6% said they had only seen lionfish in their native range, 5% said they did not have enough dive time, and 10% gave other reasons (e.g., they didn't know about lionfish or that it was legal to remove them, they don't feel comfortable killing animals, the dive master removed them, or they have killed but not removed lionfish).

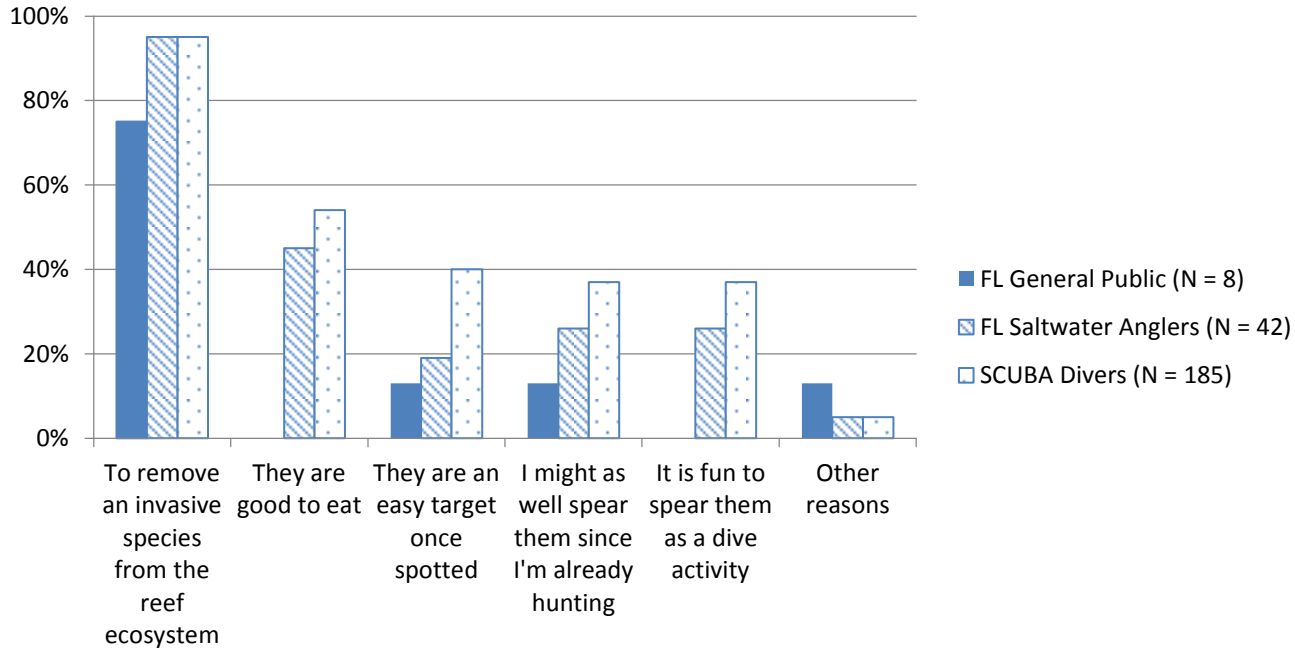

Figure 17. Reasons respondents gave for removing lionfish while SCUBA diving or snorkeling (*check all that apply; N* = 235).

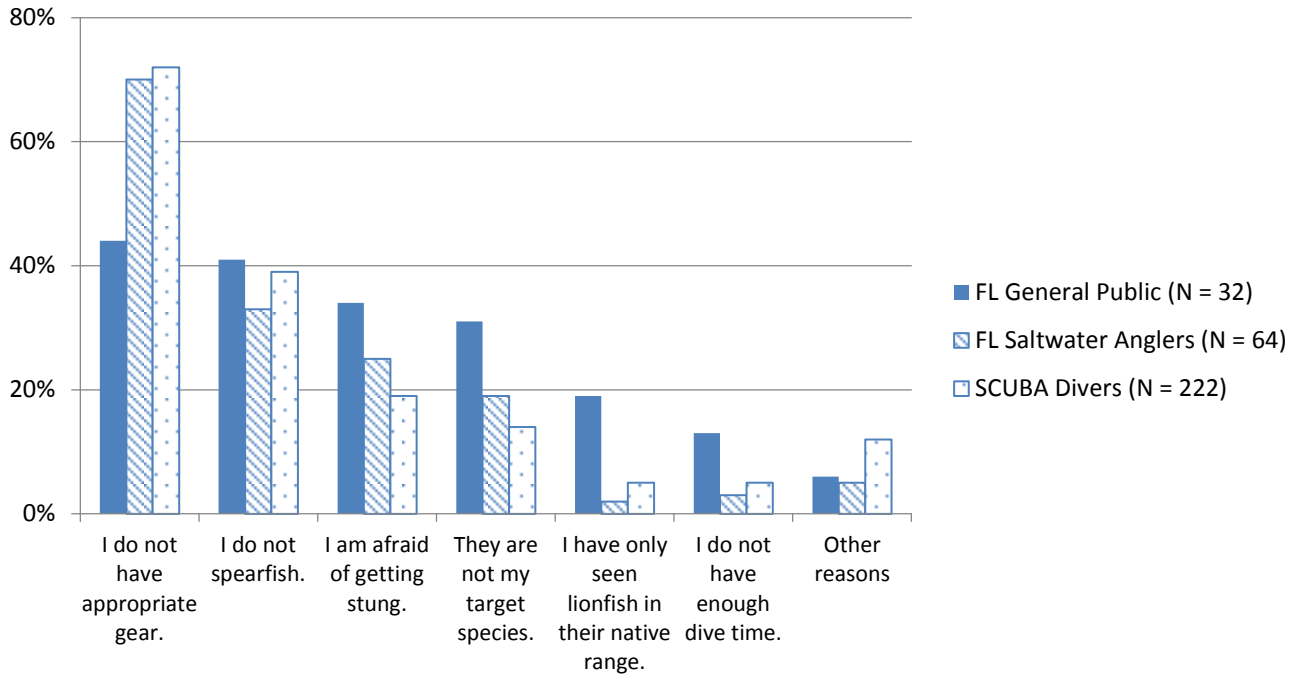

Figure 18. Reasons respondents gave for *not removing lionfish* while SCUBA diving or snorkeling (*check all that apply; N* = 235).

Other Experiences with Lionfish

Majorities of all groups (51% general public, 65% saltwater anglers, 57% SCUBA divers) reported that they had talked with other people about lionfish "a few times" during the past year, but groups differed significantly on this variable ($\chi^2 = 162.7$, $p < .001$; Figure 19).

Even among SCUBA divers, only 18% had heard about FWC's Report Lionfish App, and only 4% had downloaded it (Table 10). Nearly one-third of SCUBA divers had eaten lionfish, 18% had fileted a lionfish, and 11% had ordered lionfish on a restaurant menu. These percentages were much lower (all in single digits) among anglers and the general public.

We asked respondents how likely they would be to take lionfish-related actions in the future. The same response pattern held (SCUBA divers most likely, followed by anglers, followed by general public; Table 11). However, other than talking to others about lionfish (mean response 4.3), SCUBA divers' mean responses were all below "likely." Saltwater anglers' mean responses were between "unlikely" and "undecided," and general public mean responses were between "very unlikely" and "unlikely." Members of the general public were more likely than the other two groups to say they would keep a lionfish in an aquarium.

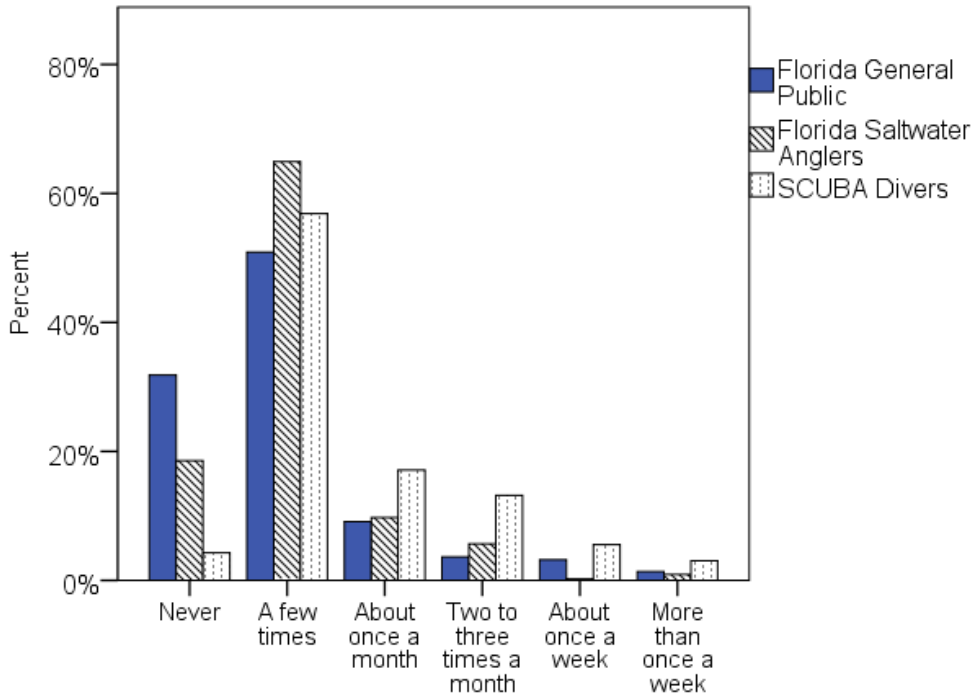

Figure 19. How often have you talked with other people about the lionfish invasion during the past year?

Table 10. Percent of respondents who have taken actions related to lionfish.

Action	**Florida General Public (*N* = 422)**	**Saltwater Anglers (*N* = 508)**	**SCUBA Divers (*N* = 593)**	χ^2
	% reporting they had taken the action			
Heard about the "Report Florida Lionfish" App for smart phones	4%	12%	18%	43.6***
Downloaded the "Report Florida Lionfish" App for smart phones	1%	1%	4%	6.7*
Eaten a lionfish	1%	7%	30%	205.2***
Ordered lionfish on a restaurant menu	0.2%	3%	11%	64.1***
Fileted a lionfish	1%	4%	18%	123.0***
Cooked a lionfish	0.2%	4%	17%	113.8***
Kept a lionfish in an aquarium	5%	5%	7%	4.9

* p <.05, ** p <.01, *** p <.001

Table 11. Respondents' reported likeliness of taking future actions related to lionfish.

Action	Florida General Public (*N* = 422)	Saltwater Anglers (*N* = 508)	SCUBA Divers (*N* = 593)	*F*-value
	Mean (SD) on five-point scale (1= very unlikely, 2=unlikely, 3=undecided, 4=likely, 5=very likely)			
Talk with others about the lionfish invasion	3.6 [a] (1.1)	3.8 [b] (1.0)	4.3 [c] (0.8)	70.0***
Download the "Report Florida Lionfish" App for smart phones	2.8 [a] (1.2)	2.9 [a] (1.2)	3.3 [b] (1.2)	25.1***
Eat a lionfish	1.7 [a] (1.0)	2.6 [b] (1.5)	3.6 [c] (1.5)	232.3***
Order lionfish on a restaurant menu	1.7 [a] (0.9)	2.5 [b] (1.5)	3.3 [c] (1.5)	179.7***
Filet a lionfish	1.6 [a] (0.9)	2.4 [b] (1.4)	3.1 [c] (1.5)	163.4***
Cook a lionfish	1.6 [a] (0.9)	2.4 [b] (1.4)	3.2 [c] (1.5)	173.7***
Keep a lionfish in an aquarium	1.7 [a] (1.1)	1.4 [b] (0.8)	1.5 [b] (1.0)	11.6***

*** $p < .001$

Different letters indicate statistically significant differences among groups ($p < .05$) based on post-hoc comparisons.

Attitudes toward Lionfish and Other Invasive Species

The survey asked respondents the extent to which they agreed or disagreed with 19 statements: 10 about lionfish and nine about Florida invasive species more generally. Exploratory factor analysis with Promax rotation (see Russell 2002) of the 19 items extracted four components, which cumulatively explained 65% of the variance in the items. The attitudinal components and individual items comprising them are summarized in Table 12.

The first component represented the attitude that invasive species have intrinsic value and should be left alone (i.e., not controlled). Consistently, the general public manifested this view more than anglers, who manifested it more than SCUBA divers. However, even among the general public, average responses were below the midpoint of the scale. Between 14% and 27% of general public respondents agreed with each of the seven statements.

The second component included three statements measuring fear of eating and encountering lionfish. The general public was significantly more fearful than anglers, who were more fearful on average than SCUBA divers. The SCUBA divers, who have the most experience both encountering and eating lionfish, expressed little fear; average responses hovered around "disagree." Anglers expressed more uncertainty about whether eating lionfish posed dangers from toxins and venom.

The third component represented the viewpoint that lionfish pose a serious threat to Florida's ecosystems and fisheries. Again, the three groups differed significantly from each other on every item. SCUBA divers strongly endorsed these beliefs, averaging between "agree" and "strongly agree" for each statement. Anglers' responses averaged slightly above "agree," while general public responses averaged slightly below "agree."

The fourth component represented a supportive attitude toward control and prevention of invasive species in Florida. All groups were moderately supportive of invasive species control. The groups all agreed similarly that "Regulations on pet ownership can help prevent the introduction of nonnative species into Florida's environment." Divers and anglers were more likely than the general public to believe that "Preventing the establishment of new nonnative species should be a top priority for wildlife managers" and "Control of some wildlife is necessary to help conserve Florida's natural ecosystems." SCUBA divers were the most concerned about invasive species and most likely to believe in the ecological importance of native species.

Finally, we asked respondents two additional questions to understand their views of lionfish management (Figures 20 and 21). Majorities of all groups (55% general public, 62% anglers, 60% SCUBA divers) said they thought it was "probably not" possible to eradicate (completely remove) lionfish from Florida's waters. However, general public respondents were significantly less likely to think "definitely not," and more likely to be undecided, than anglers or divers ($\chi^2 = 49.4$, $p < .001$; Figure 20). SCUBA divers were more likely than the other two groups to think that state agencies are not doing enough to control the lionfish population in Florida ($\chi^2 = 60.3$, $p < .001$; Figure 21). Many respondents in all groups were uncertain about whether state agencies were doing enough to control lionfish.

Table 12. Three Survey Groups' Attitudes toward Lionfish and Other Invasive Species in Florida.

	FL General Public (*N* = 422)	**FL Saltwater Anglers (*N* = 500)**	**SCUBA Divers (*N* = 548)**	***F*-value**
	Mean (SD) on 5-point scale (1= strongly disagree, 2=disagree, 3=neither agree nor disagree, 4=agree, 5=strongly agree)			
Component 1: Invasive Species have Intrinsic Value and Should be Left Alone *(Cronbach's α = .92)*				
I feel that lionfish have the right to live in Florida's waters.	2.6 [a] (1.1)	1.8 [b] (0.8)	1.6 [c] (0.8)	166.4***
I feel it is wrong to kill lionfish that are found in Florida's waters.	2.7 [a] (1.2)	1.6 [b] (0.8)	1.3 [c] (.8)	267.6***
If we leave lionfish alone, Florida's coastal ecosystems will balance themselves naturally.	2.5 [a] (1.0)	1.9 [b] (1.0)	1.8 [c] (1.0)	71.4***
Invasive species have as much right to exist in Florida as native plants and animals.	2.5 [a] (1.1)	1.7 [b] (0.8)	1.5 [c] (0.8)	150.5***
I feel that it is wrong to kill wildlife, even if it is an invasive species.	2.7 [a] (1.2)	1.7 [b] (0.9)	1.5 [c] (0.8)	199.1***
Invasive species are as important to Florida's ecosystems as other plants and animals.	2.6 [a] (1.1)	1.7 [b] (0.9)	1.6 [c] (0.8)	143.5***
Wildlife managers should worry less about getting rid of invasive species and just let nature run its course.	2.4 [a] (1.1)	1.7 [b] (0.8)	1.6 [c] (0.7)	123.3***
Component 2: Fear of Lionfish *(Cronbach's α = .86)*				
I would be afraid to eat a lionfish because I think it may contain toxins like mercury or ciguatera.	3.7 [a] (1.1)	2.7 [b] (1.2)	2.1 [c] (1.1)	231.6***
I would be afraid to eat a lionfish because I think it may contain venom.	3.8 [a] (1.0)	2.7 [b] (1.2)	2.0 [c] (1.2)	303.7***
I would feel scared if I saw a lionfish while diving or snorkeling.	3.4 [a] (1.1)	2.4 [b] (1.1)	1.6 [c] (0.9)	389.5***
Component 3: Lionfish are a Serious Threat to Florida's Ecosystems and Fisheries *(Cronbach's α = .76)*				
There are large numbers of lionfish in the waters surrounding the state of Florida.	3.6 [a] (0.7)	3.8 [b] (0.8)	4.3 [c] (0.8)	106.6***
Lionfish threaten Florida's commercial fisheries by reducing game fish populations.	3.9 [a] (0.9)	4.1 [b] (0.9)	4.3 [c] (0.9)	17.4***
Lionfish are harmful to Florida's coastal ecosystems.	3.9 [a] (0.9)	4.2 [b] (0.9)	4.5 [c] (0.8)	51.6***
Lionfish may greatly reduce populations of native fish species.	3.9 [a] (0.9)	4.1 [b] (1.0)	4.4 [c] (0.8)	46.1***
Component 4: Support for Invasive Species Control in Florida *(Cronbach's α = .73)*				
Regulations on pet ownership can help prevent the introduction of nonnative species into Florida's environment.	3.9 (0.8)	3.9 (1.1)	4.0 (1.1)	1.0
Preventing the establishment of new nonnative species should be a top priority for wildlife managers.	3.9 [a] (0.8)	4.1 [b] (0.8)	4.1 [b] (0.9)	12.9***
Invasive species in Florida are a concern to me.	3.8 [a] (0.8)	4.1 [b] (0.8)	4.4 [c] (0.8)	58.2***
Control of some wildlife is necessary to help conserve Florida's natural ecosystems.	4.0 [a] (0.8)	4.4 [b] (0.7)	4.5 [b] (0.7)	52.5***
Native plants and animals are more important to an ecosystem than nonnative plants and animals.	3.8 [a] (0.9)	4.1 [b] (1.0)	4.3 [c] (1.0)	22.1***

*** $p < .001$

Different letters indicate statistically significant differences among groups ($p < .05$) based on post-hoc comparisons.

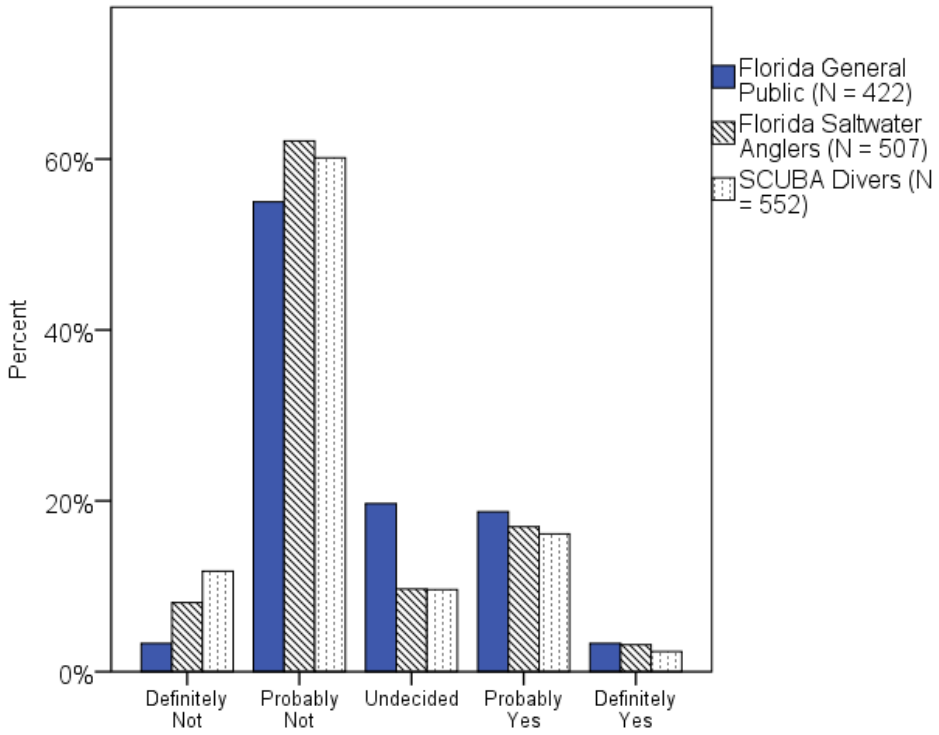

Figure 20. Do you think it is possible to eradicate (completely remove) lionfish from Florida's waters?

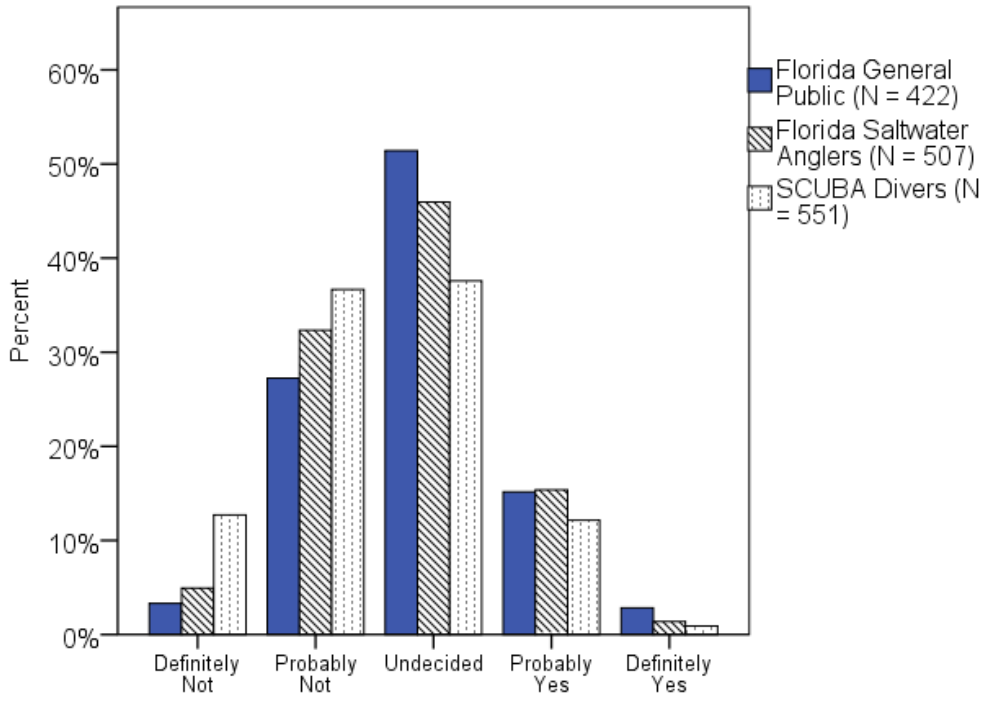

Figure 21. Do you think that state agencies are doing enough to control the lionfish population in Florida?

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Appendix 1: Newspapers and Television Shows/Channels Listed as Information Sources about Lionfish

Newspaper Name	Frequency
Sun Sentinel	13
Miami Herald	10
Tampa Bay Times	10
Palm Beach Post	8
Orlando Sentinel	7
Florida Times-Union	5
Tampa Tribune	5
Florida Today	4
Fort Myers News Press	4
Keys newspaper (unspecified)	4
Florida Sportsman Magazine	3
Keynoter	3
Pensacola News Journal	3
TCPalm	3
Bradenton Herald	2
Daytona Beach News Journal	2
Diver Magazine	2
Free Press	2
Key West Citizen	2
Keys News	2
Naples Daily News	2
North Port Sun Herald	2
New York Times	2
Bay Beacon	1
Buffalo News	1
Charlotte Sun	1
Citrus County Chronicle	1
Coastal Angler	1
Daily News	1
Gainesville Sun	1
Herald Tribune	1
Huffington Post	1
Jacksonville News Journal	1
Northwest Florida Daily News	1
Panama City News Herald	1
Washington Post	1
Waterline	1

TV Show or Channel Name	Frequency
News (unspecified)	23
Local news (unspecified)	18
National Geographic	10
Discovery Channel	8
Shark Tank	7
Fishing shows (unspecified)	5
Animal Planet	4
NBC News	4
WFTV 9 (Orlando)	4
WPTV News	4
ABC News	3
Florida (Saltwater) Fishing Report	3
FOX 13 News (Tampa)	3
Sportsman's Adventures	3
Sunsports	3
Bizarre Foods	2
Florida Sportsman	2
FOX 35 News (Orlando)	2
FOX News	2
Outdoor Channel	2
PBS NEWS	2
WEAR 3	2
WESH 2 News	2
WPEC 12	2
ABC 3	1
ABC 7 Local News	1
ABC Action News	1
Anglers Digest	1
Arte	1
Bay News 9	1
BBC	1
CBS 12 NEWS	1
CBS 6 News	1
CBS-Miami	1
Chevy Florida Fishing Report	1
Cubs News	1
DNR	1
ESPN	1
First Coast News	1
Fishing in the Flats	1
Florida Fisherman	1
Florida Sportfishing TV	1
FOX Sports angler shows	1
GA aquarium program with Jeff Corran	1
George Poveromo	1
Into The Blue	1
Keys Public Service Channel	1
Local news (Naples/Fort Myers)	1
Local news (Palm Beach)	1
NBC 2 News	1
NBC 5 News (Palm Beach)	1
New product show with Lori Grenier	1
Nova	1
Off the Hook : Extreme Catches	1
Saltwater TV	1
SCUBA Nation	1
Sun Network	1
Tanked	1
WFTS	1
WINK local news	1
WPLG Local 10 (Miami/Ft Lauderdale)	1
WTSP 10	1
WUCF	1

Appendix 1: Map of Florida Regions Used to Group Respondents based on Geographic Location of Residence.