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Mudge, C.[1], Ribbeck, A.[2], Kirk-Ballard, H.[3], , Fontenot, K.[4], , Burnett, M.[5], and Foster, M.[6]

[1]Research Biologist, U.S. Army Engineer Research and Development Center, Baton Rouge, Louisiana, 70803[1]Assistant

[2]Communication Specialist, LSU AgCenter, Baton Rouge, Louisiana, 70803

[3]Assistant Professor and Extension Specialist, University of Georgia, Statham, Georgia, 30666

[4]Professor, Louisiana State University Agricultural Center, Rayne, Louisiana, 70578

[5]Professor, LSU AgCenter, Baton Rouge, Louisiana, 70803

[6]Professor, LSU AgCenter, St. Gabriel, Louisiana, 70776

Determining Louisiana Resident Perceptions Regarding Aquatic Invasive Plant Species and Their Management to Aid the Development of Future Extension Programs

Abstract

Understanding public perceptions of invasive species in Louisiana is vital for guiding management and education. This study assessed adult residents' views on invasive aquatic plants and their management. Registered residential boaters were selected as the target audience since they most likely have encountered invasive aquatic plants. Most respondents were aged 60 or older. Giant salvinia, common salvinia, and water hyacinth were the most widely recognized species. The Louisiana Department of Wildlife and Fisheries website was identified as the most effective information source. Older adults and those involved in environmental organizations showed stronger support for management efforts. Many boaters considered invasive aquatic plants a major and serious problem in Louisiana waterways. These findings will help guide future extension programs.

Key Words: aquatic invasive species, extension education, invasive aquatic plant management, Louisiana boaters, public perception

Introduction

Aquatic invasive species (AIS) are nonnative plants, animals, and other organisms that harm ecosystems, economies, or public health (USFWS 2021), causing more than $14 billion in damage from 1960 to 2017 (Crystal Ornelas 2021). Louisiana's 2.5 million acres of wetlands and more than 125,000 miles of rivers, bayous, and streams, combined with its subtropical climate and long growing season, make the state especially vulnerable to AIS establishment (Demas and Demcheck 1996; RTI International 2016; Louisiana Department of Wildlife and Fisheries 2015). Four of the 12 most destructive invasive species in the United States occur in Louisiana, including hydrilla (Stein and Flack 1996). Water hyacinth, introduced in the late 1800s, remains one of the state's most damaging invasive plants (Louisiana Sea Grant 2025).

AIS enter and spread through multiple pathways. The aquarium and water gardening industries are major contributors, often through mislabeling and improper disposal or "aquarium dumping," which has contributed to the spread of giant salvinia, hydrilla, and other species (Padilla and Williams 2004; Kay and Hoyle 2001; Kravitz et al. 2005). Recreational activities such as boating, fishing, and hunting also facilitate spread (Kubeck 2008). Plant fragments can survive for days on boats and trailers, aiding dispersal of hydrilla, common salvinia, and giant salvinia (Johnstone et al. 1985; Jerde et al. 2012; Darnell 2022; Kravitz et al. 2005; LDWF 2015). Public education on proper boat washing practices is recommended to reduce the spread (Kelly et al. 2013). Additional pathways include river diversions, transportation corridors, baitfish and sportfish introductions, and agricultural activities (Kravitz et al. 2005).

Once established, invasive aquatic plants outcompete native species, degrade water quality, obstruct navigation, limit recreation, and damage fisheries and waterfowl habitat (Mack et al. 2000; Mudge and Ribbeck 2021; Sanders et al. 2010). Under Executive Order 13,751, invasive species are defined as those causing economic, environmental, or health-related harm (Federal Register 2016). Public awareness is essential for prevention and management, as individuals with prior knowledge are more likely to

support control efforts (Bremner and Park 2007; Novoa et al. 2017; Wilson 2012). Although Louisiana's State Management Plan emphasizes citizen-focused education, funding remains limited (Kravitz et al. 2005), and public perceptions of AIS in the state remain largely undocumented (Anifowose and Fagorite 2020). Studies in other states highlight the importance of understanding social awareness and behaviors to guide outreach (Oxley et al. 2016; Williams et al. 2021; Wilson 2012).

This study examines Louisiana residents' perceptions of AIS and their management, with emphasis on awareness and recreational behaviors. Findings will help Extension professionals develop targeted educational tools and identify trusted sources for effective outreach.

Methods

A 21-question survey was developed to assess Louisiana boaters' knowledge and perceptions of aquatic invasive species (AIS) and their management (Ribbeck 2023). Survey items addressed participant hobbies, familiarity with AIS, information sources, perceived impacts, opinions on control methods (chemical, mechanical, biological), and trusted information sources. The instrument was adapted from Wilson (2012), Bremner and Park (2007), and Oxley et al. (2016), and reviewed by experts to ensure content validity. The study received Institutional Review Board exemption (IRB 22-0002).

The target population included adult Louisiana residents (Richard 2009), estimated at 3,560,976 (U.S. Census Bureau 2019). Because recreational boating is a primary vector for AIS spread in Louisiana waterways (Kelly et al. 2013; Kravitz et al. 2005), a non-probability purposive approach was used to survey a random sample of registered Louisiana residential boaters through the Louisiana Department of Wildlife and Fisheries (LDWF), a subset of the target population.

The survey was administered in August 2022, when invasive aquatic plants are actively growing and most visible in Louisiana waterways. A random sample of 6,000 registered residential boaters (311,442 total statewide) received mailed postcards containing a QR code linking to the online survey (S. Byrd, personal communication, 2022). Mailing services were coordinated through the Office of Technology Services (OTS) Production Support Services Enterprise Print Center. Participants were given one month to respond, and no incentives were offered. Data was collected using Qualtrics and analyzed in IBM SPSS. A total of 230 usable responses were obtained, exceeding Cochran's (1977) minimum sample size requirement of 150.

The survey instrument is available in the appendix of Ribbeck's (2023) thesis. https://repository.lsu.edu/cgi/viewcontent.cgi?article=6807andcontext=gradschool_theses

Non-demographic items used structured rating scales. Familiarity and perceived seriousness were measured on a five-point scale (1 = no familiarity/not at all serious to 5 = extreme familiarity/extremely serious). Information exposure was measured on a four-point scale (1 = no information to 4 = a large amount of information). Management perceptions were measured using a five-point Likert-type scale (1 = strongly disagree/strongly oppose to 5 = strongly agree/strongly favor), and overall perception scores were calculated as scale means. Participants also ranked AIS information sources.

To examine relationships between hobbies (boating, hunting, and gardening) and management perceptions, relational and comparative analyses were conducted. Spearman's rank-order correlation was used for interval-level variables. Perception scores were compared across categorical variables, and independent-samples t-tests were used for binary variables.

Results and Discussion

Demographic Characteristics of Survey Respondents

Two hundred and thirty surveys were collected and found usable. Of the 206 respondents who identified their age, the largest group of respondents was 60 years of age or older (58.3%). The second largest group of respondents identified their age as 50-59 (21.8%) (Ribbeck 2023). Of the 203 respondents who reported their employment status, the largest percentage was employed full-time (49.3%). Respondents identifying their employment status as retired (47.8%) comprised the second largest group (Ribbeck 2023). Only six respondents were employed part-time or unemployed (Ribbeck 2023). Most respondents (96.5%) included fishing as an outdoor activity in which they participated. Additionally, of the 202 respondents answering the hobby question, 146 (72.3%) included hunting as an outdoor activity in which they participated (Table 1).

Table 1. Participation in outdoor activities by adult Louisiana residents who were registered boaters.

Outdoor Activity	Frequency[a]	Percent[b]
Fishing	195	96.5
Hunting	146	72.3
Gardening	132	65.3
Hunting, Fishing and Gardening	96	47.5
Hunting and Fishing	47	23.3
Fishing and Gardening	31	15.3
Hunting and Gardening	1	0.5

[a]A total of 202 participants responded to this item. 28 did not report their participation in gardening, fishing, and hunting.

[b]Percentages do not total to 100 since respondents were asked to mark all that apply.

Perceptions Regarding Awareness and Impacts of Invasive Aquatic Plant Species

Respondents were asked to provide an example of an invasive aquatic plant in Louisiana if they knew of one. A total of 159 respondents correctly provided an example of one or more invasive aquatic plants. The most frequently identified plant was salvinia, known as giant and/or common salvinia (48.2%). The next most frequently identified plant was water hyacinth (37.1%) (Table 2).

Table 2. Invasive aquatic plants identified by adult Louisiana residents who were registered boaters.

Invasive Aquatic Plant	Frequency[a]	Percent
Salvinia (Giant and Common)	82	48.2
Water Hyacinth	63	37.1
Hydrilla	17	9.9
Duckweed	3	1.8
Alligator Weed	3	1.8
Crested Floating Heart	1	0.6
Water Lettuce	1	0.6
Total	170	100.0

[a]159 registered boaters reported one or more invasive aquatic plant species. A total of 170 invasive aquatic plant species were reported.

Participants were asked to rate the amount of information they were exposed to (reading about or listening to programs about) regarding AIS on a scale of 1-4. The following interpretive scale was established to aid in the interpretation of the findings: 1.50 or less = “none,” 1.51 to 2.49 = “small amount,” 2.50 to 3.49 = “moderate amount”

and 3.50 or higher = “a large amount.” The invasive aquatic plant species about which the respondents reported knowing the greatest amount of information was “water hyacinth” with a mean of 2.65 (SD = 1.01). Using the interpretive scale, this item was classified as “moderate amount” along with “Giant salvinia” (mean = 2.63, SD = 1.05). In addition to the “moderate amount” category, four items were listed in the “small amount” category, and one item was in the “none” category (Table 3).

Table 3. Amount of plant information heard or read about, as reported by adult Louisiana residents who were registered boaters[a].

Invasive Aquatic Plant	Frequency	Mean (Standard Deviation)[b]	Category[c]
Water Hyacinth	211	2.65 (1.01)	Moderate Amount
Giant Salvinia	205	2.63 (1.05)	Moderate Amount
Common Salvinia	206	2.49 (1.03)	Small Amount
Hydrilla	208	2.43 (0.92)	Small Amount
Water Lettuce	208	1.79 (0.86)	Small Amount
Crested Floating Heart	209	1.51 (0.79)	Small Amount
Cuban Bulrush	209	1.43 (0.74)	None

[a]Range of responses was 1 to 4 for all listed invasive aquatic plants.

[b]Response scale included the following possible values: 4 = large amount, 3 = moderate amount, 2 = small amount, 1 = none.

[c]Interpretive scale included the values: 1.50 or less = none, 1.51 to 2.49 = small amount, 2.50 to 3.49 = moderate amount, 3.50 or higher = large amount.

Louisiana Registered Boaters' Perceptions Regarding the Management of Invasive Aquatic Plant Species

Respondents were asked their opinions on a series of management-related questions. They were asked to report their opinion for each statement on a Likert-type scale of 1-5.

The following interpretive scale was established to aid in the interpretation of the findings: 1.50 or less = “strongly disagree,” 1.51 to 2.49 = “disagree,” 2.50 to 3.49 = “neither agree nor disagree,” 3.50 to 4.49 = “agree,” and 4.50 or higher = “strongly agree.”

All four of the items included in this question received responses that were classified in the “strongly agree” category. “Invasive aquatic plant species should be controlled when they cause harm to Louisiana’s native plants and animals,” with a mean of 4.88 (SD = 0.39), was rated highest (Table 4). To further examine the data from this series of items, an overall perception of registered boaters regarding the management of invasive aquatic plants score was established as the mean of the four items in the scale. The overall perception score was 4.81 (SD = 0.43) with individual scores ranging from 2.0 to 5.0.

Table 4. Respondents reported opinions on invasive aquatic plant management statements.

Item	Mean (± Standard Deviation)[a]	Category[b]
Invasive aquatic plant species should be controlled when they cause harm to Louisiana's native plants and animals.	4.88 (0.39)[c]	Strongly Agree
Invasive aquatic plant species should be controlled when they cause economic damage to Louisiana.	4.87 (0.44)[d]	Strongly Agree
Controlling some invasive aquatic plant species is necessary to help conserve Louisiana's environment.	4.81 (0.51)[c]	Strongly Agree
Protecting Louisiana waterways from invasive aquatic plants should be a Louisiana state government priority.	4.68 (0.66)[d]	Strongly Agree

[a]Response scale of 1 to 5 included the following possible values: 5= strongly agree, 4= agree,
3 = neither agree nor disagree, 2 = disagree, 1 = strongly disagree.

[b]Interpretive scale included the values: 1.50 or less = strongly disagree, 1.51 to 2.49 = disagree, 2.50 to 3.49 = neither agree nor disagree, 3.50 to 4.49 = agree, 4.50 or higher = strongly agree.

[c]n = 211.

[d]n = 210.

Participants were asked for their opinions on invasive aquatic plant control methods, including aquatic herbicide, mechanical control, biological control, and drawdowns. The control method with the highest rating was mechanical harvesting, with a mean of 4.44 (SD = 0.76), while the control method rated the lowest was drawdowns, with a mean of

3.47 (SD = 1.22) (Table 5). As a follow-up, respondents were asked if method of control (aquatic herbicide, mechanical, biological, or drawdown) would have an influence on their decision to support a given invasive aquatic plant management project in Louisiana waterways. One hundred and eight boaters (51.7%) reported that the chosen method of control would impact their decision to support these projects (Ribbeck 2023). Slightly less (48.3%) reported that the chosen method of control would not impact their decision to support these projects.

Table 5. Opinions on invasive aquatic plant control methods from adult Louisiana residents who were registered boaters.

Control Method	Mean (± Standard Deviation)[a]	Category[b]
Mechanical harvesting methods (use of machines)	4.44 (0.76)[c]	Somewhat Favor
Biological control methods (use of insects, fish, diseases, and other bio agents)	3.93 (1.00)[c]	Somewhat Favor
Aquatic herbicide control methods (use of chemicals)	3.88 (1.17)[d]	Somewhat Favor
Drawdowns (process to lower water levels for a period of time)	3.47 (1.22)[d]	Neither Favor nor Oppose

[a]Response scale of 1 to 5 included the following possible values: 5= strongly favor, 4= somewhat favor, 3 = neither favor nor oppose, 2 = somewhat oppose, 1 = strongly oppose.

[b]Interpretive scale included the values: 1.50 or less = strongly oppose, 1.51 to 2.49 = somewhat oppose, 2.50 to 3.49 = neither favor nor oppose, 3.50 to 4.49 = somewhat favor, 4.50 or higher = strongly favor.

[c]n = 207.

[d]n = 208.

Louisiana Registered Boaters' Perceptions Regarding Use and Effectiveness of Selected Information Sources

Respondents were asked if they had heard or read about invasive aquatic plants from 15 different sources. The information sources were ranked by the number of times each was reported to have been used as an information source. "Friends and family" were reported the most frequently (45.7%), followed by the LDWF website (40%) (Table 6).

Respondents also selected and ranked three sources of information from the previous item that they considered most effective at providing information on AIS education and prevention. The following analysis procedure was utilized. Each information source ranked first was assigned a value of 15, as fifteen sources were included in the list. Any information source not ranked first was assigned a value of zero. The "LDWF website" (30.4%) was the information source ranked first by the largest number of respondents, and "LDWF social media" (11.3%) was ranked first by the second-largest number of respondents. (Table 6). Information sources ranked second by the respondents were assigned a value of 14. Any information source that was not ranked second was assigned a value of zero. The information source ranked second by the largest number of respondents was the "LSU AgCenter website" (12.2%) with the "LDWF website" (11.7%) ranked second by the second largest number of respondents (Table 6). Finally, information sources that were ranked third by the respondents were assigned a value of 13. All others were assigned a value of zero. The information source ranked third by the largest number of respondents was "Signs at Boat Ramps" (9.6%), with "Television" (9.1%) ranked third by the second largest number of respondents (Table 6).

Table 6. Invasive aquatic plant information sources ranked by most mentions and ranked effectiveness of sources by adult Louisiana residents who were registered boaters[a].

Information Source	Ranking 1st		2nd		3rd		Most Mentions	
	n	%	n	%	n	%	n	%
LDWF Website	70	30.4	27	11.7	12	5.2	92	40
LDWF Social Media	26	11.3	25	10.9	10	4.3	43	18.7
Television	18	7.8	12	5.2	21	9.1	62	27.0
Signs at Boat Ramps	18	7.8	8	3.5	22	9.6	61	26.5
LSU AgCenter Website	16	7	28	12.2	17	7.4	32	13.9
Other Websites	7	3	5	2.2	11	4.8	50	21.7
Magazines/Journals	6	2.6	13	5.7	15	6.5	81	35.2
YouTube	6	2.6	6	2.6	9	3.9	1	0.4
Other Social Media	3	1.3	15	6.5	14	6.1	56	24.3
LSU AgCenter Social Media	3	1.3	11	4.8	11	4.8	21	9.1
Other	3	1.3	0	0	6	2.6	24	10.4
Newspapers	2	0.9	12	5.2	6	2.6	48	20.9
Radio	2	0.9	4	1.7	6	2.6	14	6.1
Events/Conferences	0	0	5	2.2	7	3.0	19	8.3
Friends and Family	0	0	0	0	0	0	105	45.7

[a]Total number of respondents = 230.

Conclusion

The invasive aquatic plant identified most frequently by respondents was salvinia (giant and common), followed by water hyacinth (Table 2). Respondents also reported knowing “moderate amounts” of information about water hyacinth and giant salvinia (Table 3). Giant and common salvinia have established in nearly every parish in Louisiana (Moshman and Diaz 2019; Louisiana Department of Wildlife and Fisheries

2015), and water hyacinth was the first documented AIS in Louisiana and has the most documented observations to date (Anifowose and Fagorite 2020; Sanders et al. 2010). The sheer population of these AIS is likely the reason they are so widely identified and known by Louisiana boaters. Future extension programs should be developed to help Louisiana residents better recognize hydrilla, duckweed, alligatorweed, crested floating heart, and water lettuce, and to communicate the ecological and economic impacts associated with these lesser-known AIS. . Newly created extension documents and programs would best be placed as signs on boat ramps, or on the LDWF and LSU AgCenter's websites, or conducted by agents of either of these agencies, as they were cited as the most trusted sources (Table 6).

Mechanical harvesting was favored the most by boaters to control invasive aquatic plants, while herbicides and drawdowns were favored the least. This aligns with the findings in Oxley et al. (2016), in which cutting down and digging up invasive plant species were favored over the use of herbicides and dredging in the San Marcos River, Texas. In Wilson (2012), boaters reported their most favored control methods for AIS as mechanical and physical, but they also reported that they had the most knowledge about mechanical and physical control methods. Public awareness, knowledge, and support are important social dimensions to consider when creating plans for prevention, management, and control of invasive species (Bremner and Park 2007; Oxley et al. 2016; Novoa et al. 2017; Eiswerth et al. 2011). Previous research by Oxley et al. (2016), Bremner and Park (2007), and Wilson (2012) found that respondents favored certain control methods for invasive species over others. Therefore, creating new extension programs to teach Louisiana boaters about biological controls, aquatic herbicides, and drawdowns may help residents understand and appreciate a wider suite of control methods, potentially leading to more public support for management programs.

Limitations of this Study

These findings should be interpreted with limitations in mind. Since survey respondents were predominantly older (58.3% aged 60 or older), the results may not represent the broader boating population in Louisiana. Also, because the survey targeted registered boaters, the results may not be representative of other groups that utilize Louisiana waterways such as waterfront residents or unregistered boaters such as kayaks, paddlers, and canoes. Since many states face similar challenges with AIS, these findings could be utilized by other agencies to improve education and outreach strategies.

Future Research and Extension Programs

Findings from this study highlight the importance of expanding outreach efforts that increase public awareness and acceptance of integrated aquatic vegetation management strategies. Future research should evaluate the effectiveness of targeted Extension programming designed to improve knowledge of biological controls, aquatic herbicide use, and water level drawdowns among Louisiana boaters and other stakeholders. Aquatic extension specialists and county agents could easily partner to identify high traffic boat ramps throughout the state to place educational signage coordinated with digital content on Louisiana Department of Wildlife and Fisheries (LDWF) and LSU AgCenter websites. The websites linked specifically to the signs could be tracked for user usage and be coupled with short surveys to determine if boaters identification of aquatic invasive species and management strategies improves as a result. Extension agents may also consider using Citizen Science projects using signs with QR code for boaters to report sightings of AIS so that community clean ups and extension programs could occur in the areas with most frequent reportings rather than conducting programs at county agent offices. Tents can be set up for outdoor extension programming when boaters are most active – all determined by what times and days reportings are made on Citizen Science signs. Extension programs like this would reach both registered and unregistered boaters – addressing a specific limitation of this study.

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