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HUMAN DIMENSIONS OF NATURAL RESOURCES LAB | TEXAS A&M UNIVERSITY

AQUATIC INVASIVE SPECIES IN TEXAS FRESHWATERS: A STATEWIDE SURVEY OF RECREATIONAL BOATERS' PERCEPTIONS, PREFERENCES, AND BEHAVIORS

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Kenneth E. Wallen
Gerard T. Kyle

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Several individuals deserve special recognition for their assistance throughout this project. We are appreciative of the special efforts of Monica McGarrity and John Taylor of the Texas Parks and Wildlife Department for their assistance with survey logistics, methodological issues, and for providing us insight on the important aquatic invasive species management issues facing their staff and constituency. Despite the efforts of many others, the authors are solely responsible for any errors or omissions in this report.

KEW
GTK

Cover image: Boat ramp sign in Rains County, TX

Retrieved from: http://tpwd.texas.gov/landwater/water/aquatic-invasives/boat-ramp-signs.phtml

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EXECUTIVE SUMMARY

The purpose of the project was to provide managers and researchers with important information about the human dimensions of aquatic invasives species in Texas. These data represent a collaboration between the Texas Parks and Wildlife Department, Inland Fisheries Division and the Human Dimension of Natural Resources Lab at Texas A&M University to understand aquatic invasives species in Texas from the perspective of recreational boaters' knowledge, awareness, attitudes, beliefs, and behaviors.

METHODS OVERVIEW

- An online questionnaire was sent to 9,500 randomly selected licensed boaters in Texas between July 2016 and August 2016.
- 2,324 questionnaires were returned. Excluding non-deliverable (n = 209) and voluntary opt-outs (n = 682), an effective response rate of 27% was obtained.
- Respondents ranged from age 19–85, averaged 56-year-old, were 90% male, 94% white, and 6% Hispanic, Latino/a, or Chicano/a. Twenty-percent reported a high school diploma or equivalent, 24% a vocational or two-year degree, 36% a four-year degree, and 19% a graduate degree. Sixty-eight percent reported a gross annual income less than $100,000 and 14% less than $60,000.

KEY FINDINGS

BOATING ACTIVITY

- 75% of boaters reported not taking Texas Parks and Wildlife Department's boater education course.
- 75% of boaters reported purchasing a fishing license.
- Between mid-2015 and mid-2016:
  - 10% of boaters reported boating in freshwater and saltwater.
  - 60% of boaters reported boating in multiple waterbodies, fresh or salt.
- 40% of boaters say they boat most often in the Prairie and Lakes region of Texas and 20% in Hill Country.
- 31% of boaters report boating more than 15 times between mid-2015 and mid-2016.
- 42% of boaters report boating multiple freshwater bodies in Texas between mid-2015 and mid-2016.

BOATER KNOWLEDGE AND AWARENESS

- 30% of boaters self-report being very aware of the presence of aquatic invasive species in Texas freshwaters
- 42% of boaters say aquatic invasive species of very common in Texas freshwaters.
- In terms of the threat aquatic invasive species pose to Texas:
  - 75% say aquatic invasives are a very large threat to Texas' freshwaters environments.
  - 58% say aquatic invasives are a very large threat to Texas' economy.
  - 68% say aquatic invasives are a very large threat to freshwater recreation in Texas.

BOATER BEHAVIOR AND CLEAN, DRAIN, DRY™

- 69% report being aware that Texas state laws requires boaters to clean gear and drain boats after using public waterbodies.

- 67% of boaters report that they always removed mud, plants, and animals before transporting boat to another public waterbody (over the past 12 months).
- 49% of boaters report that they always washed their boat and trailer before traveling to another public waterbody (over the past 12 months).
- 78% of boaters report that they always drained water from livewells, bilges, motors, and other receptacles that were in contact with public waters before leaving that waterbody (over the past 12 months).
- 64% of boaters report that they always allowed their boat to dry at least 7-10 days before launching into other public waters (over the past 12 months).

- Boaters indicated that certain perceptions act as *barriers* to them doing clean, drain, and dry behaviors:
  - 47% of boaters *agree* or *strongly agree* with the statement: "I do not think clean, drain, and dry behaviors will slow the spread of aquatic invasive species".
    - 79% of boaters *disagree* or *strongly disagree* with the statement: "I do not think clean, drain, and dry actions are effective".
    - 81% of boaters *disagree* or *strongly disagree* with the statement: "I do not have the ability to do clean, drain, and dry actions".
  - 34% of boaters *agree* or *strongly agree* with the statement: "Public access points or boat ramps are too crowded to do clean, drain, and dry".
    - 14% of boaters *agree* or *strongly agree* with the statement: "There are no stations/spaces to do clean, drain, and dry".
    - 79% of boaters *disagree* or *strongly disagree* with the statement: "I do not have the time, am rushed, or am too tired to do clean, drain, and dry".
  - 23% of boaters *agree* or *strongly agree* with the statement: "I do not know what to look for with regard to aquatic invasive species".

BOATER ATTITUDES AND NORMATIVE BELIEFS

- Boaters expressed positive attitudes towards theirs and other boaters clean, drain, and dry behaviors as a means to reduce or slow the spread of aquatic invasive species:
  - 91% of boaters *agree* or *strongly agree* with the statement: "Boaters clean, drain, and dry behaviors will reduce aquatic invasive species in Texas".
  - 93% of boaters *agree* or *strongly agree* with the statement: "My clean, drain, and dry behavior it will help reduce the spread of aquatic invasive species in Texas".

- Boaters expressed positive moral and social obligations to do clean, drain, and dry behaviors:
  - 93% of boaters *agree* or *strongly agree* with the statement: "I feel a personal obligation to help reduce the spread of aquatic invasive species in Texas".
  - 92% of boaters *agree* or *strongly agree* with the statement: "I feel morally obliged to help reduce the spread of aquatic invasive species in Texas, regardless of what others do".

- 88% of boaters report that they interaction or converse with others boater.
  - However, 48% boaters report they have never discussed aquatic invasives species with other boaters.
  - In addition, 61% of boaters report never they have never discussed clean, drain, and dry behaviors with other boaters.

- 28% of boaters believe other Texas boaters either *never* or *seldom* clean their boat, gear, and trailer and remove any mud, plants, and animals before transporting boat to another public waterbody.
- 39% of boaters believe other Texas boaters either *never* or *seldom* wash their boat and trailer before traveling to another public waterbody.
- 22% of boaters believe other Texas boaters either *never* or *seldom* drain all water from their livewells, bilges, motors, and other receptacles that have been in contact with public waters before leaving that same waterbody.
- 34% of boaters believe other Texas boaters either *never* or *seldom* dry their boat and trailer for at least 7-10 days before launching into other public waters.

- 74% of boaters either *agree* or *strongly agree* that other Texas boaters expect them to clean boat, gear, and trailer and remove any mud, plants, and animals before transporting boat to another public waterbody.
- 67% of boaters either *agree* or *strongly agree* that other Texas boaters expect them to wash boat and trailer before traveling to another public waterbody.
- 76% of boaters either *agree* or *strongly agree* that other Texas boaters expect them to drain all water from livewells, bilges, motors, and other receptacles that have been in contact with public waters before leaving that same waterbody.
- 65% of boaters either *agree* or *strongly agree* that other Texas boaters expect them to dry boat and trailer for at least 7-10 days before launching into other public waters.

IDENTIFYING AQUATIC INVASIVE SPECIES

- 83% of boaters were able to correctly identify Zebra mussel (*Dreissena polymorpha*)
- 52% of boaters were able to correctly identify Water hyacinth (*Eichornia crassipes*)
- 37% of boaters were able to correctly identify Water lettuce (*Pistia stratiotes*)
- 31% of boaters were able to correctly identify Giant salvinia (*Salvinia molesta*)
- 36% of boaters were able to correctly identify Bighead carp (*Hypophthalmichthys nobilis*)

**For more information on Texas' efforts and to combat aquatic invasive species, visit http://tpwd.texas.gov/aquatic-invasives/ or contact the Texas Parks and Wildlife Department.*

INTRODUCTION

Throughout the United States, invasive species are an exigent natural resource management issue (McMichael & Bouma, 2000). Estimates put direct and indirect costs of invasive species management in the United States between $120–143 billion, annually (Pimentel et al., 2005; U.S. Fish & Wildlife Service, 2012). Invasives are defined as species that are non-native (or alien) to the ecosystem under consideration "whose introduction does or is likely to cause economic or environmental harm or harm to human health" (Executive Order No. 13,112, 1999, p. 6183). As such, invasive species continue to receive extensive research and policy attention (Genovesi & Shine, 2004; Lockwood et al., 2013).

Within inland freshwater systems, aquatic invasive species (AIS) threaten the diversity of native species, ecological stability, and the commercial, agricultural, and recreational activities dependent on such waters (Vander Zaden & Olden, 2008). The introduction and establishment of AIS often negatively affect economy, environment, and human health (McNeely, 2001; Pimentel et al., 2005; Ricciardi & MacIsaac, 2011). For example, AIS negatively affect local economies by reducing recreational activities (e.g., boating, fishing) (Johnson et al., 2001), commercial activities (e.g., transportation and fisheries) (Lovell & Stone, 2005), and development interests (e.g., property value and housing markets) (Olden & Tamayo, 2014). Ecological effects manifest as increased predation and competition, introduction of parasitism or pathogens, and significant habitat alteration. Aquatic invasives also negatively affect human health through their role in contributing to, for example, algal blooms and disease outbreaks (Ricciardi & MacIsaac, 2011).

Primary sources (vectors) of AIS introduction into U.S. freshwaters have included ballast water and the pet trade (US Commission on Ocean Policy, 2004). Though limiting introduction and establishment of AIS is the most effective way to lessen their impact (Leung et al., 2002), once introduced and established, preventing their continued spread becomes priority. Within freshwater systems, once established, management focus often shifts to resource users, typically water-based users such as boaters and angles, as the primary AIS vector (Anderson et al., 2015; Kelly et al., 2013; Vander Zanden & Olden, 2008). This focus follows from an understanding that (a) prevention is less expensive than control and (b) vessels and equipment are often unintentional vectors for AIS transportation between waterbodies that would otherwise be unconnected (Whitfield & Becker, 2014).

Recognition of the importance of the human dimensions of invasive species management has led to more human-centered approaches to manage AIS (García-Llorente et al., 2008, Santo et al., 2015; Seekamp et al., 2016). This focus on the actions of resource users requires distinct policy and management approaches, specifically those focused on understanding, influencing, and increasing mitigation behaviors (Hine et al., 2015; McLeod et al., 2015). Recent studies have employed human-centered approaches to understand landowner perceptions, preferences, and support for invasive eradication and restoration programs (Santo et al., 2015), the factors leading live-bait anglers to release baitfish (Drake et al., 2015), and qualitative assessments of individual's conceptualization of and attitude towards invasive species (Selge et al., 2011). Recent projects in the Great Lakes region have assessed boater awareness of and behavior related to AIS (Lee et al., 2015; Connelly et al., 2014). These studies found primarily negative attitudes towards AIS but mixed results related to individuals' AIS mitigation behaviors.

Similar studies echo this variability, finding that stakeholders' attitudes are varied and complex, being partially influenced by experience with invasives (Ford-Thompson et al., 2015).

Others have sought to determine factors that predict support for invasive species management practices. For example, Sharp et al. (2011) found attitude to be a significant predictor of AIS management support. However, the variability in attitude also manifested in management preferences; that is, more ecocentric attitudes preferred hands-off management while other, non-ecocentric attitudes preferred more hands-on management approaches (Sharp et al., 2011). Others have investigated the value orientation of resource users, instead of attitudes, and found those to be significant predictors of past and future AIS mitigation behavior (Pradhananga et al., 2015).

These and other studies have predominantly focused on boaters' knowledge, attitudes, and values, but few have explicitly linked behavior or intention to theory that accounts for normative social influences (McLeod et al., 2015). Relatedly, a considerable body of literature indicates a sole focus on raising awareness and education is not necessarily an effective means to encourage behavior (Bell, 2005; Blake, 1999; Kollmuss & Agyeman, 2002; Schultz, 2011). Many boaters have not yet adopted mitigation behaviors (Rothlisberger et al., 2010) but express attitudes, values, and intentions that align with essential mitigation behaviors. Given these circumstances, boaters may require salient social influences, alongside education and awareness, to initiate behavior. Thus, AIS management may benefit from applying established behavioral theory ground in the social norm literature to understand how and why boaters engage in AIS mitigation behaviors.

In Texas, aquatic invasives species (AIS) are one of the most exigent issues facing natural resource management of freshwater systems (TPWD, 2017). Species such as zebra mussel (*Dreissena polymorpha*), giant salvinia (*Salvinia molesta*), water hyacinth (*Eichornia crassipes*), water lettuce (Pistia stratiotes), and Bighead carp (*Hypophthalmichthys nobilis*) are a growing concern for natural resource management agencies in Texas (Parks & Wildlife Code § 66.0072, 2011). Exacerbating this concern in Texas are AIS within inland freshwaters frequented by resource users whose movement between waterbodies increases the potential for AIS to establish elsewhere (Vander Zaden & Olden, 2008). For instance, recreational boaters who travel to multiple waterbodies but fail to properly check and clean their boat or equipment for possible AIS create potential vectors for AIS (Anderson et al., 2015; Johnson et al., 2001; Kelly et al., 2013; Lee et al., 2015).

Currently, Texas utilizes public awareness campaigns, in particular the Clean, Drain, Dry™ campaign (CDD), and boater education courses to encourage AIS mitigation behaviors among resource users (for other campaign assessments see, Kemp et al., 2017; Seekamp et al., 2016). The CDD campaign aims to raise public awareness and promote the eponymous behaviors, primarily via sign, billboard, and other messaging placements near public access points to waterbodies, at relevant businesses and vendors, or online (e.g., States Organization for Boating Access [SOBA], 2015).

This technical report, and data herein, reflects research conducted in 2016 by the Human Dimensions of Natural Resources Laboratory within the Dept. of Recreation, Park, and Tourism Sciences at Texas A&M University. Survey research methods were employed to administer an online questionnaire to a statewide sample of licensed Texas boaters. The questionnaire examined boaters' perceptions and behaviors

related to AIS and CDD in Texas public freshwaters. This research adds to a growing body of applied research and practice focused on invasives species management. Five primary results sections structure this report, Texas boaters': (1) recreational boating preferences and behavior, (2) awareness and knowledge of aquatic invasives, (3) behaviors related to clean, drain, and dry, (4) ability to identify common aquatic invasives, and (5) socio-demographic characteristics.

METHODS

Sampling Design

Participants consisted of 9,500 licensed boaters randomly selected from Texas' boater registration database. Participants were solicited via email and provided a link to a questionnaire administered through the web-based Qualtrics research software (Qualtrics, 2016). A modified tailored design protocol was followed. Participants were contacted via email up to five times, approximately one week apart, until questionnaire completion, opting-out, or the conclusion of the study (Dillman, Smyth, & Christian, 2014). After accounting for bounced emails and voluntary opt-outs, 8,609 participants received an invitation, with 2,324 questionnaires completed or partially completed (27% effective response rate).

Questionnaire Development

A 33-question instrument was developed to assess licensed boaters' recreational boating behaviors, preferences, and experiences over the previous 12-months, their attitude, awareness, mitigation behavior (clean, drain, dry compliance) related to aquatic invasive species, and other issues pertinent to management decision-making (i.e., ability to identify common aquatic invasives and socio-demographic characteristics). Topics and questions were developed in consultation with state management agency staff and past research conducted on this topic by other human dimensions researchers.

The questionnaire consisted primarily of close-ended, Likert-type questions. Topics were primarily focused on: 1) recreational boating preferences and behavior, (2) awareness and knowledge of aquatic invasives, (3) behaviors related to clean, drain, and dry, (4) ability to identify common aquatic invasives, and (5) socio-demographic characteristics. A copy of the questionnaire is provided in the appendix.

Solicitation Procedure

Following tailored design procedures recommended by Dillman, Smyth, and Christian (2014), participants were contacted via email using the Qualtrics online survey platform between July and August 2016, up to five times and approximately one week apart, until participants completed the questionnaire, voluntarily opted-out, and the study ended.

1. 2016-07-05 (Invitation): A personalized email introducing the study and inviting respondent to complete the questionnaire online (hyperlink and URL provided). Contact information and an option to opt-out of receiving additional follow-up emails were provided;
2. 2016-07-11 (Reminder 1): An initial reminder to participants of the previously sent invitation to participate with an abridged message about the study (hyperlink and URL provided). Contact information and an option to opt-out of receiving additional follow-up emails were provided;
3. 2016-07-18 (Reminder 2): A second reminder to participants to complete the questionnaire (hyperlink and URL provided). Contact information and an option to opt-out of receiving additional follow-up emails were provided;

4. 2016-07-25 (Reminder 3): A third reminder to participants to complete the questionnaire (hyperlink and URL provided). Contact information and an option to opt-out of receiving additional follow-up emails were provided;
5. 2016-08-01 (Reminder 4): A final reminder to participants of the previously sent invitation to participate with an abridged message about the study (hyperlink and URL provided). Contact information provided.

Survey participants were assigned a unique ID number, allowing Qualtrics to track and manage respondent invitations, non-deliverables (email bounce backs), and started and completed questionnaires. This facilitated efficient invitation and reminder protocol and assured respondents were not sent multiple emails, unnecessarily. Non-deliverable email addresses and respondents who voluntarily opted-out of the survey were tagged in Qualtrics and not sent any further emails.

Response Rate

The effective response rate was slightly superior to the overall effective response rates of comparable studies conducted in Texas with related resource user groups (i.e., Kyle *et al*., 2013; Landon *et al*., 2012). In relation to these past surveys online, email-solicited survey response rates, the present effective response rate is comparable but slightly lower (27% vs. 29.2%; Wallen et al., 2016).

Table 1. Response rates for survey of licensed Texas boaters.

Number emailed	Returned usable	Non-deliverable	Voluntary opt-out	Raw response rate (%)	Effective response rate (%)
9,500	2,324	209	682	24.5	27.0

RESULTS

Results of the 2016 Statewide Boater Survey: Aquatic Invasive Species are presented in five sections below. In the first section, basic socio-demographic information of the sample are presented. In the second section, general information regarding participants' recreational boating activities and background are presented. In the third and fourth sections, information and behavior specifically regarding aquatic invasive species and mitigation behaviors (i.e., clean, drain, dry) are presented. In the fifth section, the results of a species identification quiz are presented.

Socio-demographic Characteristics

Participants' age ranged from 19–85, with an average age of 56.3 years. Participants were 89.9% male and 93.9% white. In terms of education, 21% reported high school as their highest level of education, with 23.8% reporting a vocational or two-year degree, 35.7% a four-year college degree, and 18.8% reporting a graduate degree. (<1% reported less than high school). A gross annual household income of over $120,000 was reported by 49.1% of participants and 14.3% under $60,000.

Table 2. Socio-demographic characteristics of licensed Texas boater sample.

Gender	**%**
Female	10.1
Male	89.9

Age distribution	**%**
Mean (SD)	56.3 (11.7)
Median	57.0
Min–Max	19–85

Ethnicity	**%**
Hispanic, Latino/a, Chicano/a	5.6

Race	**%**
American Indian/Native	0.9
Asian	0.4
Black/African American	1.1
Hawaiian/ Pacific Islander	0.2
White	93.9
Other	3.6

Education	**%**
Less than high school	0.7
High school graduate	21.0
Vocational/trade school	6.4
Two-year college degree	17.4
Four-year college degree	35.7
Graduate degree	18.8

Income (gross household)	**%**
Under $20,000	1.6
$20,000–$39,999	3.9
$40,000–$59,999	8.8
$60,000–$79,999	10.3
$80,000–$99,999	11.4
$100,000–$119,999	15.0
$120,000–$139,999	10.3
$140,000–$159,999	7.1
$160,000 +	31.7

Boating Activity

Of the 2,324 respondents who returned completed or partially completed questionnaires, 1,703 indicated they had boated in the past 12 months and owned a boat, which qualifies their data for inclusion in the following analyses; 610 were exclude because they indicated they had not boated in the last 12 months and 11 excluded as they indicated they no longer own a boat. Respondents were also asked to indicate their primary watercraft, activities engaged in:

- The majority of respondents indicated (i.e., "select one") their primary watercraft used over the past 12 months was a powerboat (941). The remaining respondents indicated their primary watercraft was a: fishing boat (531), jet ski (376), pontoon (280), johnboat (145), trolling motor (120), sailboat (59), or other (i.e., commercial vessel, canoe/kayak; 53).
- Recreational fishing (1070) was the most select (i.e., "select all that apply") activity by respondents. The remaining recreational activities were: pleasure cruising (843), water skiing/tubing (723), sightseeing (333), hunting (85), other (31), transportation (9), or commercial/industrial (2).

In terms of other boater characteristics and background information (see Table 3), near seventy-five-percent indicated they have not taken a voluntary boater education course. Approximately seventy-five-percent of respondents purchased a fishing license for the same time period they purchased a boating license (i.e., within the last 12-months). Only ten-percent of respondents indicated their boat was used across freshwater and saltwater locations in the past year. Close to forty-percent of respondents indicated their boat remained in the same waterbody, either stored in marina or moored to a private dock.

The majority of respondents indicate the Prairie and Lakes region (40.3%) of Texas was their preferred location to engage in boating activities, followed by the Hill Country region that includes the Highland Lakes chain (Fig. 1a, Table 4). Responses indicate Texas boaters are active, with approx. 30% of respondents reporting they used their boat 15+ times in the past 12 months (Fig. 2, Table 5). While active, approximately 60% of respondents indicated they used only a single waterbody in the past 12 months (Fig. 3, Table 6).

Table 3. Location of boat usage, boater education experience, and other licenses purchased by licensed Texas boater sample

		Frequency	%
Over the past 12 months, have you used your boat in both freshwater and saltwater?	Yes	172	10.2
	No	1509	89.8
Over the past 12 months, has your boat remained in the same waterbody (e.g., kept in marina or moored to dock)?	Yes	659	39.1
	No	1025	60.9
Have you taken the Texas Parks and Wildlife Department's boater education course?	Yes	422	25.1
	No	1256	74.9
Have you purchased a fishing license in the past 12 months?	Yes	1253	74.5
	No	430	25.5

Figure 1a. Chosen boating locations in Texas

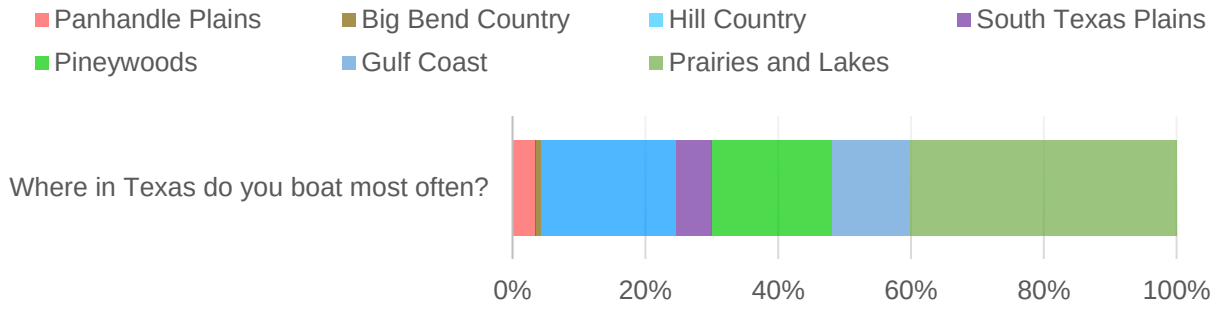

Table 4. Distribution of chosen boating locations in Texas

Item	Panhandle Plains	Big Bend Country	Hill Country	S. Texas Plains	Piney-woods	Gulf Coast	Prairies & Lakes
	% (count)						
Where in Texas do you boat most often?	3.5 (59)	.8 (14)	20.3 (342)	5.3 (89)	18.2 (306)	11.5 (194)	40.3 (679)

Figure 1b. Designated regions of Texas.

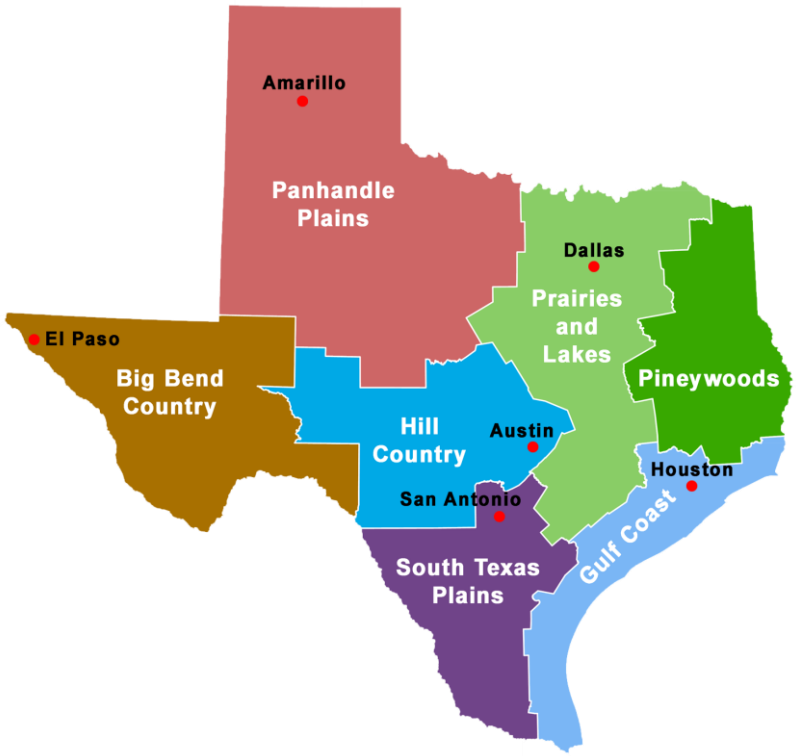

Figure 2. Frequency of boating in freshwater over 12-month period

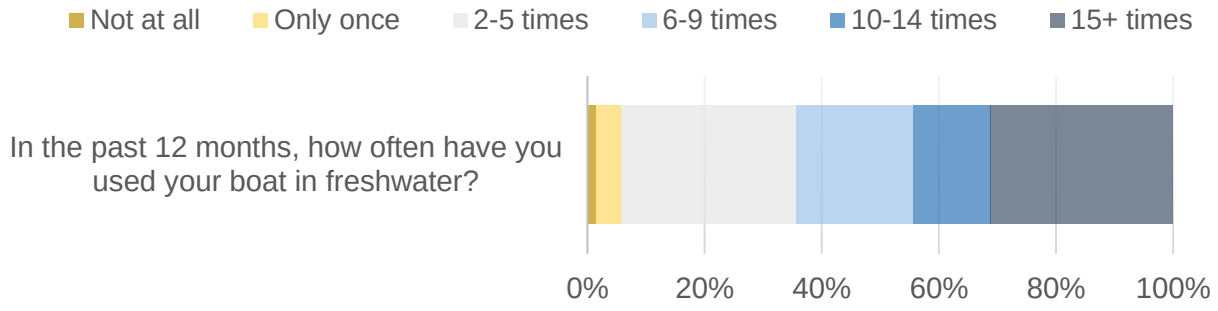

Table 5. Frequency of boating in freshwater over 12-month period

	Not at all	Only once	2-5	6-9	10-14	15+
Item	% (count)					
In the past 12 months, how often have you used your boat in freshwater	1.5 (25)	4.3 (72)	29.8 (503)	19.9 (336)	13.3 (224)	31.2 (526)

Figure 3. Number of freshwater locations boated over 12-month period

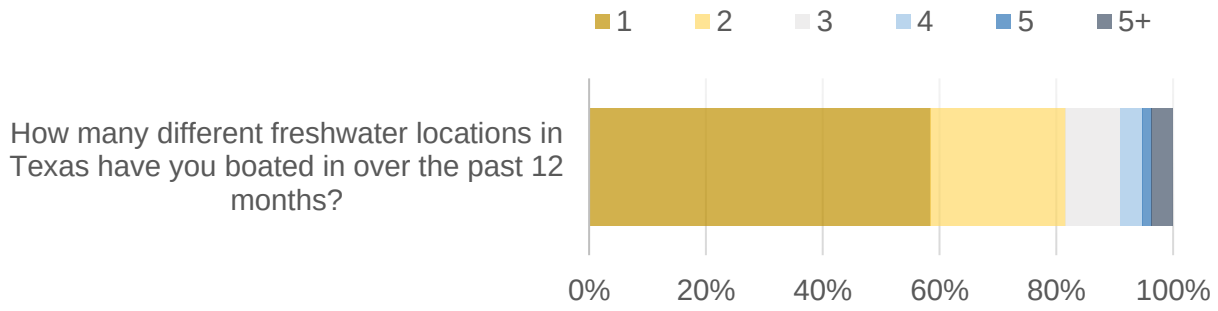

Table 6. Number of freshwater locations boated over 12-month period

	1	2	3	4	5	5+
Item	% (count)					
How many different freshwater locations in Texas have you boated in over the past 12 months?	58.4 (977)	23.2 (388)	9.3 (155)	3.8 (63)	1.6 (27)	3.7 (62)

Boater Knowledge and Awareness of Aquatic Invasive Species in Texas

The primary focus of this statewide survey of licensed Texas boaters was to understand this resource-user population's understanding of and behaviors related to aquatic invasive species (AIS) within the state. In general, a majority of respondents indicated they were somewhat or very aware of the presence of AIS within Texas freshwaters and that AIS were somewhat or very common within those waterbodies (Fig 4, Table 7). Moreover, a majority of respondents indicated AIS are a significant threat to Texas' environments, economy, and recreational opportunities (Fig 5, Table 8). In terms of were respondents indicated (i.e., "select any that apply") they have received information about AIS in Texas, the Texas Parks & Wildlife website and signs near marinas dock, or boat launches were most frequently reported (959 and 938, respectively). These sources of information were followed by: TV or radio (526); fishing or conservation organizations (395); friends or family (370); other boaters (358); Texas Parks & Wildlife staff (327); other (204); boat captains or guides (87); window stickers at gas stations (71); and TexasInvasives.com (46).

Figure 4. Knowledge and belief of AIS in Texas

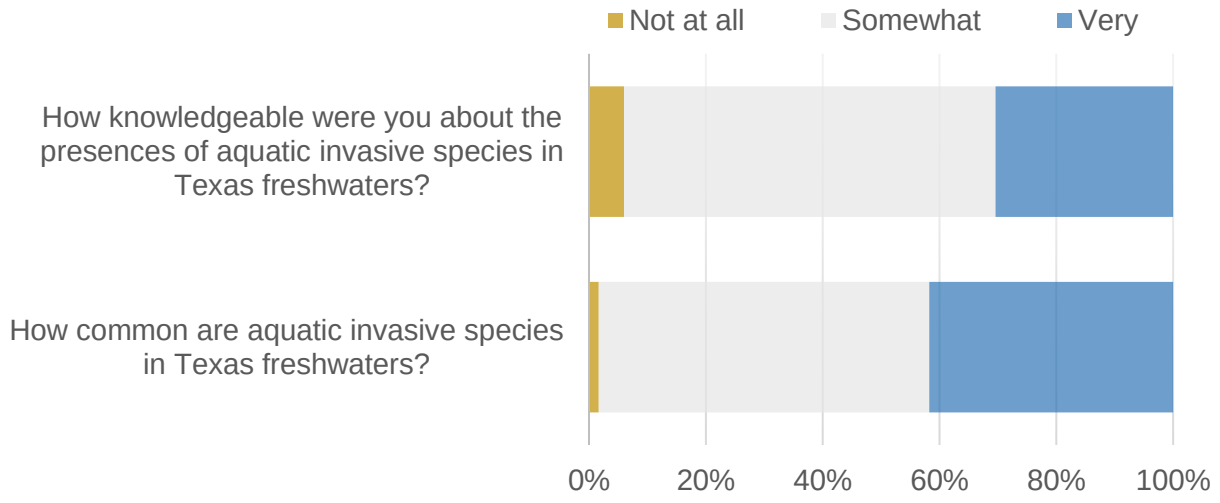

Table 7. Knowledge and belief of AIS in Texas

	Not at all	Somewhat	Very
Item		% (count)	
How knowledgeable were you about the presences of aquatic invasive species in Texas freshwaters?	6.0 (100)	63.6 (1063)	30.4 (509)
How common are aquatic invasive species in Texas freshwaters?	1.64 (27)	56.63 (935)	41.73 (689)

Figure 5. Perceived threat AIS pose to Texas

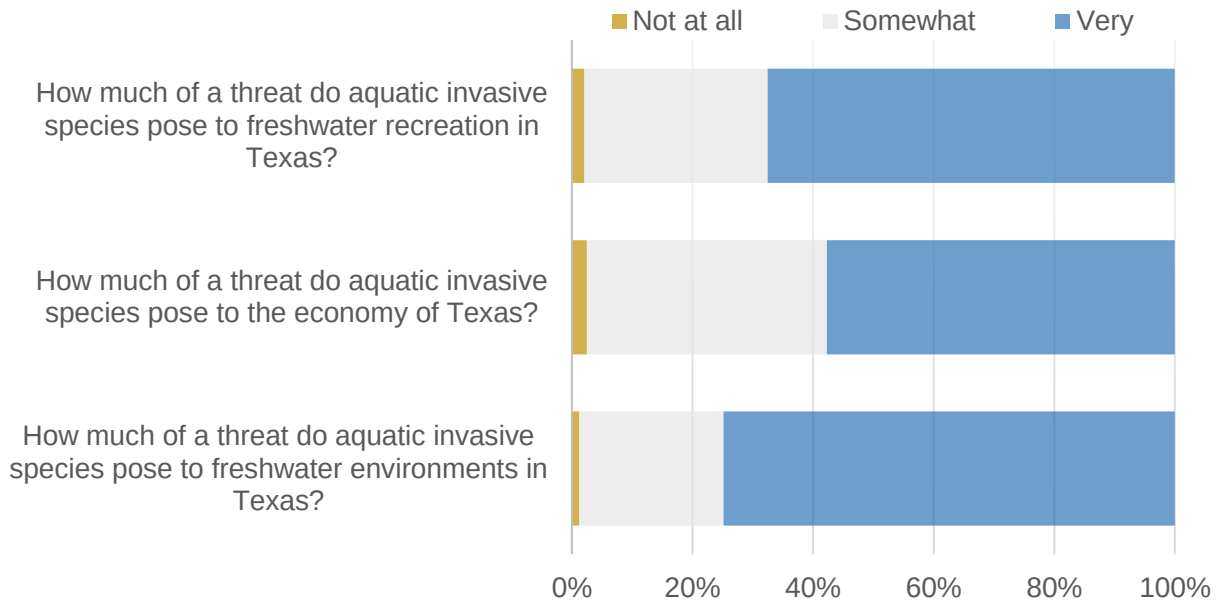

Table 8. Perceived threat AIS pose to Texas

	Not at all	Somewhat	Very
Item		% (count)	
How much of a threat do aquatic invasive species pose to freshwater environments in Texas?	1.21 (20)	23.96 (396)	74.83 (1237)
How much of a threat do aquatic invasive species pose to the economy of Texas?	2.48 (41)	39.82 (657)	57.7 (952)
How much of a threat do aquatic invasive species pose to freshwater recreation in Texas?	2.06 (34)	30.43 (503)	67.51 (1116)

Clean, Drain, and Dry™ in Texas

Aquatic invasive species mitigation behaviors are essential to AIS management. When boaters move among waterbodies without engaging in proper mitigation behaviors, (e.g., clean, drain, dry) they can, unintentionally, introduce aquatics invasives into other freshwaters. A critical first step for management is to understand resource-users' levels of awareness, behaviors, and behavioral barriers related to the mitigation actions deemed necessary by state natural resources management agencies, which then may informs appropriate management decisions regarding AIS. To that end, responses suggest a majority of licensed Texas boaters are very aware of state laws requiring boaters to engage in proper AIS mitigation behaviors (Fig. 8, Table 11). Relatedly, a majority of respondents indicated that, over the past 12 months, they have engaged in clean, washing, draining, and drying behavior most or every time they have boated. In terms of barriers to these mitigation actions, a belief (i.e., agree or strongly agree) that clean, drain, and dry behaviors will not slow the spread of AIS and that public access points or boat ramps are too crowded to do clean, drain, and dry were most frequently selected.

Figure 6. Awareness of Texas AIS laws

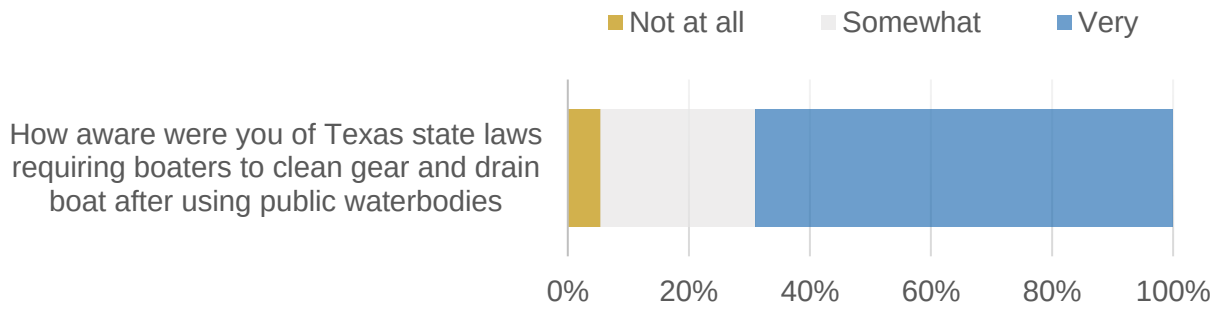

Table 9. Awareness of Texas AIS laws

	Not at all	Somewhat	Very
Item	% (count)		
How aware were you of Texas state laws requiring boaters to clean gear and drain boat after using public waterbodies?	5.4 (91)	25.6 (428)	69.0 (1153)

Figure 7. Frequency of boaters' clean, drain, and dry behavior over 12-month period

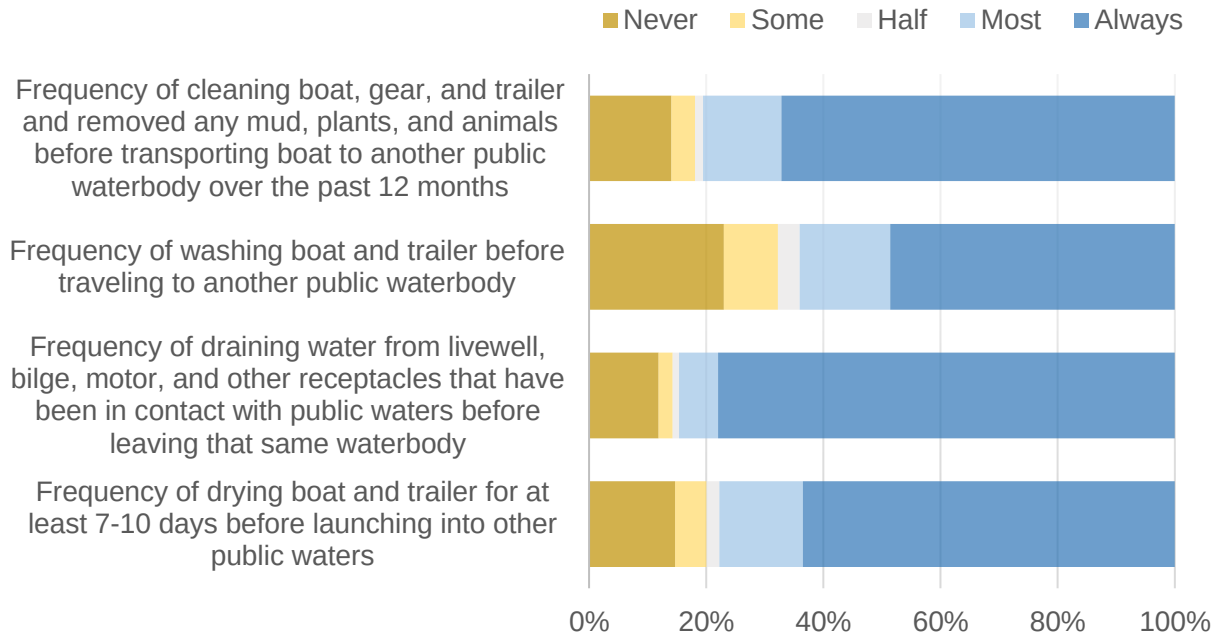

Table 10. Frequency of boaters' clean, drain, and dry behavior over 12-month period

	Never (1)	Sometimes (2)	Half the time (3)	Most of the time (4)	Always (5)
Item	% (count)				
Frequency of cleaning boat, gear, and trailer and removed any mud, plants, and animals before transporting boat to another public waterbody over the past 12 months	14.06 (219)	4.04 (63)	1.35 (21)	13.41 (209)	67.14 (1046)
Frequency of washing boat and trailer before traveling to another public waterbody	23.03 (353)	9.2 (141)	3.72 (57)	15.46 (237)	48.6 (745)
Frequency of draining water from livewell, bilge, motor, and other receptacles that have been in contact with public waters before leaving that same waterbody	11.86 (184)	2.39 (37)	1.1 (17)	6.71 (104)	77.95 (1209)
Frequency of drying boat and trailer for at least 7-10 days before launching into other public waters	14.72 (227)	5.32 (82)	2.2 (34)	14.27 (220)	63.49 (979)

Figure 8. Perceived barriers to clean, drain, and dry behavior

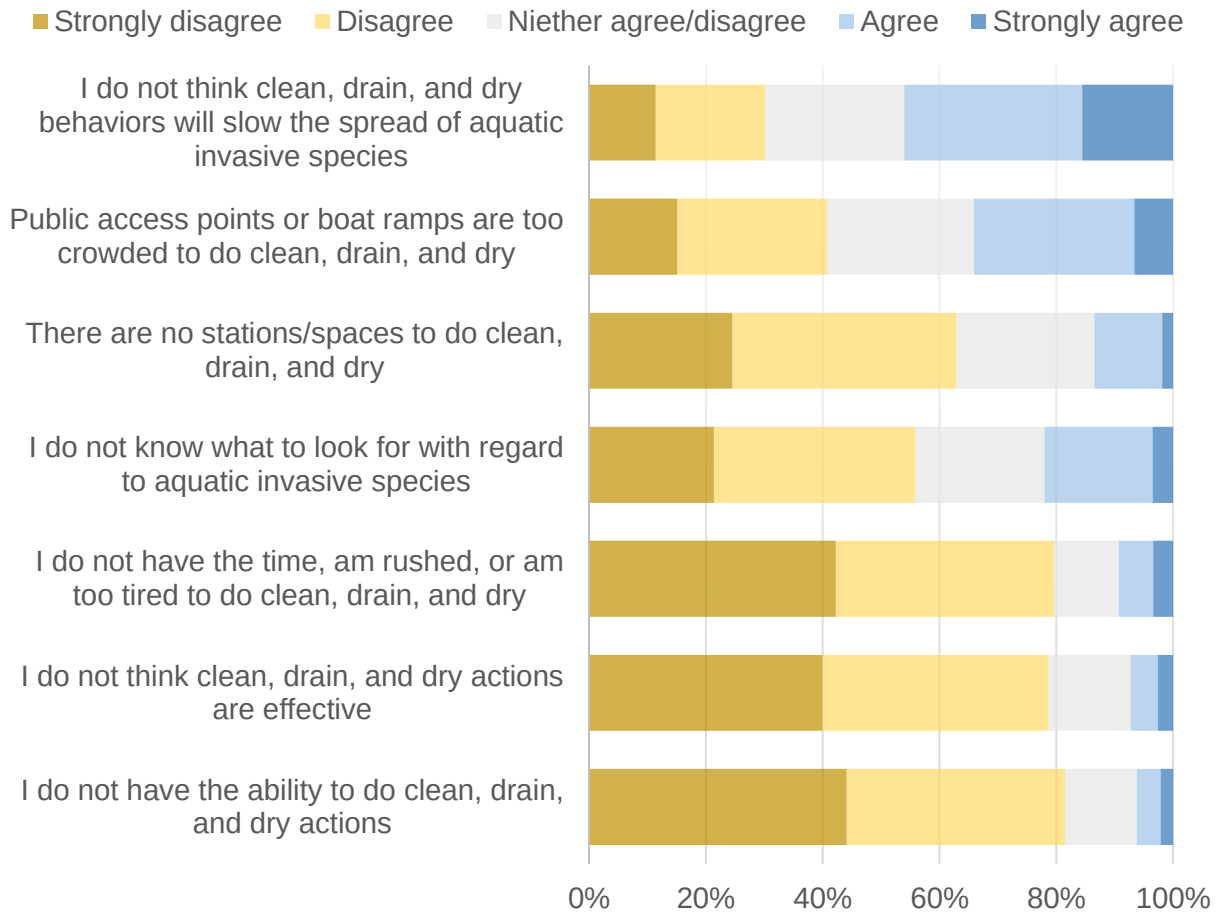

Table 11. Perceived barriers to clean, drain, and dry behavior					
	Strongly disagree (1)	Disagree (2)	Neither dis)agree (3)	Agree (4)	Strongly Agree (5)
Item	% (count)				
I do not think clean, drain, and dry behaviors will slow the spread of aquatic invasive species.	11.4 (134)	18.72 (220)	23.83 (280)	30.47 (358)	15.57 (183)
Public access points or boat ramps are too crowded to do clean, drain, and dry.	15.12 (178)	25.57 (301)	25.23 (297)	27.44 (323)	6.63 (78)
There are no stations/spaces to do clean, drain, and dry.	24.53 (289)	38.37 (452)	23.6 (278)	11.63 (137)	1.87 (22)
I do not know what to look for with regard to aquatic invasive species.	21.36 (251)	34.47 (405)	22.13 (260)	18.55 (218)	3.49 (41)
I do not have the time, am rushed, or am too tired to do Clean, Drain, Dry.	42.25 (499)	37.34 (441)	11.09 (131)	5.93 (70)	3.39 (40)
I do not think clean, drain, and dry actions are effective.	39.97 (472)	38.7 (457)	14.06 (166)	4.66 (55)	2.62 (31)
I do not have the ability to do clean, drain, and dry actions.	44.1 (519)	37.38 (440)	12.32 (145)	4.08 (48)	2.12 (25)

Attitudes and Normative Beliefs

Boaters' attitude, i.e., their positive or negative evaluation, toward AIS mitigation behaviors, including clean, drain, dry actions, may influence their behavior and measures of those attitudes can be used to inform management decisions (Fig. 9, Table 12). Boaters' beliefs about what behaviors they feel personally obligated to engage in, termed normative personal beliefs (or moral beliefs), are similarly informative (Fig. 10, Table 13). Furthermore, given the social and public context in which recreational boating occurs (, boaters may be influence by the implied, perceived, or actual behavior or behavioral expectations of other boaters (Fig. 11, 12, Table 14, 15). These types of beliefs, termed normative social beliefs, can be informative and useful to the design of management strategies or an element considered during the management decision-making process (see Hine *et al*., 2015; McLeod *et al*., 2015).

Figure 9. Attitude towards clean, drain, and dry in Texas

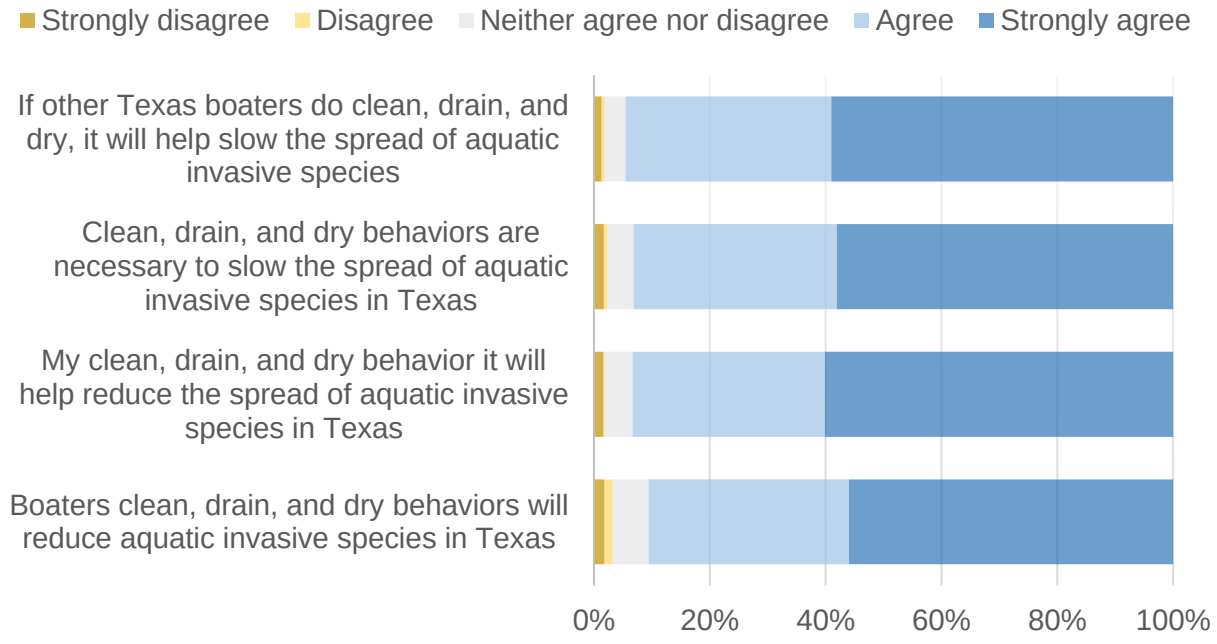

Table 12. Attitude towards clean, drain, and dry in Texas

	Strongly disagree (1)	Disagree (2)	Neither dis)agree (3)	Agree (4)	Strongly agree (5)	
Item	% (count)					Mean (SD)
Boaters clean, drain, and dry behaviors will reduce aquatic invasive species in Texas	1.83 (29)	1.45 (23)	6.18 (98)	34.55 (548)	55.99 (888)	4.41 (.82)
My clean, drain, and dry behavior it will help reduce the spread of aquatic invasive species in Texas	1.70 (27)	.69 (11)	4.47 (71)	35.05 (557)	58.09 (923)	4.47 (.76)
Clean, drain, and dry behaviors are necessary to slow the spread of aquatic invasive species in Texas	1.64 (26)	.25 (4)	4.79 (76)	33.19 (526)	60.13 (953)	4.50 (.75)
If other Texas boaters do clean, drain, and dry, it will help slow the spread of aquatic invasive species	1.32 (21)	.57 (9)	3.58 (57)	35.51 (565)	59.02 (939)	4.50 (.72)

Figure 10. Personal normative beliefs related to clean, drain, and dry behaviors

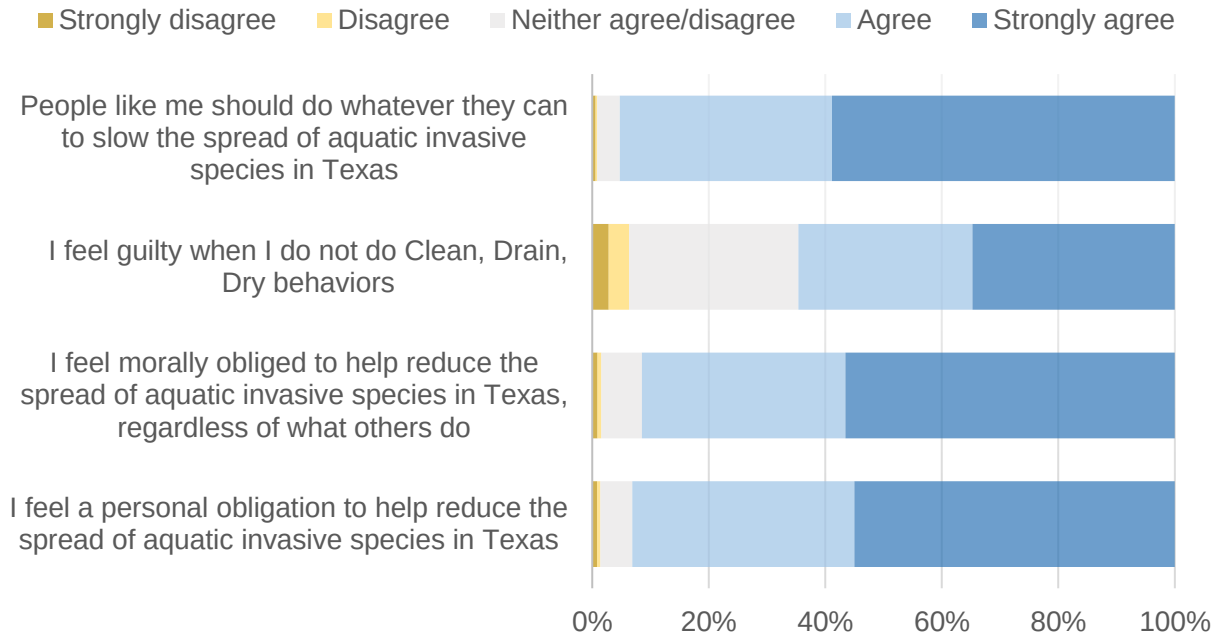

Table 13. Personal normative beliefs related to clean, drain, and dry behaviors

	Strongly disagree (1)	Disagree (2)	Neither (dis)agree (3)	Agree (4)	Strongly Agree (5)
Item	% (count)				
I feel a personal obligation to help reduce the spread of aquatic invasive species in Texas	.82 (13)	.57 (9)	5.5 (87)	38.12 (603)	54.99 (870)
I feel morally obliged to help reduce the spread of aquatic invasive species in Texas, regardless of what others do	.88 (14)	.69 (11)	6.94 (110)	34.95 (554)	56.53 (896)
I feel guilty when I do not do Clean, Drain, and Dry behaviors	2.82 (43)	3.54 (54)	29.03 (443)	29.88 (456)	34.73 (530)
People like me should do whatever they can to slow the spread of aquatic invasive species in Texas	.57 (9)	.25 (4)	3.91 (62)	36.43 (577)	58.84 (932)

Figure 11. Boater interactions and topics discussed

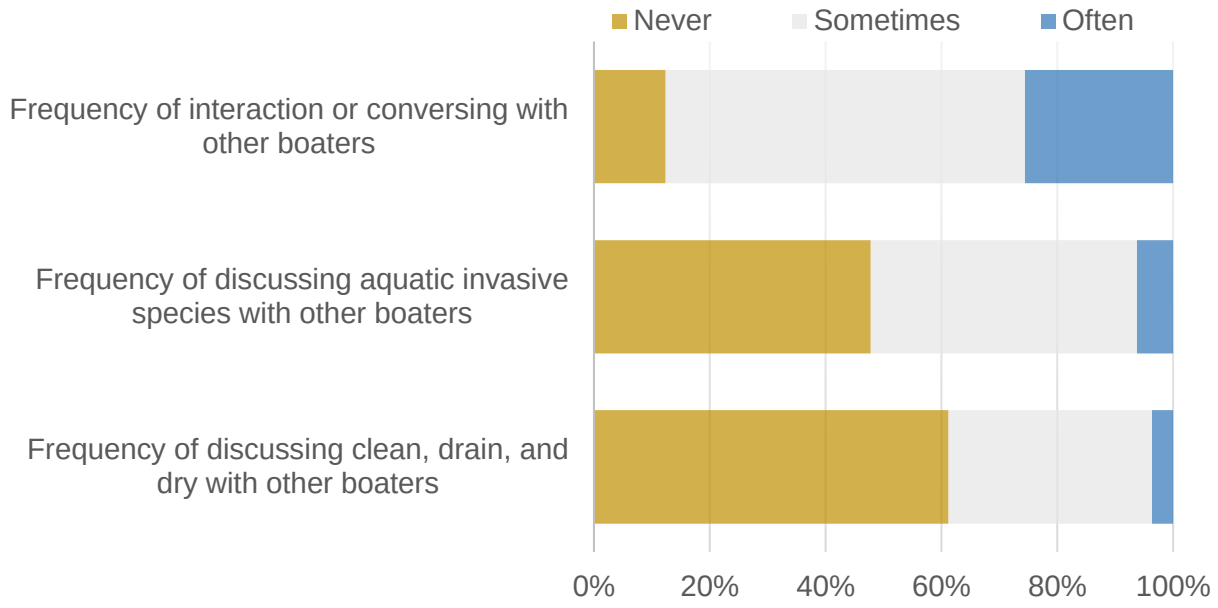

Table 14. Boater interactions and topics discussed

	Never	Sometimes	Often
Item	% (count)		
Frequency of interaction or conversing with other boaters	12.35 (158)	62.08 (794)	25.57 (327)
Frequency of discussing AIS with other boaters	47.81 (612)	45.94 (588)	6.25 (80)
Frequency of discussing CDD with other boaters	61.22 (783)	35.11 (449)	3.67 (47)

Figure 12. Descriptive normative beliefs related to clean, drain, and dry behaviors

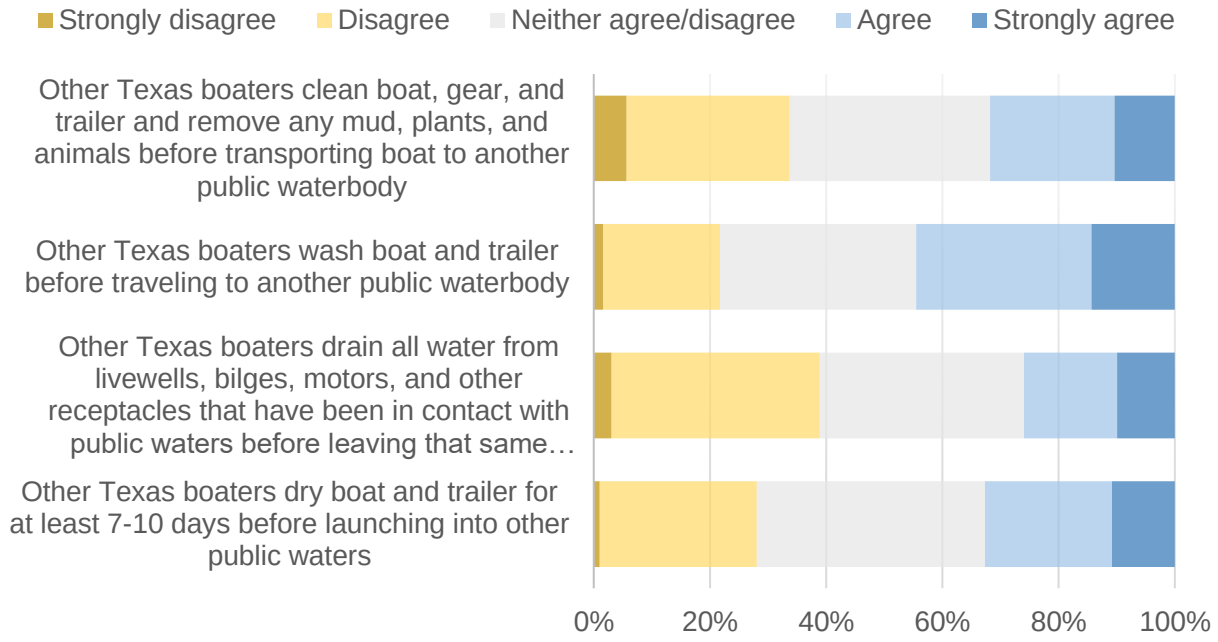

Table 15. Descriptive normative beliefs related to clean, drain, and dry behaviors

Item	Never (1)	Seldom (2)	Half the Time (3)	Often (4)	Always (5)
	% (count)				
Other Texas boaters clean boat, gear, and trailer and remove any mud, plants, and animals before transporting boat to another public waterbody	1.03 (15)	27.05 (395)	39.25 (573)	21.85 (319)	10.82 (158)
Other Texas boaters wash boat and trailer before traveling to another public waterbody	3.03 (44)	35.88 (521)	35.12 (510)	16.05 (233)	9.92 (144)
Other Texas boaters drain all water from livewells, bilges, motors, and other receptacles that have been in contact with public waters before leaving that same waterbody	1.65 (24)	20.1 (292)	33.72 (490)	30.21 (439)	14.32 (208)

Other Texas boaters dry boat and trailer for at least 7-10 days before launching into other public waters	5.67 (82)	28.06 (406)	34.49 (499)	21.42 (310)	10.37 (150)

Figure 12. Injunctive normative beliefs related to clean, drain, and dry behaviors

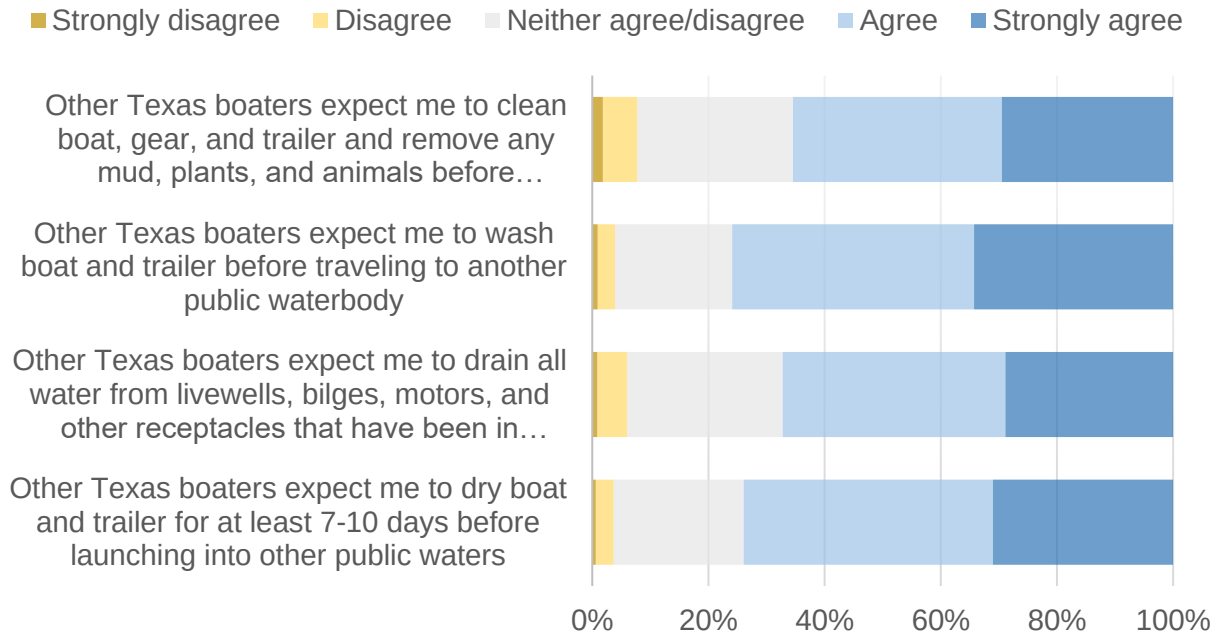

Table 16. Injunctive normative beliefs related to clean, drain, and dry behaviors

Item	Strongly disagree (1)	Disagree (2)	Neither (dis)agree (3)	Agree (4)	Strongly Agree (5)
	% (count)				
Other Texas boaters expect me to clean boat, gear, and trailer and remove any mud, plants, and animals before transporting boat to another public waterbody	.6 (9)	3.07 (46)	22.39 (335)	42.91 (642)	31.02 (464)
Other Texas boaters expect me to wash boat and trailer before traveling to another public waterbody	.87 (13)	5.16 (77)	26.74 (399)	38.34 (572)	28.89 (431)
Other Texas boaters expect me to drain all water from livewells, bilges, motors, and other receptacles that have been in contact with public waters before leaving that same waterbody	.94 (14)	2.97 (44)	20.18 (299)	41.63 (617)	34.28 (508)

Other Texas boaters expect me to dry boat and trailer for at least 7-10 days before launching into other public waters	1.83 (27)	5.95 (88)	26.79 (396)	35.93 (531)	29.5 (436)

Aquatic Invasive Species Identification

An important aspect of efficient and effective AIS management and the necessary cooperation between boaters and practitioners is boaters' ability to know what an aquatic invasive is, and correctly identify those species. Results of a short AIS identification quiz at the end of the questionnaire suggest boaters are able to correctly identify some species more than others, but a significant portion of quiz respondent indicate they were unable to identify a species (Fig. 14, Table 17).

Figure 14. Aquatic invasive species identification quiz (N = 408).

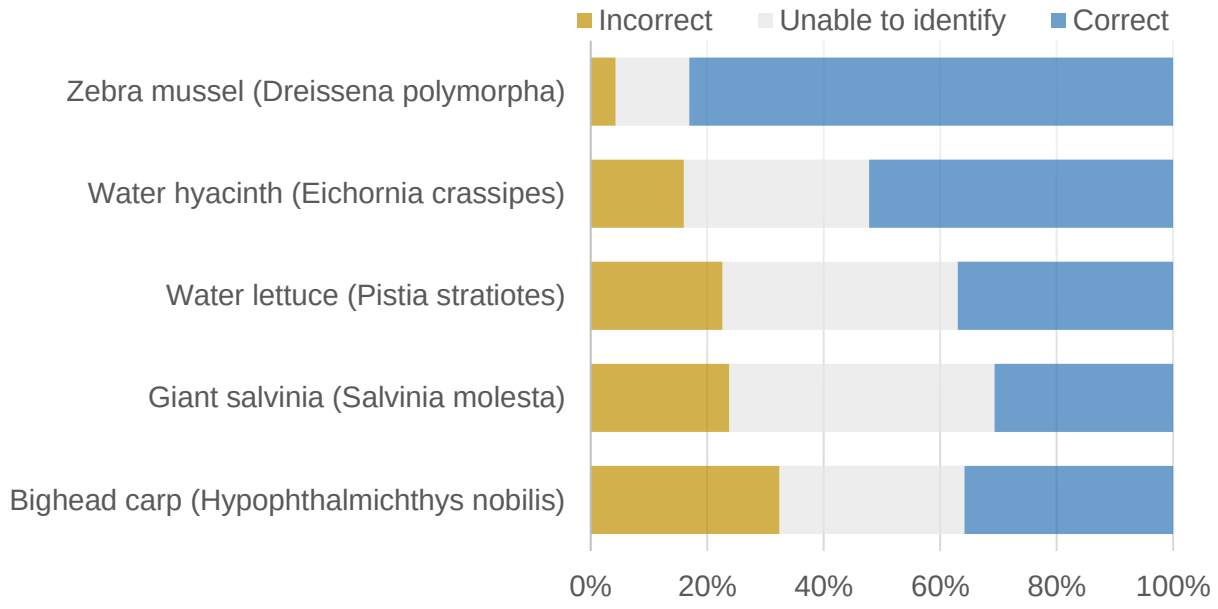

Table 17. Aquatic invasive species identification quiz (N = 408).

	Incorrect	Unidentifiable	Correct
Item	% (count)		
Zebra mussel (*Dreissena polymorpha*)	4.3 (18)	12.65 (53)	83.05 (348)
Water hyacinth (*Eichornia crassipes*)	16.01 (65)	31.77 (129)	52.22 (212)
Water lettuce (*Pistia stratiotes*)	22.63 (93)	40.39 (166)	36.98 (152)
Giant salvinia (*Salvinia molesta*)	23.77 (97)	45.59 (186)	30.64 (125)
Bighead carp (*Hypophthalmichthys nobilis*)	32.45 (134)	31.72 (131)	35.84 (148)

REFERENCES

Anderson, L. G., Rocliffe, S., Haddaway, N. R., & Dunn, A. M. (2015). The role of tourism and recreation in the spread of non-native species: A systematic review and meta-analysis. *PLoS ONE*, *10*, e0140833.

Bell, D. R. (2005) Environmental learning, metaphors and natural capital. *Environmental Education Research*, *11*(1), 53–69.

Blake, J. (1999) Overcoming the value-action gap in environmental policy: Tensions between national policy and local experience, *Local Environment: The International Journal of Justice and Sustainability*, *4*(3), 257–278.

Connelly, N. A., Lauber, B. T., & Stedman, R. C. (2014). Reducing the spread of aquatic invasive species and fish pathogens in the great lakes: The role of anglers. Cornell University. Retrieved from https://ecommons.cornell.edu/bitstream/ handle/1813/ 40358/HDRUReport14-07.pdf.

Drake, D. A. R., Mercader, R., Dobson, T., & Mandrak, N. E. (2015). Can we predict risky human behaviour involving invasive species? A case study of the release of fishes to the wild. *Biological Invasions*, *17*(1), 309–326.

Executive Order No. 13,112, 1999

Ford-Thompson, A. E., Snell, C., Saunders, G., & White, P. C. (2015). Dimensions of local public attitudes towards invasive species management in protected areas. *Wildlife Research*, *42*(1), 60-74.

García-Llorente, M., Martín-López, B., González, J. A., Alcorlo, P., & Montes, C. (2008). Social perceptions of the impacts and benefits of invasive alien species: Implications for management. *Biological Conservation*, *141*(12), 2969–2983.

Genovesi, P., & Shine, C. (2004). European strategy on invasive alien species. https://www.cbd.int/doc/external/cop-09/bern-01-en.pdf. Accessed 3 Sept 2016

Hine, D. W., Please, P. M., McLeod, L. J., & Driver, A. B. (2015). Behaviourally effective communications for invasive animals management: A practical guide. Invasive Animals Cooperative Research Centre, Canberra.

Johnson, L. E., Ricciardi, A., & Carlton, J. T. (2001). Overland dispersal of aquatic invasive species: A risk assessment of transient recreational boating. *Ecological Applications*, *11*, 1789–1799.

Kelly, N., Wantola, K., Weisz, E., & Yan, N. (2013). Recreational boats as a vector of secondary spread for aquatic invasive species and native crustacean zooplankton. *Biological Invasions*, *15*(3), 509–519.

Kemp, C., van Riper, C. J., BouFajreldin, L., Stewart, W. P., Scheunemann, J., & van den Born, R. J. (2017). Connecting human–nature relationships to environmental behaviors that minimize the spread of aquatic invasive species. *Biological Invasions*, *19*(7), 2059-2074.

Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior. *Environmental Education Research*, *8*, 239–260.

Lee, J., O'Keefe, D., Oh, C., & Han, J. (2015). 2015 Michigan AIS and boating survey final report. Michigan State University. Retrieved from http://www.miseagrant.umich.edu/wp-content/blogs.dir/1/files/2012/03/2015-AIS-Final-Report.pdf

Leung, B., Lodge, D. M., Finnoff, D., Shogren, J. F., Lewis, M. A., & Lamberti, G. (2002). An ounce of prevention or a pound of cure: bioeconomic risk analysis of invasive species. *Proceedings of the Royal Society of London B: Biological Sciences*, *269*(1508), 2407-2413.

Lockwood, J. L., Hoopes, M. F., & Marchetti, M. P. (2013). *Invasion ecology*. Oxford, UK: Blackwell Publishing.

Lovell, S. J., Stone, S. F., & Fernandez, L. (2006). The economic impacts of aquatic invasive species: a review of the literature. *Journal of Agricultural Resource Economics*, *35*(1), 195–208.

McLeod, L. J., Hine, D. W., Please, P. M., & Driver, A. B. (2015). Applying behavioral theories to invasive animal management: towards an integrated framework. *Journal of Environmental Management*, *161*, 63–71.

McMichael, A. J., & Bouma, M. J. (2000). Global changes, invasive species, and human health. In H. Mooney & R. Hobbs (Eds.), *Invasive species in a changing world* (pp. 191–210). Washington, DC: Island Press.

McNeely, J. A. (2001). *The great reshuffling: human dimensions of invasive alien species*. Cambridge, UK: International Union for Conservation of Nature and Natural Resources.

Olden J. D., & Tamayo, M. (2014) Incentivizing the public to support invasive species management: Eurasian milfoil reduces lakefront property values. *PLoS ONE 9*(10): e110458. doi:10.1371/journal.pone.0110458.

Parks & Wildlife Code § 66.0072, 2011

Pimentel, D., Zuniga, R., & Morrison, D. (2005). Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics*, *52*(3), 273–288.

Pradhananga, A., Davenport, M. A., Seekamp, E., & Bundy, D. (2015). Preventing the spread of aquatic invasive species: boater concerns, habits, and future behaviors. *Human Dimensions of Wildlife*, *20*(5), 381–393.

Pradhananga, A., Davenport, M. A., Seekamp, E., & Bundy, D. (2015). Preventing the spread of aquatic invasive species: boater concerns, habits, and future behaviors. *Human Dimensions of Wildlife*, *20*(5), 381–393.

Rothlisberger, J. D., Chadderton, W. L., McNulty, J., & Lodge, D. M. (2010). Aquatic invasive species transport via trailered boats: what is being moved, who is moving it, and what can be done. *Fisheries*, *35*(3), 121–132.

Santo, A. R., Sorice, M. G., Donlan, C. J., Franck, C. T., & Anderson, C. B. (2015). A human-centered approach to designing invasive species eradication programs on human-inhabited islands. *Global Environmental Change*, *35*, 289–298.

Schultz, P. W. (2011). Conservation means behavior. *Conservation Biology*, *25*(6), 1080–1083.

Seekamp, E., McCreary, A., Mayer, J., Zack, S., Charlebois, P., & Pasternak, L. (2016). Exploring the efficacy of an aquatic invasive species prevention campaign among water recreationists. *Biological Invasions*, *18*(6), 1745–1758.

Selge, S., Fischer, A., & van der Wal, R. (2011). Public and professional views on invasive non-native species: a qualitative social scientific investigation. *Biological Conservation*, *144*(12), 3089-3097.

States Organization for Boating Access [SOBA] (2015). *Construction and integration of aquatic invasive species (AIS) prevention areas at recreational boating facilities*. Retrieved from www.sobaus.org/pdf/AIS-Best-Management-Practices-FINAL.pdf.

Texas Parks and Wildlife Department [TPWD]. (2017). Fighting aquatic invaders: progress in delivery of statewide aquatic vegetation and invasive species management. Aquatic Invasive Species Working Group. Austin, TX.

U.S. Commission on Ocean Policy. (2004). An ocean blueprint for the 21st century. Retrieved from http://www.oceancommission.gov.

U.S. Fish & Wildlife Service. (2012). The cost of invasive species. Retrieved from https://www.fws.gov/verobeach/PythonPDF/CostofInvasivesFactSheet.pdf

Vander Zanden, M. J., & Olden, J. D. (2008). A management framework for preventing the secondary spread of aquatic invasive species. *Canadian Journal of Fisheries and Aquatic Sciences*, *65*(7), 1512–1522.

Whitfield, A. K., & Becker, A. (2014). Impacts of recreational motorboats on fishes: a review. *Marine Pollution Bulletin*, *83*(1), 24-31.

APPENDIX

TEXAS BOATER SURVEY: AQUATIC INVASIVE SPECIES

Conducted for the

TEXAS PARKS & WILDLIFE DEPARTMENT

By

TEXAS A&M UNIVERSITY
COLLEGE STATION, TX 77843-2261

1. Have you been boating in the past 12 months in Texas freshwaters?

- ❍ Yes
- ❍ No

If No, skip to Q8

2. What type(s) of boat(s) do you have licensed with the state of Texas? (select all that apply)

- ❑ Powerboat
- ❑ Pontoon
- ❑ Johnboat / Jon boat
- ❑ Fishing / Duck Boat
- ❑ Jet Ski
- ❑ Commercial-use vessel
- ❑ Sailboat
- ❑ Trolling motor
- ❑ Other: _____

3. Which freshwater activities do you use your boat for most often? (select all that apply)

- ❑ Sightseeing
- ❑ Recreational fishing
- ❑ Water skiing / tubing
- ❑ Pleasure cruising
- ❑ Transportation
- ❑ Commercial / Industrial uses
- ❑ Hunting (for example, duck hunting)
- ❑ Other: _____

4. In the past 12 months, how often have you used your boat in freshwater for the activities indicated above?

- ❍ Not at all
- ❍ Only once
- ❍ 2-5 times
- ❍ 6-9 times
- ❍ 10-14 times
- ❍ 15 or more times

5. How many different freshwater locations in Texas have you boated in over the past 12 months?

- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ more than 5

6. Where in Texas do you boat most often?

- ❍ Big Bend Country
- ❍ Gulf Coast
- ❍ Hill Country
- ❍ Panhandle Plains
- ❍ Prairies and Lakes
- ❍ Pineywoods
- ❍ South Texas Plains

7. Over the past 12 months, have you used your boat in both freshwater and saltwater?

- ❍ Yes
- ❍ No

8. Over the past 12 months, has your boat remained in the same waterbody (e.g., kept in marina or moored to dock)?

- ❍ Yes
- ❍ No

9. Have you taken the Texas Parks and Wildlife Department's boater education course?

- ❍ Yes
- ❍ No

10. Have you purchased a fishing license in the past 12 months?

- ❍ Yes
- ❍ No

SECTION BREAK

AIS AQUATIC INVASIVE SPECIES (AIS) are plants, animals, parasites or diseases present in waterbodies outside their native range that are harmful to the environment (fish, wildlife, vegetation, and humans). Aquatic invasive species in Texas include, for example, giant salvinia and zebra mussels. In Texas, these and other aquatic invasive species are present in many public freshwaters and can be spread by boaters from one waterbody to another. The following questions will help us understand your perspective and experience with aquatic invasive species and provide important information for the continued management of aquatic invasive species in Texas.

11. Prior to taking this survey:

	Not at all knowledgeable	Somewhat knowledgeable	Very knowledgeable
How knowledgeable were you about the presences of aquatic invasive species in Texas freshwaters?	❍	❍	❍

12. Prior to taking this survey:

	Not at all aware	Somewhat aware	Very aware
How aware were you of Texas state laws requiring boaters to clean gear and drain boat after using public waterbodies?	❍	❍	❍

13. In your opinion:

	Not at all	Somewhat	Very
How common are aquatic invasive species in Texas freshwaters?	❍	❍	❍
How much of a threat do aquatic invasive species pose to freshwater environments in Texas?	❍	❍	❍
How much of a threat do aquatic invasive species pose to the economy of Texas?	❍	❍	❍
How much of a threat do aquatic invasive species pose to freshwater recreation in Texas?	❍	❍	❍

14. Please indicate where you have received information about aquatic invasive species in Texas. (select all that apply)

- ❑ Texas Parks & Wildlife website
- ❑ Texas Parks & Wildlife personnel
- ❑ TexasInvasives.com
- ❑ Signs near marina, docks, or boat launches
- ❑ Window stickers at gas stations
- ❑ Boat captains or fishing guides
- ❑ Fishing or conservation organizations
- ❑ Friends or family
- ❑ TV or radio
- ❑ Other Boaters
- ❑ Other: _____

SECTION BREAK

CDD CLEAN, DRAIN, DRY Boats, trailers, and other gear can spread aquatic invasive species when boaters don't inspect, clean, wash, drain, and dry them after use. The Texas Parks and Wildlife Department is working to help boaters avoid unintentionally spreading aquatic invasive

species with the “Clean, Drain, Dry” program, which encourages Texas boaters to: CLEAN off all plants, animals, and mud and thoroughly wash boats, trailers, and equipment DRAIN all water onto land before leaving an area (including livewells, bilges, ballast, and engine cooling water) DRY boats and equipment completely before launching into another body of water We are interested in understanding Texas boaters engagement with Clean, Drain, Dry behaviors. Your responses to following questions will help the Texas Parks and Wildlife Dept. better manage aquatic invasive in Texas.

15. Please recall your boating activity over the past 12 months and answer to the best of your ability. Over the past 12 months, I have:

	Never	Sometimes	About half the time	Most of the time	Always
Cleaned my boat, gear, and trailer and removed any mud, plants, and animals before transporting my boat to another public waterbody	❍	❍	❍	❍	❍
Washed my boat and trailer (for example, with a pressure washer or car wash) before traveling to another public waterbody	❍	❍	❍	❍	❍
Drained all water from my livewell, bilge, motor, and other receptacles that have been in contact with public waters before leaving that same waterbody	❍	❍	❍	❍	❍
Dried my boat and trailer for at least 7-10 days before launching into other public waters	❍	❍	❍	❍	❍

16. These statements focus on attitudes boaters may express toward the Clean, Drain, Dry program and aquatic invasive species. For each statement, please indicate your level of agreement.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Clean, drain, and dry behaviors will reduce aquatic invasive species in Texas	❍	❍	❍	❍	❍
If I do clean, drain, and dry, it will help reduce the spread of aquatic invasive species in Texas	❍	❍	❍	❍	❍
Clean, drain, and dry behaviors are necessary to slow the spread of aquatic invasive species in Texas	❍	❍	❍	❍	❍
If other Texas boaters do clean, drain, and dry, it will help slow the spread of aquatic invasive species	❍	❍	❍	❍	❍

17. The following questions focus on the behavior of other Texas boaters. Please indicate how often you believe other Texas boaters engage in Clean, Drain, Dry behaviors

	Never	Seldom	About half the time	Often	Always
Clean their boat, gear, and trailer and remove any mud, plants, and animals before transporting their boat to another public waterbody	❍	❍	❍	❍	❍
Wash their boat and trailer (for example, with a pressure washer or car wash) before traveling to another public waterbody.	❍	❍	❍	❍	❍
Drain all water from their livewells, bilges, motors, and other receptacles that have been in contact with public waters before leaving that same waterbody.	❍	❍	❍	❍	❍
Dry their boat and trailer for at least 7-10 days before launching into other public waters.	❍	❍	❍	❍	❍

18. The following statements focus on other boaters' expectations. Please indicate your level of agreement with each statement about other boaters' expectations of your behavior

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Clean my boat, gear, and trailer and remove any mud, plants, and animals before transporting their boat to another public waterbody	❍	❍	❍	❍	❍
Wash my boat and trailer (for example, with a pressure washer or car wash) before traveling to another public waterbody.	❍	❍	❍	❍	❍
Drain all water from my livewells, bilges, motors, and other receptacles that have been in contact with public waters before leaving that same waterbody.	❍	❍	❍	❍	❍
Dry my boat and trailer for at least 7-10 days before launching into other public waters.	❍	❍	❍	❍	❍

19. These statements focus on personal beliefs boaters may have about Clean, Drain, Dry behaviors and aquatic invasive species. For each statement, please indicate your level of agreement.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I feel a personal obligation to help reduce the spread of aquatic invasive species in Texas	❍	❍	❍	❍	❍
I feel morally obliged to help reduce the spread of aquatic invasive species in Texas, regardless of what others do	❍	❍	❍	❍	❍
I feel guilty when I do not do Clean, Drain, Dry behaviors	❍	❍	❍	❍	❍
People like me should do whatever they can to slow the spread of aquatic invasive species in Texas	❍	❍	❍	❍	❍

20. We are interested to learn how often you interact with other boaters, for example, while boating or while at the boat ramp launching or loading your boat. Please indicate:

	Never	Sometimes	Often
How often do you interact or talk with other boaters?	❍	❍	❍
How often do you talk with other boaters about aquatic invasive species?	❍	❍	❍
How often do you discuss Clean, Drain, Dry with other boaters?	❍	❍	❍

21. Please indicate the extent to which any of the following keeps you from doing Clean, Drain, and Dry behaviors.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Public access points or boat ramps are too crowded to do Clean, Drain, Dry	❍	❍	❍	❍	❍
I do not know what to look for with regard to aquatic invasive species	❍	❍	❍	❍	❍
After boating, I do not have the time, am rushed, or am too tired to do Clean, Drain, Dry	❍	❍	❍	❍	❍
I do not think Clean, Drain, Dry will slow the spread of aquatic invasives	❍	❍	❍	❍	❍
There are no cleaning stations to do Clean, Drain, Dry	❍	❍	❍	❍	❍
I do not think Clean, Drain, or Dry actions are effective	❍	❍	❍	❍	❍
I do not think I have the ability to do Clean, Drain, Dry	❍	❍	❍	❍	❍

22. What year were you born? (yyyy)

23. Which gender do you identify with?

- ❍ Female
- ❍ Male (0)

24. Which racial group(s) do you identify with? (select all that apply)

- ❍ American Indian or Alaska Native
- ❍ Asian
- ❍ Black or African American
- ❍ Native Hawaiian or Pacific Islander
- ❍ White
- ❍ Other _____

25. Are you of Spanish/Hispanic origin?

- ❍ No, not Spanish / Hispanic
- ❍ Yes, Mexican, Mexican American, Chicano
- ❍ Yes, other Spanish / Hispanic group (Please specify) _____

26. Which of the following indicates your level of education?

- ❍ Less than high school
- ❍ High school graduate
- ❍ Vocational/trade school certificate
- ❍ Two-year college degree
- ❍ Four-year college degree
- ❍ Graduate degree

27. What is your approximate annual household income before taxes?

- ❍ Under $20,000
- ❍ $20,000 - $39,999
- ❍ $40,000 - $59,999
- ❍ $60,000 - $79,999
- ❍ $80,000 - $99,999
- ❍ $100,000 - $119,999
- ❍ $120,000 - $139,999
- ❍ $140,000 - $159,999
- ❍ $160,000 and above

28. What is the zip code of your primary residence?

29. Is there anything else you would like to share with us? (open-ended)

30. Would you like to participate in our species identification section? If not, your survey is complete and we thank you for your participation. We are interested in understanding how well Texas boaters can identify aquatic invasive species that are a management priority for the Texas Parks and Wildlife Department. The following section will ask you to visually identify the aquatic invasive species presented. If you feel you can visually identify the following species, please check the correct box for the species presented.

- ❍ Yes
- ❍ No

If No, end of questionnaire

1. Please check the box next to the species shown in the photo. If you do not feel you are able to identify the species, please check the first box/option.

- ❍ Not Able to Identify
- ❍ Texas fatmucket (*Lampsilis bracteata*)
- ❍ Quagga mussel (*Dreissena bugensis*)
- ❍ Zebra mussel (*Dreissena polymorpha*)

2. Please check the box next to the species shown in the photo. If you do not feel you are able to identify the species, please check the first box/option.

- ❍ Not Able to Identify
- ❍ Water lettuce (*Pistia stratiotes*)
- ❍ Water hyacinth (*Eichornia crassipes*)
- ❍ Giant salvinia (*Salvinia molesta*)

3. Please check the box next to the species shown in the photo. If you do not feel you are able to identify the species, please check the first box/option.

- ❍ Not Able to Identify
- ❍ Bighead carp (*Hypophthalmichthys nobilis*)
- ❍ Grass carp (*Ctenopharyngodon idella*)
- ❍ Tilapia (*Oreochromis aureus*)

4. Please check the box next to the species shown in the photo. If you do not feel you are able to identify the species, please check the first box/option.

- ❍ Not Able to Identify
- ❍ Water lettuce (*Pistia stratiotes*)
- ❍ Water hyacinth (*Eichornia crassipes*)
- ❍ Giant salvinia (*Salvinia molesta*)

5. Please check the box next to the species shown in the photo. If you do not feel you are able to identify the species, please check the first box/option.

- ❍ Not Able to Identify
- ❍ Water lettuce (*Pistia stratiotes*)
- ❍ Water hyacinth (*Eichornia crassipes*)
- ❍ Giant salvinia (*Salvinia molesta*)