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Hydrilla Infestations in Florida Freshwater Bodies: How Results from a Management Needs Assessment Survey Helped Develop Suitable Information Delivery Platforms

Abstract

Hydrilla is an invasive aquatic plant that is expensive to control and exhibits increasing resistance to commonly used herbicides. Alternative control tactics for implementation in novel integrated management strategies are being investigated, but information needs to be delivered to stakeholders so new tactics can be adopted and used. Here, we report results from a low-cost, Web-based survey that assessed stakeholder access to hydrilla management information in Florida. We highlight the general benefits of needs assessment surveys for project development and exemplify how results from such surveys can be used by Extension professionals to tailor their information platforms to stakeholder-preferred outlets.

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Introduction

Hydrilla verticillata (hydrilla) is an invasive plant that arrived in Florida from Sri Lanka through the aquarium trade in the early 1950s and has become one of the most problematic aquatic weeds in the United States (Schmitz, Nelson, Nall, & Schardt, 1991; Langeland, 1996). Aquarium enthusiasts likely released this aggressive submersed plant into several areas of Florida, and hydrilla then rapidly spread to every watershed in the state. By the early 1990s, hydrilla populations occupied more than 140,000 acres of Florida's lakes and rivers (FWC, n.d.). Nationally, hydrilla infestations occur as far north as Maine on the Atlantic coast, and extend westward into Indiana, Texas, and California, and northward to the state of Washington on the Pacific coast (EDDMapS, 2012).

A major factor contributing to the invasiveness of hydrilla is its growth pattern. It grows as a sparsely branched, erect, rooted plant until it reaches the water surface, where it forms numerous

side branches. Dense surface canopies can cover an entire water body within 1 to 2 years of introduction. These surface mats displace native vegetation; interfere with navigation and flood control; affect native plant, fish, and zooplankton communities; and alter water temperature and chemistry (FWC, n.d.). Furthermore, hydrilla disperses easily by stem fragments, runners, and tubers. A single stem fragment attached to boating or fishing equipment and moved to new waters can initiate a new infestation. The Florida Fish and Wildlife Conservation Commission (FWC), and previously the Florida Department of Environmental Protection (DEP), have been spending $10-12 million on hydrilla control from the Aquatic Plant Control Trust Fund and other tax revenues each year (FLDEP, 2006; FWC, 2009). Additionally, water management districts, drainage districts, and state and local governments are spending significant public funds for hydrilla control.

As part of our program, educational materials are being developed to help resource managers understand how new control strategies, including biological control tactics, can fit into a hydrilla integrated pest management (IPM) plan. To ensure that the educational campaign would address the needs of stakeholders with widely varying interests in Florida's freshwater resources, University of Florida (UF) Institute of Food and Agricultural Sciences (IFAS) Extension and the Entomology and Nematology Department conducted a needs assessment survey with the following objectives:

1. Analyze what users of Florida's freshwater bodies know about hydrilla and its management
2. Identify types of water body usage by the sampled population
3. Determine types of educational resources regarding hydrilla management utilized by people who visit Florida's freshwater bodies

Delivering outreach material based on stakeholder needs will increase the likelihood that new management practices will be adopted and used. Although our survey addressed a specific problem in Florida, we expected results from the analysis not only to facilitate our programmatic campaign efforts but also, given availability to a broad audience on eXtension, to benefit Extension professionals in general. Benefits would include potential technology transfer for campaign development in other states with hydrilla infestations and determining whether online needs assessment surveys are suitable tools for program development.

Methods

An assessment survey called Hydrilla Infestations in Florida Freshwater Bodies was developed by the authors, optimized based on feedback from UF/IFAS faculty, and approved by the UF Institutional Review Board (UFIRB #2011-U-450). Florida residents who visit freshwater bodies for recreational or occupational purposes were the target population and considered as stakeholders with a potential interest in water body management practices. To reach a representative sample, UF/IFAS county Extension offices, water management districts, and professional associations/societies of natural resource managers, airboaters, duck hunters, anglers, etc. helped distributing the survey by newsletters and email to their clientele and members.

The project team chose Web delivery through SurveyMonkey due to the rising costs associated with mailing a traditional survey and the benefits of Web-based survey options (Archer, 2003). During 6

weeks, approximately 6,000 Florida stakeholders were contacted once, and 541 (9.0%) participated in the survey. Ninety participants skipped more than 50% of the 12 questions and were excluded from the analysis, rendering the usable response rate at 7.5% (451/6,000). The data was analyzed in an Excel spreadsheet and reported as percentages. To account for a potential sampling error resulting from the low response rate, the data was also compared statistically between early (first 3 weeks) and late (last 3 weeks) respondents (Miller & Smith, 1983). Demographic data were not collected, but participants could provide their names and contact information if they wanted to receive additional programmatic information as it became available. The survey was delivered during the first year of a 4-year grant, so our Extension program could be developed while the research was being performed.

Results and Discussion

Perceived Knowledge of Hydrilla and Its Management

Of the 451 survey respondents, 94.9% (428) were familiar with hydrilla. Surprisingly, only 40.6% (183) considered hydrilla a problem in the water bodies they visited, whereas 50.6% (228) did not and 8.6% (39) were not sure. In an earlier survey of pond users in Arkansas, 54.8% of the respondents indicated that aquatic weeds were a problem in visited ponds, but of that group, only 19.6 % reported submersed weeds like hydrilla as the cause (Neal, 2010). There are several reasons why people might not perceive hydrilla as a problem. Hydrilla is sometimes managed to minimize heavy infestation, leading stakeholders to underestimate the problem. Also, many anglers, bird watchers, and duck hunters view hydrilla as a positive attribute in lakes for the increased cover and food hydrilla provides for certain game fish and fowl.

Sixty-seven percent (301) knew who was responsible for managing hydrilla in the visited water bodies. Of those, 92.4% (278) specified responsible entities as state, county, and city governments; FWC; regional or state Water Management Districts (WMD); the U.S. Army Corps of Engineers; DEP; individual land owners or property managers; and private companies.

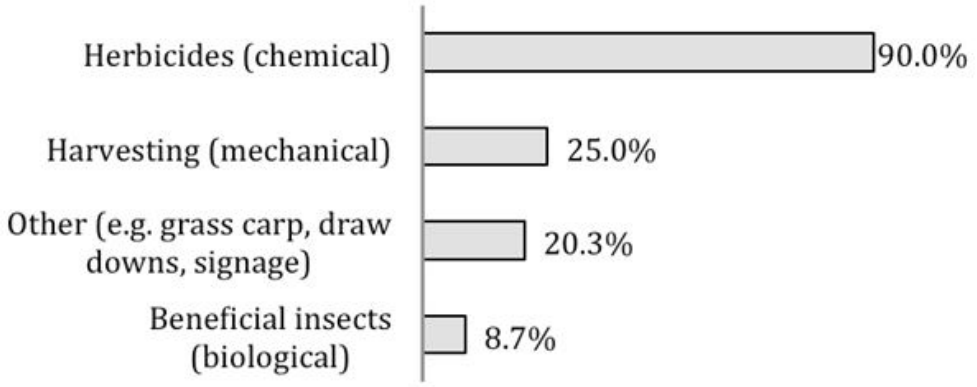
Furthermore, 66.5% (300) of the survey participants knew what types of hydrilla control tactics were applied. Responses showed that the perceived use of chemical herbicides was predominant, while mechanical harvesting appeared to be used less and biological control agents such as beneficial insects used least (Figure 1). Other mentioned tactics included the Asian grass carp (another biological control agent), draw downs, and educational signage.

This perception agrees with information from FWC stating that "[m]ost hydrilla control in Florida is achieved via herbicides registered with the U.S. Environmental Protection Agency and the Florida Department of Agriculture and Consumer Services" (FWC, 2011). This heavy reliance on herbicides is a factor leading to the increasing number of herbicide-resistant biotypes (Michel, Arias, Scheffler, Duke, Netherland, & Dayan, 2004; MacDonald, Netherland, & Haller, 2001; Netherland, 2009; Koschnik, Haller, & Netherland, 2006). It is important to note that replacing one chemical by another is no solution to the problem. Overuse of any chemical will promote tolerant or resistant biotypes, as recently demonstrated for hydrilla (Berger & MacDonald, 2011).

Resistance management requires the integration of alternative control options, and the survey results clearly showed that this shift has not yet happened in Florida. Most if not all of our nation's 23 states with hydrilla infestations will face the same problem. We therefore have included detailed information on biological control tactics and emphasized the concept of integrated pest management in our educational materials.

Figure 1.

Percentage of Survey Respondents Indicating Management Practices That Are Currently Applied at the Water Bodies They Frequent



Water Body Usage by Survey Participants

Figure 2 indicates that Florida's water bodies were visited mainly for recreational activities and predominantly for fishing. This aligns with an earlier survey of pond users, where 67.9% reported fishing as their primary use of ponds (Neal, 2010). Additionally, 27.9% (126) of the participants conducted water body and/or aquatic plant management, and 13.3% (60) indicated other reasons, including work-related activities and lakefront residence. Furthermore, various types of freshwater bodies were frequented by the survey participants (Figure 3), with freshwater lakes visited by most, followed by rivers, canals, ponds, and other water bodies, including springs, swamps, storm water treatment areas, and the ocean. These results showed that the sampled population met our expectation by exhibiting a variety of reasons to frequent water bodies. They also suggested that, to reach the majority of people who visit water bodies, our educational materials should include items useful on a fishing boat. We therefore designed and printed durable 1-yard fish rulers with information on hydrilla in particular and invasive aquatic plants in general. These rulers have been distributed at fishing tournaments, workshops for natural resource managers, and various meetings and conferences held by organizations involved in lake management.

Figure 2.

Reasons to Visit Florida Freshwater Bodies as Reported by a Survey of Water Body Users

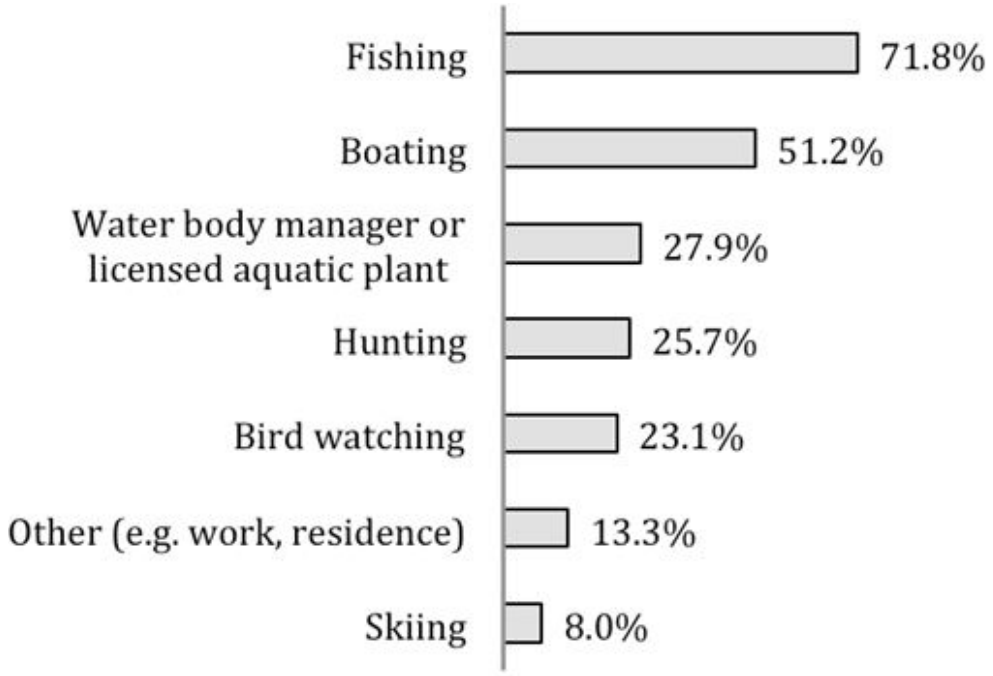
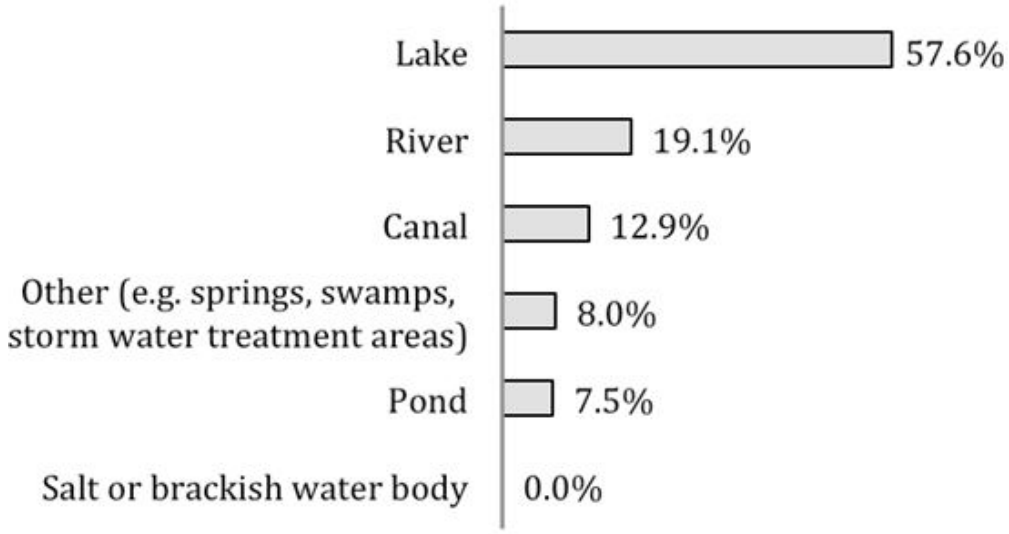


Figure 3.
Types of Water Bodies Visited as Reported by a Survey of Water Body Users



Determining Suitable Information Delivery Platforms

Easy access to new information on hydrilla control tactics is important for management of this invasive, exotic weed. The following questions helped determine the channels that were used and preferred by stakeholders to receive such information. Ninety-eight percent (444) specified how they obtain hydrilla management information. With descending predominance, they used FWC, the Internet, boat launch signs, Extension offices, chemical companies, and local news (Figure 4). Other sources included meetings, newsletters, journals, WMD offices, and park staff, and 13.3% (59) admitted that they never looked before. When asked "How would you like to get hydrilla management information," respondents clearly preferred the Internet (Figure 4), followed by FWC,

boat launch signs, Extension offices, and local news. When asked where on the Internet they searched for hydrilla management information, 303 respondents (67.2%) skipped the question, although 44 of those respondents indicated Internet use in a preceding question. The reason for skipping this question is unclear. Still, responses indicated clearly that besides general search engines, problem-specific websites were an important source of hydrilla-related information (Figure 5). In contrast, Facebook and the UF/IFAS Extension website Solutionsforyourlife.com were used minimally.

Figure 4.

Comparison of Currently Used and Preferred Channels to Receive Hydrilla Management Information as Reported by a Survey of Water Body Users

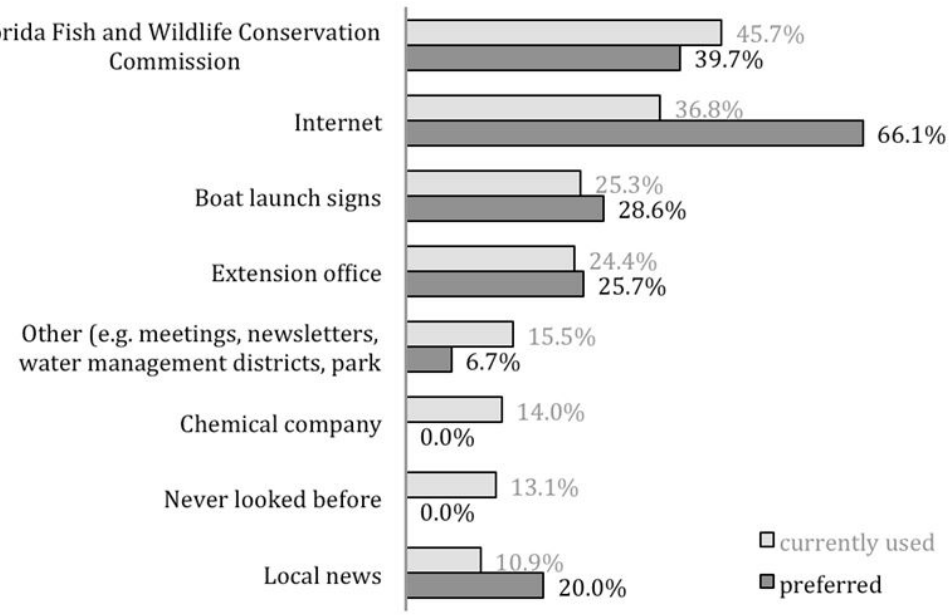
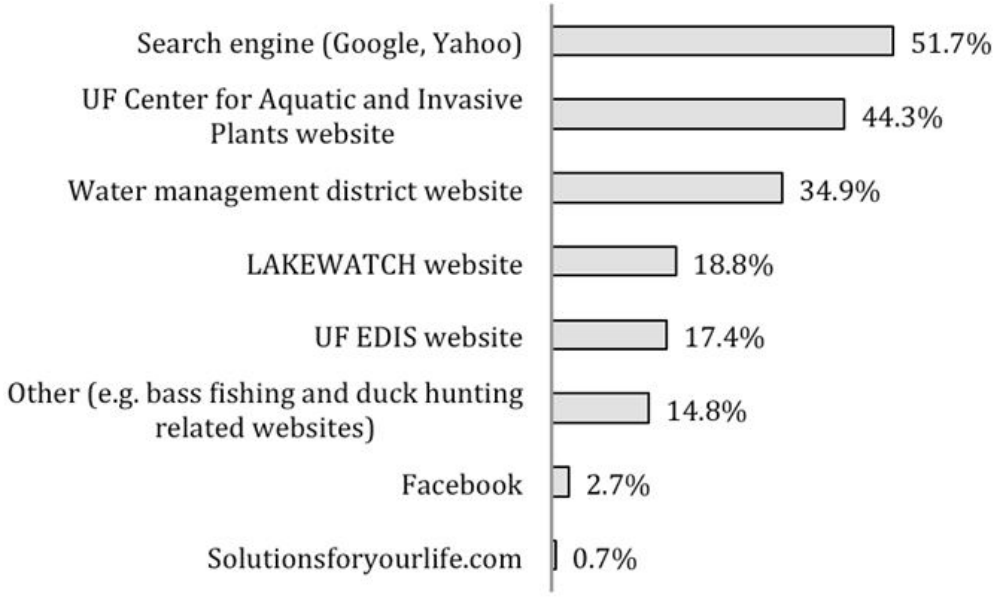


Figure 5.

Internet Sources Used to Search for Hydrilla Management Information as Reported by a Survey of Water Body Users



Using this information, the Extension team of the USDA-funded Hydrilla IPM Risk Avoidance and Mitigation Project with guidance from their Extension Advisory Committee developed a Web portal (URL: http://entomology.ifas.ufl.edu/hydrilla), including narrated learning lessons and a newsletter and launched campaigns with local newspaper and television stations. Furthermore, educational hand-out materials were provided statewide to FWC and county Extension offices, and signs for popular boat launch areas are being developed. Between August 2011 and May 2013, the educational items as well as news releases have generated 16,717 visits to our website. We established links with the national eXtension Invasive Species Community of Practice (URL: http://www.extension.org/invasive_species) and numerous other websites dealing with IPM and aquatic plants to facilitate increased visibility, broad accessibility, and adoption of new tactics by natural resource and aquatic plant managers as well as the general public visiting Florida's freshwater bodies.

Finally, the survey participants expressed high interest (75.8%, 342) for alerts and publicly posted updates as soon as new information on hydrilla IPM would become available. All of them provided their contact information. This result was unexpected and indicates the general need for education in hydrilla management. The Extension team will continue to send information as it is released to the list of interested participants in the future.

Response Rate

The low response rate and completion rate (7.5%) may indicate that many of the surveyed individuals felt the survey was irrelevant to their interests (Archer, 2008). Many natural resource agents, for instance, may not be involved in aquatic systems or invasive species management. Additionally, low response rates have been reported elsewhere (Wiersma, 2007; Raes Harms, Presley, Hettiarachchi, & Thien, 2013), and we suspect that they are common, especially because many studies fail to state return rates at all (Linder & Wingenbach, 2002). Whereas several researchers (Miller & Smith, 1983; Lindner, Murphy, & Briers, 2001; Lindner & Wingenbach, 2002; Wiseman, 2003) have pointed out that survey results need to be corrected for non-response error

whenever response rates fall below 85%, Archer (2008) argued that, especially in needs assessment studies, surveys with low response rates still produce valuable information.

Low response rates can be handled in various ways. If resources allow, follow-up mail reminders including a mail-in questionnaire and pre-paid return envelope may help retrieve additional responses (Israel, 2010). However, if the survey is aimed mainly at program development or improvement, responses from a small number of the surveyed clientele will provide useful and meaningful input (Archer, 2008). Finally, if comparing key results from early respondents with those from late respondents yields no statistically significant differences, the findings may be generalized to the entire surveyed population (Miller & Smith, 1983). This commonly accepted approach to handling non-response error assumes that non- and late respondents are similar (Radhakrishna & Doamekpor, 2008). Analysis of our data by chi-square tests did not yield differences (P 0.860) in the responses of early and late respondents and, hence, allowed generalizing the outcomes to the entire sampled population.

Major Outcomes and Implications for Extension

While we value the input from our Extension Advisory Committee members, it was important for us to seek additional guidance from water body users and managers. Our program is novel because we incorporated guidance from the survey and Advisory Committee in our plan of work while the grant team was in the early stages of research. This allowed us to begin building a robust Extension program that could be augmented with new findings when they became available. This practice has helped us overcome the lag in distributing new information to the public that often follows the availability of new research.

Survey results showed that stakeholders' awareness of problematic infestations was low and that the use of non-chemical hydrilla management strategies was reported to be minimal. The implications of these results for Extension activities are twofold: First, all visitors of freshwater bodies not only in Florida but also in the increasing numbers of other states with hydrilla infestations need to be alerted of the risks associated with this invasive aquatic weed. They need to be able to identify hydrilla and understand what they can do to prevent further spread. Second, resistance management is an increasingly important topic in agriculture and natural resource management. Although chemical control may offer short-term reduction of heavy infestations, the risk of resistance development needs to be acknowledged and understood. Long-term management of invasive species requires an integrated approach that combines different techniques and accounts for site-specific conditions. Our program, although focused on the specific problem of hydrilla infestations in Florida, is devoted to raising public awareness of invasive species and educating about new management options, including biological control tactics, as they become available through scientific research.

Furthermore, the survey allowed us to identify that Internet access to specific information regarding hydrilla management was an important educational resource. We responded to this need by launching a Web portal and linking it with local, national, and Web-based Extension outlets, and we expect that this linkage will support the promotion of new management practices and provide access to the information long after the completion of the program's funding period. By focusing our actions on the data presented here, we will be able to provide future reports on project outcomes and

impacts using channels that are utilized by Florida freshwater body users. Moreover, by placing the information in the public domain, it will be readily accessible to Extension specialists in other states with problematic hydrilla infestations.

The initial success of the project was based on determining stakeholder needs and practices. Despite a low response rate, using a Web-based survey provided high-quality results to the Extension team at a very low cost. We encourage Extension professionals to use this valuable tool after critically assessing the pros and cons of online surveys, many of which are discussed by Archer (2003), for their own program development.

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