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Transfer of integrated aquatic weed management knowledge following face-to-face training with citizen scientists

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ABSTRACT

Citizen scientists are valuable targets for education because their elevated interest usually leads to improved knowledge and dissemination of the taught information to the community. Education of the community is crucial because the major causes of establishment and spread of invasive plant species are anthropogenic. The objective of this study was to determine if face-to-face delivery of educational material would result in transfer of knowledge and engagement with the hydrilla integrated pest management program. We provided training to 368 Florida LAKEWATCH volunteers from 40 counties at 15 events through 30-minute seminars. At 10 events we provided pre- and posttests ($n = 177$) to evaluate learning, engagement, and potential for dissemination of the information taught. We found that working face to face with citizen scientists we were able to increase knowledge about invasive species, we were likely to change the way people felt about hydrilla management, and the learned information was likely to be shared. Therefore, face-to-face training of citizen scientists allows an educational program to reach far beyond its logistical means and ensure more of the community becomes aware of the necessary steps to prevent or reduce the impact of invasive species on the environment.

Key words: biological control, broader impacts, extension, outreach.

INTRODUCTION

Invasive aquatic nonnative plant species have multiple negative impacts on the environment that affect individuals such as lakefront homeowners, anglers, and boaters, as well as those that are responsible for managing natural areas (Weeks et al. 2020). Invasive plants typically reproduce quickly and may have multiple means of reproduction. Aquatic plants can be easily moved from one water body to another by humans who are not aware of their biology and ecology or the necessary precautions to prevent their spread to new water bodies (Seekamp et al. 2016, Kemp et al. 2017). For example, fragments of hydrilla (*Hydrilla verticillata*) on boats can produce new plants, even if dried out for an hour (Baniszewski et al. 2016). Therefore, education of the community is necessary in order to ensure that adequate precautions are taken to reduce the risk of further spread and establishment.

Community support of management tactics is important to allow natural resource managers to effectively do their work. Community members that care about the environment are often concerned by the nontarget effects of interventions for aquatic plant management (Oxley et al. 2016). For example, 59% of surveyed participants were against the use of herbicides for aquatic plant control (Oxley et al. 2016). It is important that the pros and cons of these tactics are understood so that the process is transparent, and any concerns are alleviated if justified. The community may also be helpful with assisting management efforts. Physical removal, which might be the only option in environmentally sensitive areas such as wetlands, is labor intensive, time consuming, and physically demanding work (Gillett-Kaufman et al. 2014). In aquatic areas there can also be safety concerns related to wildlife, such as alligators and snakes. Regardless, community invasive species monitoring can help alleviate the strain on government resources (Lodge et al. 2006); however, this requires mobilization, typically from within the community itself, from members educated about the plant's appearance, biology, ecology, and necessary tools and techniques for removal. Additionally, community collaboration in controlling plants on private properties reduces spread and the costs associated (Epanchin-Niell and Wilen 2014), which is likely to reduce or prevent invasion into natural and pubic areas.

Reaching the whole community has logistical issues including the time and funding required to provide training to many people. Targeting an already engaged group of people within a community is one way to ensure that participation in a program will be high and that dissemination of knowledge beyond the original trainees in the program is likely, due to the group's dedication to the target issues (Alender 2016). Citizen scientists working on data collection for environmental or ecological objectives are a group of people that are already engaged with the scientific community and are known to be keen to learn new information and teach it to others (Roggenbuck et al. 2001). Volunteers have been demonstrated to provide valuable input to monitoring and management of various invasive species throughout the world (for example, Brown et al. 2001, Delaney et al. 2008, Andow et al. 2016, Chao and

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Lin 2017, Grason et al. 2018, Dechoum et al. 2019, Nimis et al. 2019).

Alender (2016) found the four top motivations for volunteering as water quality monitors to be 1) helping/enhancing the environment, 2) helping the community, 3) getting outside and connecting with nature, and 4) contributing to scientific knowledge. Similarly, Roggenbuck et al. (2001) found protecting the environment to be the most cited motivator. This corresponds with Bruyere and Rappe (2007), who reported that learning about the environment and improving areas personally used by volunteers were high incentives. Motivations are known to be dynamic, and those that inspire a member of the public to become a citizen scientist are different from those that promote retention of volunteers (Jennett et al. 2016). A later stage motivation is often the demonstration that their data are useful and being used to influence changes in management decisions. Several studies have shown that the data collected by these citizen scientists can be statistically equal to that collected by professionals (Fore et al. 2001, Canfield et al. 2002, Delaney et al. 2008, Edgar and Stuart-Smith 2009), and although biased and unbiased errors may be introduced to the data, these are typically similar to those in other datasets and can be managed with statistical tools (Bird et al. 2014). Citizen-scientist–collected data improve when well-thought-out protocols are provided and detailed training is given (Cohn 2008, Crall et al. 2010). Training can be provided online or face to face. Previous studies have shown that both text-only and multimedia online trainings are equally effective at preparing citizen scientists to collect data (Newman et al. 2010). Flipped classrooms, which have online followed by face-to-face trainings, have shown knowledge gain as well as participant satisfaction (Larkin et al. 2018). However, other studies have found in-person learning modules to be as effective at volunteer recruitment and retention as a letter (Andow et al. 2016).

The University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Florida LAKEWATCH program is a citizen-scientist–based lake-monitoring program that has been sampling water bodies in Florida since 1986 (Hoyer et al. 2012, 2014). Currently, Florida LAKEWATCH citizen science volunteers actively monitor more than 600 lakes, 125 rivers, and 150 coastal sites in Florida, recording data and taking samples on a monthly basis for further analyses by Florida LAKEWATCH. Their citizen scientists' dedication to water body protection is evidenced by their continued participation in Florida LAKEWATCH and their careful sampling, which was demonstrated to equal that of professional environmental monitoring staff (Canfield et al. 2002, Hoyer et al. 2012). Our aquatic invasive plant species working group partnered with Florida LAKEWATCH with the aim of increasing dissemination of our scientific data to communities throughout Florida using their already established network of citizen science volunteers.

The objective of this study was to determine if face-to-face delivery of this material would result in transfer of knowledge and engagement with an aquatic invasive plant integrated pest management program.

MATERIALS AND METHODS

Training sessions

We partnered with UF/IFAS Florida LAKEWATCH to deliver face-to-face training sessions to Florida citizens throughout 2014. Training sessions at Florida LAKEWATCH annual regional meetings included a 30-min presentation with pre- and posttest evaluation. No protected health information was collected during the testing process, and so our testing instruments were granted an exemption from the Code of Federal Regulations by the UF Institutional Review Board (UF IRB Exemption no. 201600234).

Presentations were the same at all events and provided by one of five trainers, all of whom had doctoral-level training and experience in the fields of entomology, biological control, and aquatic plant management. All were involved in the project and so had detailed knowledge of the material to be presented as well as extensive background knowledge of the topic.

Pretest evaluation

Questions asked in the pretest were the following:

- Why do you visit Florida water bodies? Free text answer.
- Are you familiar with the invasive aquatic plant hydrilla? Yes/no answer.
- Do you think hydrilla is a problem in Florida? Yes/no answer.
- Please list hydrilla control tactics that you know about. Free text answer.

Posttest evaluation

Questions asked in the posttest were the following:

- Did the information that you heard today change the way you think about hydrilla management? Yes/no answer.
- Will you share the hydrilla integrated pest management information you received today with other people? Yes/no answer.
- Please list hydrilla control tactics that you know about. Free text answer.
- Would you like to learn more about hydrilla integrated pest management in the future? Yes/no answer.

Data handling

Responses from all testing events were compiled into one database for interpretation and analysis. For the free text answers, categories were chosen based on the frequency of responses. For the question "Why do you visit Florida water bodies?" if lakefront owner was mentioned with other activities, "lakefront owner" was listed as the answer. For

Table 1. Questions that comprised the pre- and posttests provided to participants of face-to-face training at Florida LAKEWATCH events. Percentage responses given for the yes/no questions and the demographical questions that were not analyzed statistically. Answers to free text questions not provided here are provided in Figures 1 and 2.

Question	Targeted Information	Answer Type	n	Yes (%)	No (%)	Participant Type	%
Why do you visit Florida water bodies?	Demographics	Free text	175			Lakefront homeowner	68.6
						Recreational user	17.1
						Other	14.3
Are you familiar with the invasive aquatic plant hydrilla?	Awareness	Yes/No	176	85.8	14.2		
Do you think hydrilla is a problem in Florida?	Awareness	Yes/No	170	95.9	4.1		
Please list hydrilla control tactics that you know about.	Learning	Free text					
Did the information that you heard today change the way you think about hydrilla management?	Opinion change/ learning	Yes/No	164	91.5	8.5		
Will you share the hydrilla integrated pest management information you received today with other people?	Dissemination	Yes/No	163	99.4	0.6		
Please list hydrilla control tactics that you know about.	Learning	Free text					
Would you like to learn more about hydrilla integrated pest management in the future?	Engagement	Yes/No	148	70.9	29.1		

the question "Please list hydrilla control tactics that you know about," which appears in the pre- and the posttest, these answers were sorted into the main categories of management: chemical (spraying/herbicide/chemical etc.), mechanical (mechanical removal/harvesting), biological (biological/fish/grass carp/bugs etc.), and physical (hand removal/dredging/drawdowns etc.), based on the author's knowledge. If a specific biological control tactic was mentioned, such as "grass carp," it was noted in the specific biological control tactic category, which in this example would be the "fish" category and the "biological control" category for later analysis. If integrated pest control or integrated pest management (IPM) was mentioned, this was listed separately. If the question was skipped, it was considered that the person did not know the answer either in the pre- or posttest because less than 3% of participants skipped the question in both the pre- and posttests. The numbers of tactics known in the pre- and posttests were calculated for each participant. Only the main management tactics, i.e., chemical, mechanical, physical, and biological control, were counted.

Statistical analysis

Statistical analysis was completed on select questions of pre- and posttests to compare knowledge before and after training about hydrilla management tactics using SAS version 9.4 (SAS Institute Inc., Carey NC; $\alpha = 0.05$). Specifically, the number of responses for each control tactic (chemical, mechanical, biological, physical, IPM, or other) and the number of responses for the subcategories of the biological control tactic (fish, insects, or fungi) were compared before and after training. Additionally, the number of participants that skipped the question "Please list hydrilla control tactics that you know about" and the number of participants that said "I don't know" in answer to the same question were compared pre- and posttest. For all the above comparisons, a generalized linear mixed model was fitted to the responses by controlling for the random factors of county (where the participants resided) and trainer (who provided the training) under a binomial distribution with a logit link. Comparisons between the pre- and posttest responses were done with a Wald test that included the Kenward-Roger's correction of degrees of freedom. Additionally, the sum of the tactics known before and after training was compared by fitting a linear mixed model controlling for the random factors of county and trainer under a Normal distribution.

RESULTS AND DISCUSSION

Training was provided to 368 Florida LAKEWATCH volunteers from 40 counties (at 15 events). Unfortunately, staff trained in testing procedures were not able to attend all training events. Therefore, testing was conducted at only 10 events. In total, 177 attendees completed the pre- and posttests (on average 75% per event). Answers are summarized in Table 1. Most of the participants were lakefront homeowners and recreational users, typically boaters or anglers. Less frequent answers were volunteer, work, wildlife, fun, and enjoying the beauty of nature; these answers were grouped into the category "other." Most of the participants were familiar with hydrilla and thought hydrilla was a problem in Florida.

Learning is the second most important reason, behind protecting the environment, that motivates citizen scientists to be involved in a water-monitoring program (Roggenbuck et al. 2001). The test results demonstrated that participants in the face-to-face training sessions gained knowledge about hydrilla management tactics previously unknown to them. In the pretest Florida LAKEWATCH volunteers were asked to list hydrilla control tactics that they knew about prior to the training provided. More participants knew about all of the categories of pest management, chemical ($F_{1,352} = 17.91$, $P < 0.0001$), mechanical ($F_{1,352} = 20.82$, $P < 0.0001$), biological ($F_{1,352} = 37.2$, $P < 0.0001$), and physical ($F_{1,352} = 8.31$, $P = 0.0042$), posttest compared with pretest (Figure 1). The number of participants that listed IPM increased from 1.6% to 17.9% ($F_{1,352} = 17.46$, $P < 0.0001$). The percentage of participants that listed a tactic that was categorized as other (i.e., cleaning boats, nutrition management, education, etc.) was significantly fewer in the posttest than in the pretest ($F_{1,352} = 5.27$, $P = 0.0223$). Following training, a significantly higher percentage of participants listed the

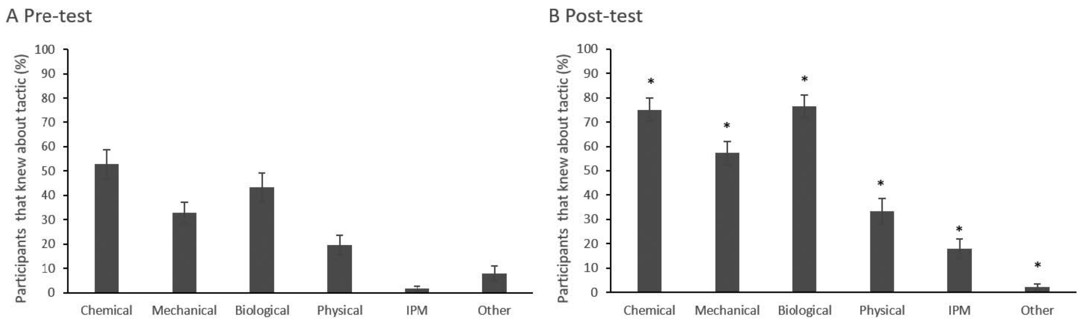

Figure 1. Evaluation of the pretest (A) and posttest (B) responses to the question: Please list hydrilla control tactics that you know about (IPM = integrated pest management). There were 177 participants, and those that skipped the question were considered to not know the tactic. Bars indicate mean percentage of participants that knew tactic ± standard errors. Asterisks indicate significant differences between pre- (A) and posttest (B) responses, $P <$ 0.05 in all cases.

alternatives to fish (i.e., grass carp), fungi ($F_{1,352} = 19.67$, $P <$ 0.0001) and insects ($F_{1,352} = 51.14$, $P < 0.0001$) as biological control agents in the posttest compared with in the pretest (Figure 2).

In the pre- and posttests, participants were asked to list all control tactics that they currently know. Significantly more tactics (i.e., chemical, mechanical, physical, and biological) were known in the posttest (2.41 ± 0.11 standard error) compared to in the pretest (1.49 ± 0.11 standard error; $F_{1,346} = 49.7$, $P < 0.0001$). There was no significant difference in the participants that said "I don't know" in the posttest compared with in the pretest ($F_{1,352} = 0$, $P = 0.9764$). However, the number that gave this answer was low in the pretest ($n = 8$), and in the posttest no participants gave this answer. Combined, these results indicate that the participants knew more tactics and felt more confident answering the question after our training compared with before our training.

A limitation of our study is that we do not know if those participants that skipped the question did so because they did not know the answer or because they did not wish to answer the question. When the numbers of participants that skipped the question related to naming control tactics in the pre- and posttests were compared there was no significant difference ($F_{1,352} = 2.6$, $P = 0.1077$). In the pretest 19% skipped the question and posttest slightly less at 13%; however, only five participants (3%) skipped this question in both the pre- and posttests. This indicates that in most cases a participant that skips the question is doing so because they do not know the answer. For this reason, we decided to include those that skipped the question in the analysis.

When asked, approximately 70% of the participants would like to learn more about hydrilla IPM in the future. Research on volunteer engagement is focused on organization commitment, satisfaction, and intention to remain involved (Vecina et al. 2012). Our participants indicated their engagement through intention to remain involved when 70% wanted to learn more about the topic and 50% provided their e-mail address so that they could be contacted further and added to a newsletter mailing list. This lead us to believe they were highly engaged with the program. In general, participants that are more engaged are more able to learn and perform better in project-specific tests. For example, Masters et al. (2016) found that measures of engagement, specifically the amount of work completed and the time spent active on the project, correlated with the score in a project-specific test. This indicates that our highly engaged volunteers will perform better in tests on hydrilla IPM because they are more likely to have learned the material.

Of our face-to-face trainees the majority reported that they would share the information they received, a form of "teaching." According to Roggenbuck et al. (2001), the third most important reason for being motivated to be involved

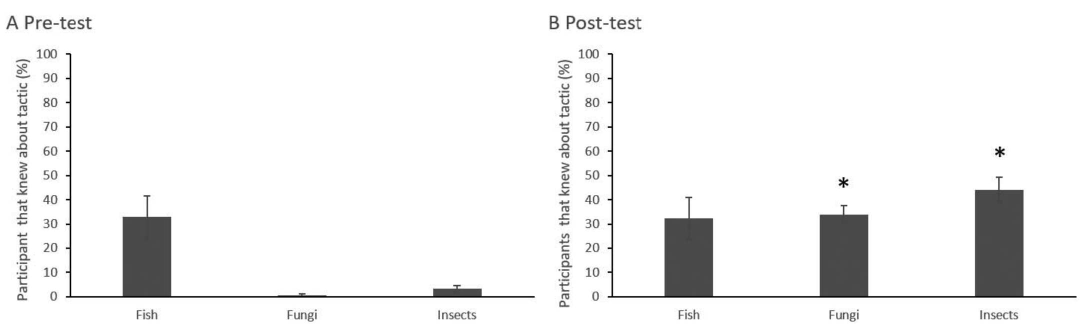

Figure 2. Evaluation of the pretest (A) and posttest (B) responses to the question: Please list hydrilla control tactics that you know about, with emphasis on specific biological control tactics. There were 177 participants, and those that skipped the question were considered to not know the tactic. Bars indicate mean percentage of participants that knew tactic ± standard errors. Asterisks indicate a significantly higher percentage posttest, $P < 0.0001$ in all cases.

in a water-monitoring program is the opportunity to teach others what they have learned or know.

In the future attempts should be made to follow up with the training participants to determine if the learning gains were short term or longer term. The current study assessed learning immediately following the training session, which would measure retention of the material short term. Although it is well understood that it is difficult to provide training that results in long-term retention, face-to-face trainings have shown greater success than online trainings (Turner and Turner 2017). Other studies have found that an in-person training module resulted in similar volunteer recruitment and retention and comparable data quality to a letter (Andow et al. 2016). Unfortunately, we were not able to compare our face-to-face training with an online version in the current study.

Furthermore, it would be worthwhile to follow up on engagement and dissemination outcomes. For example, an online survey could be sent to those participants that provided their e-mail addresses, asking if they continued to be involved with the program and if they shared the information they received with others, respectively.

The objective of this study was to determine if face-to-face delivery of this material would result in transfer of knowledge and engagement with the hydrilla IPM program. Our face-to-face trainings changed the way that the majority of our participants felt about hydrilla management. Therefore, the results of our pretesting and posttesting demonstrate that face-to-face delivery of this material would result in transfer of knowledge and engagement with the hydrilla IPM program. This is not surprising given the knowledge that verbal appeals to potential volunteers for assistance are highly persuasive (Clary et al. 1994, Asah and Blahna 2012).

Delivering technical scientific information to stakeholders is challenging, particularly in natural resource management, as the user group is diverse with varied needs and concerns. With this in mind, the goal of our study was to determine if we could use face-to-face trainings to train citizen scientists who would, by their motivation to learn and teach, be engaged to take in the information and pass it on to others. Our face-to-face trainings with citizen scientists were highly effective, with a significant learning gain on average. In general, our face-to-face trainees indicated that they were likely to share the information they received, a form of teaching. As they are likely to share the information they received, these trainings are also an effective way to disseminate our information into the community without additional costs. Moving forward we hope to continue to use citizen scientist volunteers to facilitate technology transfer and help stakeholders and volunteers find the answers to their questions about aquatic plant management.

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LITERATURE CITED

Alender B. 2016. Understanding volunteer motivations to participate in citizen science projects: A deeper look at water quality monitoring. JCOM 15(03), Article A04. https://jcom.sissa.it/sites/default/files/documents/JCOM__1503__2016__A04.pdf.

Andow DA, Borgida E, Hurley TM, Williams AL. 2016. Recruitment and retention of volunteers in a citizen science network to detect invasive species on private lands. Environ. Manage. 58:606–618.

Asah ST, Blahna DJ. 2012. Motivational functionalism and urban conservation stewardship: Implications for volunteer involvement: Urban conservation stewardship. Conserv. Lett. 5(6):470–477.

Banizewski J, Cuda JP, Gezan SA, Sharma S, Weeks ENI. 2016. Stem fragment regrowth of *Hydrilla verticillata* following desiccation. J. Aquat. Plant Manage. 54:53–60.

Bird TJ, Bates AE, Lefcheck JS, Hill NA, Thomson RJ, Edgar GJ, Stuart-Smith RD, Wotherspoon S, Krkosek M, Stuart-Smith JF, Pecl GT, Barrett N, Frusher S. 2014. Statistical solutions for error and bias in global citizen science datasets. Biol. Conserv. 173:144–154.

Brown WT, Krasny ME, Schoch N. 2001. Volunteer monitoring of nonindigenous invasive species in the Adirondack Park, New York, USA. Nat. Areas J. 21:189–196.

Bruyere B, Rappe S. 2007. Identifying the motivations of environmental volunteers. J. Environ. Plan. Manage. 50(4):503–516.

Canfield DE Jr, Brown CD, Bachmann RW, Hoyer MV. 2002. Volunteer lake monitoring: Testing the reliability of data collected by the Florida LAKEWATCH program. Lake Reservoir Manage. 18:1–9.

Chao RF, Lin TE. 2017. Effect of citizen action on suppression of invasive alien lizard population: A case of the removal of *Eutropis multifasciata* on Green Island, Taiwan. Appl. Ecol. Environ. Res. 15:1–13.

Clary EG, Snyder M, Ridge RD, Miene PK, Haugen JA. 1994. Matching messages to motives in persuasion: A functional approach to promoting volunteerism. J. Appl. Social Psychol. 24:1129–1146.

Cohn JP. 2008. Citizen science: Can volunteers do real research? BioScience 58:192–197.

Crall A, Newman GJ, Jarnevich CS, Stohlgren TJ, Waller DM, Graham J. 2010. Improving and integrating data on invasive species collected by citizen scientists. Biol. Invasions 12:3419–3428.

Dechoum MD, Giehl ELH, Suhs RB, Silveira TCL, Ziller SR. 2019. Citizen engagement in the management of non-native invasive pines: Does it make a difference? Biol. Invasions 21:175–188.

Delaney DG, Sperling CD, Adams CS, Leung B. 2008. Marine invasive species: Validation of citizen science and implications for national monitoring networks. Biol. Invasions 10:117–128.

Edgar GJ, Stuart-Smith RD. 2009. Ecological effects of marine protected areas on rocky reef communities—A continental-scale analysis. Mar. Ecol. Prog. Ser. 388:51–62.

Epanchin-Niell RS, Wilen JE. 2014. Individual and cooperative management of invasive species in human-mediated landscapes. Am. J. Agric. Econ. 97:180–198.

Fore LS, Paulson K, O'Lauhlin K. 2001. Assessing the performance of volunteers in monitoring streams. Freshwater Biol. 46:109–123.
Gillett-Kaufman JL, Lietze V-U, Weeks ENI. 2014. Hydrilla integrated management. University of Florida Institute of Food and Agricultural Sciences Entomology and Nematology Department, document IN104400. http://edis.ifas.ufl.edu/pdffiles/IN/IN104400.pdf. Accessed September 16, 2019.
Grason EW, McDonald PS, Adams J, Litle K, Apple JK, Pleus A. 2018. Citizen science program detects range expansion of the globally invasive European green crab in Washington State (USA). Manage. Biol. Invasions 9: 39–47.
Hoyer MV, Bigham DL, Bachmann RW, Canfield DE Jr. 2014. Florida LAKEWATCH: Citizen scientists monitoring aquatic systems and how data are used. Fla. Sci. 77:184–197.
Hoyer MV, Wellendorf N, Frydenborg R, Bartlett D, Canfield DE Jr. 2012. A comparison between professionally (Florida Department of Environmental Protection) and volunteer (Florida LAKEWATCH) collected trophic state chemistry data in Florida. Lake Reservoir Manage. 28:277–281.
Jennett C, Kloetzer L, Schneider D, Iacovides I, Cox AL, Gold M, Fuchs B, Eveleigh A, Mathieu K, Ajani Z, Talsi Y. 2016. Motivations, learning and creativity in online citizen science. JCOM 15(03), Article A05. https://jcom.sissa.it/sites/default/files/documents/JCOM__1503__2016__A05.pdf.
Kemp C, van Riper CJ, BouFajreldin L, Stewart WP, Scheunemann J, van den Born RJG. 2017. Connecting human–nature relationships to environmental behaviors that minimize the spread of aquatic invasive species. Biol. Invasions 19:2059–2074.
Larkin DJ, Weber MM, Galatowitsch SM, Gupta AS, Rager A. 2018. Flipping the classroom to train citizen scientists in invasive species detection and response. J. Extension 56(05), Article 5T0T1. https://joe.org/joe/2018september/pdf/JOE__v56__5tt1.pdf.
Lodge DM, Williams S, MacIssac HJ, Haynes KR, Leung B, Reichard S, Mack RN, Moyle PB, Smith M, Andow DA, Carlton JT, McMichael A. 2006. Biological invasions: Recommendations for U.S. policy and management. Ecol. Appl. 16:2035–2054.
Masters K, Oh EY, Cox J, Simmons B, Lintott C, Graham G, Greenhill A, Holmes K. 2016. Science learning via participation in online citizen science JCOM 15(03), Article AOT. https://jcom.sissa.it/sites/default/files/documents/JCOM__1503__2016__A07.pdf.
Newman G, Crall A, Laituri M, Graham J, Stohlgren T, Moore JC, Kodrich K, Holfelder KA. 2010. Teaching citizen science skills online: Implications for invasive species training programs. Appl. Environ. Ed. Comm. 9:276–286.
Nimis PL, Pittao E, Altobelli A, De Pascalis F, Laganis J, Martellos S. 2019. Mapping invasive plants with citizen science. A case study from Trieste (NE Italy). Plant Biosyst. 153:700–709.
Oxley FM, Waliczek TM, Williamson PS. 2016. Stakeholder opinions on invasive species and their management in the San Marcos river. Exten. Educ. Methods 26:514–521.
Roggenbuck JW, Haas SC, Hall TE, Hull RB. 2001. Motivation, retention, and program recommendations of Save Our Streams volunteers. Virginia Water Resources Research Center at Virginia Polytechnic Institute and State University, Blacksburg, VA. https://vtechworks.lib.vt.edu/handle/10919/49465. Accessed September 2, 2019.
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. Biol. Invasions 18:1745–1758.
Turner C, Turner KD. 2017. The effects of educational delivery on knowledge retention. J. Educ. Business 92:201–209.
Vecina ML, Chacón F, Sueiro M, Barrón A. 2011. Volunteer engagement: Does engagement predict the degree of satisfaction among new volunteers and the commitment of those who have been active longer? Appl. Psychol. 61:130–148.
Weeks ENI, Gillett-Kaufman JL, Hoyer MV. 2020. A survey of hydrilla management educational materials for optimal stakeholder preference, learning, and knowledge transfer in Florida. J. Aquat. Plant Manage. 58:55–60.