IRCF REPTILES & AMPHIBIANS
CONSERVATION AND NATURAL HISTORY

The North American Freshwater Turtle Research Group (NAFTRG): An Undergraduate Research Experience (URE) and Citizen Scientist Project

Eric C. Munscher[1], Brian P. Butterfield[2], Jessica S. Munscher[3], Eleanor Alia Barrett[4], and J. Brian Hauge[5]

[1]Department of Natural Resources, SWCA Environmental Consultants, Houston, Texas 77040 (emunscher@swca.com)
[2]Department of Biological, Physical, and Human Sciences, Freed-Hardeman University, Henderson, Tennessee 38340
[3] De Chaumes Elementary School, Houston ISD, 155 Cooper Rd, Houston, Texas 77076
[4]Huxley College of the Environment, Bellingham, Washington 98225
[5]Department of Biology, Peninsula College, Port Angeles, Washington 98362

Abstract.—Researchers today understand the importance of incorporating undergraduate research experiences (URE) and citizen-science methods into data collection and long-term research projects. The North American Freshwater Turtle Research Group (NAFTRG) is an example of a project in which both methods are implemented. The NAFTRG conducts long-term studies on turtle populations in seven state park springs in Florida and the largest freshwater spring in Texas. Although the study began as an undergraduate biology class, it has expanded throughout the years into a study that many parks and researchers rely upon for important data on turtle populations and for information that helps manage the stability of ecosystems. Through the use of UREs, the research investigators are enabling undergraduates to gain valuable research experiences while maintaining a volunteer base that has a vested interest in the study itself. Students from Pennsylvania State University, University of North Florida, Peninsula College, Freed-Hardeman University, and Western Washington University have chosen to participate in the study. Many of these students have volunteered additional time and efforts during subsequent research trips. A project of this nature enables students to see the importance of ecosystem awareness. Through the use of citizen science, investigators can form a large volunteer base while incorporating sophisticated ecological methodologies and furthering conservation efforts. Many participating citizen scientists have jobs unrelated to the sciences; they volunteer their time because they understand the importance of the group's objectives and are willing to support them with their time and energy. Our current volunteer base receives further support from local zoos, aquariums, amusement parks, and the public. Based on standardized values for volunteer work, citizen scientists and donations from governmental and non-governmental organizations have contributed approximately one million dollars to this project. Citizen science is helping to bridge the gap between the general public and the scientific community by allowing the two to work together in monitoring, managing, maintaining, and understanding the ecological issues around us.

Key Words: Citizen scientist; long-term monitoring; undergraduate research; volunteer

Biologists who work at undergraduate teaching institutions often encounter difficulties when trying to develop and maintain long-term active research programs. These biologists usually carry a heavy teaching load that minimizes time to conduct research, and often lack research funding and space. However, research has become an important component of the portfolios of faculty members seeking promotion, even in undergraduate teaching institutions. Additionally, incorporating undergraduate research experiences (URE) into higher education curricula has become a priority for educators and educational institutions (Millspaugh and Millenbah 2004, Krebs 2005). Biologists at undergraduate teaching institutions and consulting firms often lack the time available to collect field-oriented data alone. However, URE students can provide the labor force needed for data collection. Researchers in need of a labor force also have recognized the

Fig. 1. Large Florida Softshell (*Apalone ferox*) captured at Wekiwa Springs State Park (WSSP). Photograph by Jessica Weber.

value of involving interested citizens as volunteers engaged in scientific data collection (Trumbull et al. 2000, Evans et al. 2005, Cooper et al. 2007).

Oberhauser and Prysby (2008) described citizen science as projects involving people who are not professionally trained scientists in some level of scientific research (i.e., training, project design and implementation, and analyzing and publishing data). In contrast to the majority of scientific research, citizen science is not merely focused on answering a particular set of questions, but instead offers projects designed to combine conservation efforts within the local community (Delaney et al. 2008, Oberhauser and Prysy 2008). This is accomplished by using a research project to construct an educational tool accessible to anyone.

Researchers using URE and citizen science models for conducting field research have the benefits of harnessing relatively large labor forces but also face unique challenges. Researchers entrust portions of data collection to undergraduates and citizen volunteers who often have little biological training, therefore requiring more direct supervision than do graduate research assistants (Hammer 2001, Evans et al. 2005). Also, time constraints and outside commitments facing undergraduates and citizen volunteers frequently conflict with those of researchers and graduate research assistants.

Despite these challenges, URE and citizen-science models can be implemented to the benefit of all participants. Researchers, especially university faculty members, have an avenue for meeting long-term research goals while providing instruction to undergraduates (Millspaugh and Millenbah 2004). Undergraduates gain skills to further their education and to pursue careers in the sciences (Millspaugh and Millenbah 2004, McCleery et al. 2005). Citizen volunteers become actively engaged in both empirical research and applied conservation efforts (Trumbull et al. 2000, Cooper et al. 2007, Oberhauser and Prysby 2008), and by participating, citizens can better understand and appreciate ecological research (Evans et al. 2005, Delaney et al. 2008). Citizen-science programs also have been shown to increase public awareness of specific environmental issues, academic requirements, as well as an understanding of the challenges many universities face when designing and implementing these kinds of projects (Alabri and Hunter 2010). Delaney et al. (2005) stated that citizen science has begun to contribute substantially to the wealth of information about population structures, distributions, and behaviors of many organisms, all of which facilitate the effective conservation of various animals and their habitats.

The North American Freshwater Turtle Research Group (NAFTRG) has become successful because it has specifically

adopted a URE/Citizen Science research model to conduct long-term turtle research (Figs. 1 & 2). In this article we demonstrate how a URE/Citizen Science research model can be an effective way of conducting long-term field studies using our long-term freshwater turtle research project as a model. We also encourage other researchers to consider implementing a URE/Citizen Science research model for establishing and conducting long-term field studies.

History of the North American Freshwater Turtle Research Group

During May 1999, J. Brian Hauge (JBH) and Brian P. Butterfield (BPB), with the support of Brian Emanuel (Wekiwa Springs State Park Biologist), set out to develop field research experiences, such as removal of invasive species and turtle population studies, that could be incorporated into undergraduate courses offered at their respective universities. These courses were designed to generate baseline data on native and invasive species of reptiles and amphibians in Florida while simultaneously providing students with opportunities to conduct meaningful research as part of their undergraduate education.

The creation of the long-term turtle population study at Wekiwa Springs State Park contributed to a significant portion of these field research classes. Research at Wekiwa Springs has yielded publications including a master's thesis (Hrycyshyn 2006) and several peer-reviewed journal articles (Weber et al. 2011, describing a new marking method for soft-shelled turtles; Munscher and Weber 2012), as well as other articles and notes currently in press or preparation for submission.

The courses were taught regularly until 2004, at which time JBH left Pennsylvania State University and BPB assumed administrative duties at Freed-Hardeman University, leaving little time to lead the turtle study. Fortunately, they were able to entrust the turtle study to two of JBH's students, Gabrielle Hrycyshyn (GH) and Eric C. Munscher (ECM). GH used the 1999–2005 data as the basis for her MS Thesis at the University of Florida (Hrycyshyn 2006), and ECM became the principle investigator of the research

Fig. 2. A large Florida Red-bellied Cooter (*Pseudemys nelsoni*) and a friend at Wekiwa Springs State Park. Photograph by Joanne Bolemon.

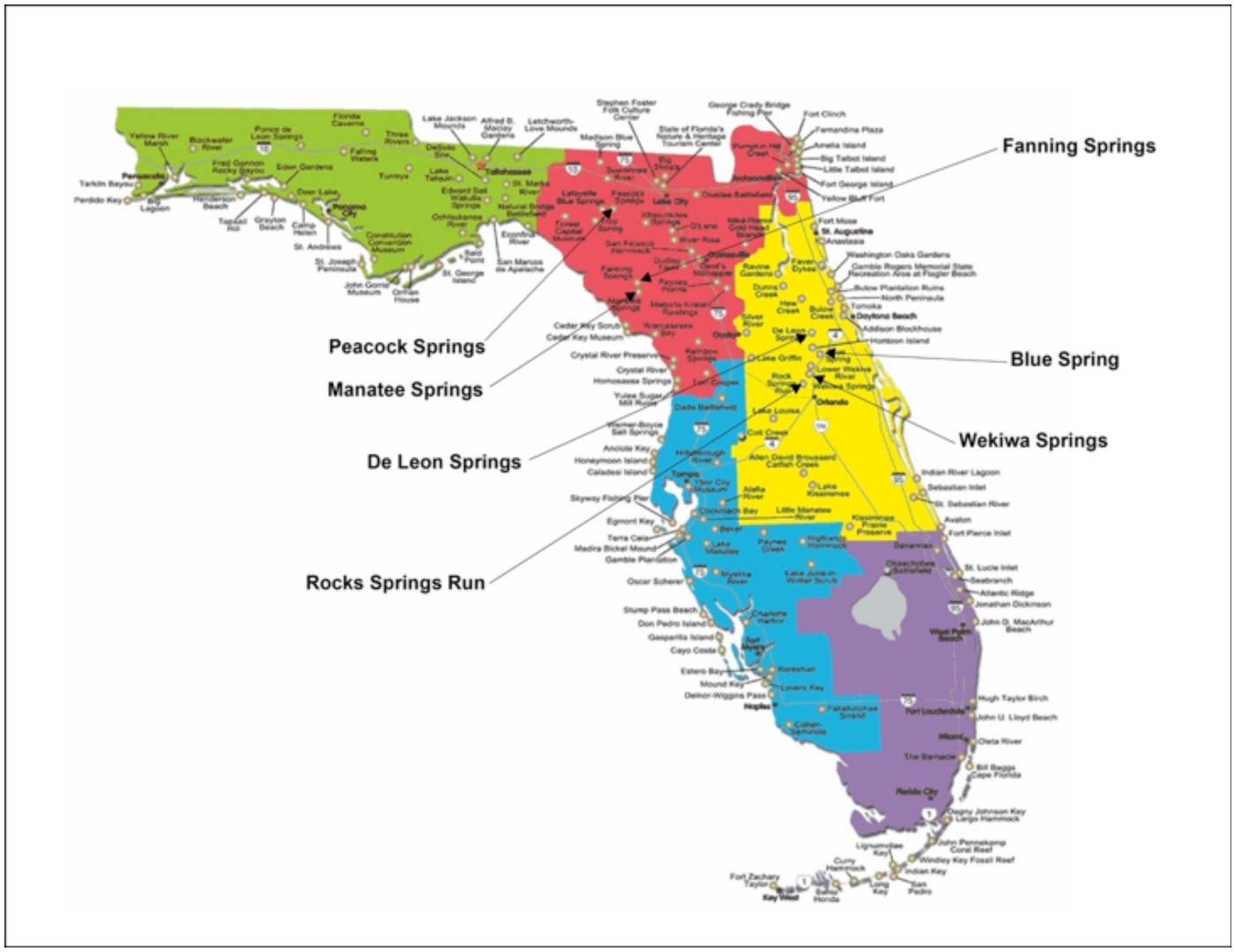

Fig 3. Research sites at seven freshwater springs in State Parks in Florida (map courtesy of Florida DEP).

group. Under the direction of ECM, the scope of the project was expanded to include additional research sites in Florida and Texas. In 2007, Blue Spring, De Leon Springs, and Rock Springs Run State Preserve were added. In 2010, Manatee Springs, Fanning Springs, and Peacock Springs were added at the request of the Florida Department of Environmental Protection (Figs. 3 & 4). In 2012, Comal Springs (Fig. 5), a new research site in Texas, was added.

ECM eventually expanded the group into a network of personnel beyond the undergraduate students of JBH and BPB and formally named the group The Central Florida Freshwater Research Group in 2009, since renamed to The North American Freshwater Turtle Research Group. The NAFTRG now includes current and former students as well as state park employees, professional biologists, and volunteers from the Central Florida Zoo, Disney's Animal Kingdom, Busch Gardens, SeaWorld-San Antonio, and elsewhere. The NAFTRG currently has active members representing 15 states. This vast network of researchers has captured the interest of state and local organizations, non-governmental organizations (NGOs), and a documentary filmmaking company. The Turtle Survival Alliance (TSA) used the research project as its first ever conference field trip in 2011. The NAFTRG formally became the TSA's official North American working group in late 2012. The NAFTRG currently has over 250 members and even has a Facebook page (see Facebook: North American Freshwater Turtle Research Group).

The URE/Citizen Science Research Model

We have found that using a URE/Citizen Science model based in part on research models presented by Millspaugh and Millenbah (2004) can be an effective way to carry out long-term monitoring field research (Fig. 6). The research group starts students primarily by using a technician model described by Millspaugh and Millenbah (2004) that allows volunteers to collect data, learn research techniques, and work

Fig 4. Study sites (years when studies were initiated are shown in parentheses): (A) Study Lagoon at Wekiwa Springs State Park (1999); (B) Spring run at Blue Spring State Park (2007); (C) Spring run at Manatee Springs State Park (2010); and (D) Fanning Springs State Park (2010). All studies are currently ongoing.

Fig 5. Comal Springs, New Braunfels, Texas.

Fig. 6. (A) Students Heather Mosley and Marklyn Johnson reading a PIT-tag in a Peninsula Cooter (*Pseudemys floridana peninsularis*). (B) Central Florida Turtle Research Group biologist Josh Brown and Candace Cox snorkeling for turtles at Wekiwa Springs State Park. (C) Principal Investigator Eric Munscher holding a Florida Softshell (*Apalone ferox*) with Citizen Scientist Volunteer Irene Gaz. (D) Wekiwa springs student and citizen scientist volunteer crew March 2013.

as a team. This method also can be advantageous to students because it allows them to explore particular career paths, develop relationships with mentors, understand how course work is tied to field work, get hands-on training, and investigate disciplines in depth (e.g., field ecology and conservation biology; Millspaugh and Millenbah, 2004). The technician model also allows students to gain independent research experience (since they often work alone) that allows them to develop problem-solving skills (Millspaugh and Millenbah 2004).

Throughout the years, the project has garnered many motivated students that decide to come back for another year of volunteering. In these instances, driven volunteers occasionally reach levels of input that justify an increase in their research responsibilities, and they will move from being technicians to student colleagues (Millspaugh and Millenbah 2004). In the student-colleague model, students are viewed as colleagues and get the opportunity to make significant contributions to the research project. They work with mentors (Fig. 7) to develop hypotheses, design projects, analyze data, and present findings (Hammer 2001, Millspaugh and Millenbah 2004, Evans et al. 2005). This allows students to gain a better understanding of the research process, learn the scientific methodology used, and actually incorporate their own ideas in efforts to build upon previous concepts (Kremer and Bringle 1990, Millspaugh and Millenbaugh 2004). To date, over 125 undergraduate students (Table 1) and over 150 citizen-scientist volunteers have participated in this project.

Our research model is unusual in that volunteers who initially have no scientific training can quickly learn to carry out basic data collection (Oberhauser and Prysby 2008). However, managing a large number of volunteers does present challenges. We have policies in place to effectively manage our volunteer personnel as well as maintain the integrity of our data (Delaney et al. 2008, Oberhauser and Prysby 2008). All volunteers sign release forms to provide the group with liability protection. We require volunteers who capture turtles to be strong swimmers and to work in teams of two or more. We brief volunteers on potential hazards (e.g., depth of water and presence of manatees and American Alligators, *Alligator mississippiensis*). Data quality can be an issue even with more centralized projects; scientists who use citizen scientists often have to defend the quality of their data (Oberhauser and Prysby 2008). To solve this issue, all volunteers who participate in our data collection are trained and closely supervised by senior project personnel (Obserhauser and Prysby 2008). Only experienced and properly trained individuals record data. Finally, ECM maintains all data sets for the research group.

We have found that a URE/Citizen Scientist model can have lasting benefits for volunteers. This model allows volunteers to gain valuable research experience and to become a part of a network of professionals, and many have extended their education in the sciences (Table 1). A secondary benefit is that some citizen scientists have written articles describ-

Fig. 7. NAFTRG Principle Investigator Eric C. Munscher processing a Texas River Cooter (*Pseudemys texana*) captured at Comal Springs, New Braunfels, Texas. Photograph by Christine Westerman.

Table 1. Degrees earned for NAFTRG students from 1999–2013 who participated in the project for some form of college credit. Penn State University (PSU), Freed-Hardman University (FHU), Peninsula College (PC), and Western Washington University (WWU) students received 1–3 credits for field biology or herpetology for this project. Students from the University of North Florida (UNF) came as a field trip for their herpetology class, bonus credit, and volunteer experience.

University	Total Number of Students	Ph.D. Sciences	M.S. Sciences	B.S. Sciences	Other	Unknown
PSU	57	4	11	24	1	17
FHU	40	3	17	10	5	5
UNF	15	3	6	2	0	4
PC	16	0	2	9	1	4
WWU	1	0	0	2	0	0
Total	**127**	**10**	**36**	**45**	**6**	**30**

ing the project and their experiences for media such as local newspapers (e.g., Judah 2009), thus bringing the projects to the attention of the general public. Our team has provided hands-on teaching experiences for a number of groups, including 4-H clubs, science day camps, and public audiences at the state parks where conservation talks are held. Valiela (2009) emphasized the inability of scientists to communicate effectively with the public as one cause of public mistrust of science. Allowing citizen scientists to take part in formal research, having them report their experiences through popular media, and allowing them to teach other citizens helps to alleviate this problem and makes science more accessible to the general public.

Student volunteers often find the experience of participating in our study an important part of their education. A former student contacting faculty or others involved in the project and mentioning that participation in the project was a highlight of their undergraduate career is not unusual. To date, over 30 former student volunteers have returned after graduation and remain active (yearly) members of the research group.

The Study

Our turtle community studies have spanned more than 14 years and are one of only two such studies that are currently ongoing in freshwater springs in Florida. The NAFTRG has processed (marked, measured, weighed, etc.) over 5,800 individual turtles (>8,900 including recaptures) representing 13 species among all study sites (Figs. 8–11). At Wekiwa Springs State Park alone, the group has processed more than 3,700 individual turtles (ca. 6,500 including recaptures) representing eight species, making this one of the largest long-term turtle population studies conducted in the United States. Ten-day sampling sessions are scheduled during the spring and summer and a five-day sampling session during the fall of each year. Turtles are captured by a variety of methods,

Fig. 8. A crate full of Loggerhead Musk Turtles (*Sternotherus minor*) captured at Manatee Springs State Park, Chiefland, Florida. Photographs of individuals by Eleanor Alia Barrett; crate photograph by Jessica Weber.

Fig. 9. Citizen Scientist volunteers Jesse Wales and Noreen Engstrom with a canoe filled with Florida Peninsula Cooters and Florida Red-bellied Cooters. Photograph by Virginia Oros.

Fig. 10. Snappers galore! (A) A Juvenile Alligator Snapping Turtle (*Malaclemys temminckii*) captured at Manatee Springs State Park, Chiefland, Florida. Photograph by Eleanor Havens. (B) Measuring a large Common Snapping Turtle (*Chelydra serpentina*) at Wekiwa Springs. Photograph by Candace Cox. (C) A state size record Common Snapping Turtle taken at Blue Spring. Photograph by Tabitha Barbaree.

including hand-capture while snorkeling, dip netting, and live-trapping using hoop nets. Turtles are measured, weighed, sexed, observed for physical damage and parasites, marked, and released. The data have shown that Wekiwa Springs has some of the highest population densities, biomass, and survivability estimates ever recorded for freshwater turtles in the state of Florida (Hauge and Harrison 2002).

Each study site faces pressures from an expanding human population. These pressures include habitat destruction, reduced water flow due to increased water use, decreased recharge of spring aquifers due to paving, runoff with high levels of nutrients and toxins, and the introduction of exotic species (Belleville and Giguere 2000, Mattson et al. 2006, WSI 2007). The recharge area for Wekiwa Springs is within the greater Orlando metropolitan area, one of the fastest growing population centers in the United States (Belleville and Giguere 2000). Much of the recharge surface has been paved, making it impermeable to rain water, and more is being paved every year. One estimate shows that the stream outflow from this spring could be halved in the coming two decades (Bellville and Giguere 2000, WSI 2007). The effect this will have on turtles as well as other aquatic and semi-aquatic organisms is unknown. Bringing these anthropogenic changes to the attention of the general public is important, and including citizen scientists with their connections to NGOs, the popular media, etc. will help in these efforts. Continued research at this site is crucial to understanding normal population fluctuations so the effects of climate change and anthropogenic changes can be detected. This project will supply data for years to come on the effects of human activities on Florida's natural ecosystems.

In addition to our work with turtles, our team also removes a depressingly large amount of trash from the study sites. We do so in a way that allows the public to see the huge piles of bottles, cans, and other trash that we remove. This becomes another important learning opportunity, citizen scientists teaching other citizens (especially younger ones) the importance of protecting natural areas.

Fig. 11. Common Musk Turtles (*Sternotherus odoratus*) captured at Comal Springs, New Braunfels, Texas. Photograph by Christine Westerman.

Discussion

A URE/Citizen Scientist Model can be a key component of establishing long-term field studies (Evans et al. 2005). This model not only provides the labor force necessary for such studies, but also provides direct benefits to all participants (Table 1; Brewer 2002, Evans et al. 2005). Biologists at teaching institutions and consulting firms have the ability to conduct long-term field projects, mentor undergraduate students, and develop professionally. Undergraduates (Fig. 12) have opportunities to apply their formal classroom training, experience "hands-on" research, and become better prepared for careers in science. Citizen scientists get to experience field research and have the satisfaction of contributing to science.

The magnitude of this study (detailed above) is only possible because of volunteer participation and the monetary/infrastructure support it has received over the past 14 years. Citizen science can play a vast role in reducing the costs that can be associated with long-term research projects (Delaney et al. 2008, Alabri and Hunter 2010). Many conservation projects in Europe have incorporated citizen volunteers; far fewer groups in North America have realized their value, both educationally and economically (Delaney et al. 2008). One of the premiere citizen scientist projects in the country based out of the Cornell University Lab of Ornithology has calculated that individual volunteers have contributed to over $70,000 worth of work and time in a single year (Bhattacherjee 2005, McEver et al. 2007). Using our average work periods (ten-hour days, two ten-day sampling periods per year, one five-day sampling period per year, and four three-day sampling sessions per year), assuming an average number of 10 volunteers per sampling period since 1999, and using a standardized average volunteer wage scale of $20.08/hour (independentsector.org 2012), we have calculated that our volunteer base has contributed $74,296 per year for the past 13 years. This equates to approximately one million dollars in work and time that has been allocated to the research project through volunteer time and effort. In that same amount of time, State Park support in the form of campsites and canoe use has saved our group ca. $19,500.00. Generous monetary support from Friends of the Wekiva River, Wekiva River Wild and Scenic Committee, the Save Florida Springs license plate program, Disney's Animal Kingdom, SWCA Environmental Consultants, and private donors has provided an additional $28,700.00 in funds for materials such as PIT tags. Much of this support was initiated or greatly influenced by our citizen science partners. Without the help of students and citizen scientists, a project of this scale would not have been possible.

Fig. 12. Wekiwa Springs undergraduate research experience class of 2012. Photograph by Eleanor Alia Barrett.

Likewise, these types of projects can provide benefits to other stakeholders. Collaborative activity between professional wildlife research ecologists and community stakeholders (concerned individuals and nonprofit groups) can lead to improved identification of environmental issues that could become management concerns for an entire community (Decker et al. 2005). For example, citizen-science based nonprofit organizations such as the Friends of the Wekiva River Foundation and the Wekiva Wild and Scenic Committee assist research groups such as NAFTRG in interacting with state agencies such as the Florida Department of Environmental Protection (FDEP) and the Florida Wildlife Commission (FWC), which use data generated by the NAFTRG to monitor and protect Florida springs.

The North American Freshwater Turtle Research Group has become a model of a truly rigorous study/conservation initiative that can be replicated regardless of the scientific knowledge base of the majority of the personnel. The FDEP, FWC, and Texas Parks & Wildlife Department (TPWD) have come to rely on data collected by the NAFTRG, which demonstrates the value of the research group. By monitoring turtle populations, this study provides data to state and municipal agencies and can serve as an early warning system if a habitat parameter is in need of adjustment. In many ways, turtles can act as indicators of overall system health. Continued monitoring of these populations is important to assure that they are healthy, which in turn will help assess the overall health of our natural resources.

The NAFTRG has been successful in accomplishing the stated goals formulated at its inception: (a) To successfully provide undergraduates with opportunities to participate in field research; (b) to provide the scientific community and resource managers with valuable, long-term data; and (c) to provide outreach to the public via educational and experiential opportunities. Like many other citizen-scientist programs, the focus is on long-term monitoring, which has been shown to have particularly important conservation implications.

The volunteer base for this project has expanded to include not only students looking for undergraduate research experiences, but citizen scientists that are interested in local conservation efforts. The NAFTRG is now truly composed of citizen scientists, many of whom were introduced to the study through UREs. In this way, our project can serve as a model for scientists interested in conducting long-term research while educating students and public volunteers interested in field conservation efforts. Citizen scientists also are a key solution to projects that are constrained by limited funding and personnel from carrying out intensive research (Delaney el al. 2008). Evans et al. (2005) stated that the motivation of students and citizen scientists for taking personal attention and action within their local environments should be among the highest of priorities for ecological and conservation-based partnerships. Citizen science is helping to bridge the gap between the general public and the scientific community by allowing the two to work together in monitoring, managing, maintaining, and understanding the ecological issues around us.

Acknowledgments

The authors thank the past and current staff of Wekiwa Springs, Blue Spring, De Leon Springs, Rocks Springs Run, Manatee Springs, Fanning Springs, Peacock Springs State Parks, and the Florida Department of Environmental Protection for providing support and making this research possible. We also thank the City of New Braunfels and the park staff at Comal Springs for their hospitality and interest in our studies. Gratitude must be expressed to Andy Weber, Josh Brown, Jessica Weber, Candace and Brad Cox, Brittany Taylor, Emily and Joel Kuhns, Hannah Peterson, Tabitha Barbree, Heather Mosley, Joe MacDonald, David Rogers, Marklyn Johnson, Daniel Barret, Stephen Ross, Megan Keserauskis, Graham Williams, and the many other individuals who have aided this research. Krystal Schneider provided a critical review of the manuscript. Additional thanks go to Deborah Shelley and Marsha Butler from the Wekiva River Aquatic Preserve, as well as Friends of the Wekiva River and the Wekiva River Wild and Scenic Committee. Grants and grants-in-kind from Peninsula College, Penn State Hazleton, and The Pennsylvania State University supported students and faculty. SWCA Environmental Consultants provided much-needed monetary and infrastructural support. All turtles were collected and handled in accordance with American Society of Ichthyologists and Herpetologists guidelines for animal care and use in research. This study was conducted under Florida Department of Environmental Protection permit no. 06240913 and Florida Fish and Wildlife Conservation Commission permit no. LSSC-09-0411.

Literature Cited

Alabri, A. and J. Hunter. 2010. Enhancing the quality and trust of citizen science data, pp. 81–88. In: *Proceedings of the 2010 IEEE Sixth International Conference on e-Science*. Brisbane, Queensland, Australia.

Belleville, B. and B. Giguere. 2000. *Wekiva: Legacy or Loss?* WMFE Television/BBB Productions, Orlando, Florida.

Bhattacherjee, Y. 2005. Citizen scientists supplement work of Cornell researchers. *Science* 308:1402–1403.

Brewer, C. 2002. Outreach and partnership programs for conservation education where endangered species conservation and research occur. *Conservation Biology* 16:4–6.

Cooper, B.C., J. Dickinson, T. Phillips, and R. Bonney. 2007. Citizen science as a tool for conservation in residential ecosystems. *Ecology and Society* 12:11 (http://www.ecologyand society.org/vol12/).

Decker, J.D., D.B. Raik, L.H. Carpenter, J.F.Organ, and T.M. Schusler. 2005. Collaboration for community-based wildlife management. *Urban Ecosystems* 8:227–236.

Delaney, G.D., C.D. Sperling, C.S. Adams, and B. Leung. 2008. Marine invasive species: Validation of citizen science and implications for national monitoring networks. *Biological Invasions* 10:117–128.

Evans, C. E. Abrams, R. Reitsma, K. Roux, L Salmonsen, and P.P. Marra. 2005. The neighborhood nestwatch program: Participant outcomes of a citizen-science ecological research project. *Conservation Biology* 19:589–594.

Hammer, S. 2001. Enhancing biological understanding through undergraduate field research. *Journal of General Education* 50:192–201.

Hauge, J.B. and G. Harrison. 2002. Characteristics of the semi-aquatic turtle assemblage at Wekiwa Springs State Park, pp. 7–12. In: *First Undergraduate Research Symposium Proceedings*, Commonwealth College, The Pennsylvania State University, University Park, Pennsylvania.

Hrycyshyn, G. 2006.Survival probabilities and density of four sympatric species of freshwater turtles In Florida. Unpublished M.S. thesis, University of Florida, Gainesville.

Judah, Glen. 2009. Turtle-tagging study affirms a healthy Wekiwa Springs. *The Sanford Herald*, Sanford, Florida (26 October 2009).

Krebs, P. M. 2005. Colleges focused on teaching too often neglect research. *The Chronicle of Higher Education*, 23 September 2005:B14–B15.

Mattson, R.A., E.F. Lowe, C.L. Lippincott, J. Di, and L. Battoe. 2006. Wekiva River and Rock Springs Run Pollutant Load Reduction Goals. Report to the Florida Department of Environmental Protection. St. Johns River Water Management District, Palatka, Florida.

McCleery, R.A., R.R. Lopez, L.A. Harveson, N.J. Silvy, and R.D. Slack. 2005. Integrating on-campus wildlife research projects into the wildlife curriculum. *Wildlife Society Bulletin* 33:802–809.

McEver, C., R. Bonney, J. Dickinson, S. Kelling, K. Rosenberg, and J. Shrik (eds.). 2007. *Proceedings of the Citizen Science Toolkit Conference*. Cornell Laboratory of Ornithology, Ithaca, New York (20–23 June 2007).

Millspaugh, J.J. and K.F. Millenbah. 2004. Value and structure of research experiences for undergraduate wildlife students. *Wildlife Society Bulletin* 32:1185–1194.

Munscher, E.M. and A.S.Weber. 2012. First account of the Northern Red-bellied Cooter (*Pseudemys rubriventris*) in the State of Florida, Orange County, Wekiwa Springs State Park. *Reptiles & Amphibians* 19:219–220.

Oberhauser, S.K. and M.D. Prysby. 2008. Citizen Science: Creating a research army for conservation. *American Entomologist* 54:103–105.

Trumbull, J.D., R. Bonney, D. Bascom, and A. Carbal. 2000. Thinking scientifically during participation in a citizen-science project. *Science Education* 84:265–275.

Valiela, I. 2009. *Doing Science: Design, Analysis, and Communication of Scientific Research.* Oxford University Press, New York, New York.

Weber, A.S., E.C. Munscher, J.R. Brown, C.A. Cox. and J.B. Hauge. 2011. Using tattoos to mark *Apalone ferox* for individual recognition. *Herpetological Review* 42:530–532.

Wetland Solutions, Inc. (WSI). 2007. Data Summary Report on the Human Use and Ecological Water Resource Values Assessments of Rock and Wekiwa Springs (Orange County, Florida). Prepared for the Florida Department of Environmental Protection and the St. Johns River Water Management District, Gainesville, Florida.