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The Prairie Science Class: A Model for Re-Visioning Environmental Education within the National Wildlife Refuge System

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J. Ernst Science and D. Class Stanek
University of Minnesota, Duluth, Duluth, Minnesota, USA
Chief, Visitor Services and Outreach, Region 3, U.S. Fish and Wildlife Service

ABSTRACT

The Prairie Science Class, a partnership between Independent School District 544 and the U.S. Fish and Wildlife Service's National Wildlife Refuge System (NWRS), uses a local prairie wetlands ecosystem as an integrating and motivating context to engage fifth-grade students in science, math, and writing through real world, field-based learning experiences. This article describes the Prairie Science Class and a research base for this educational approach. A program evaluation was conducted during the first year of its implementation with results suggesting positive cognitive and affective outcomes. The Prairie Science Class illustrates how one NWRS site has transitioned from providing traditional one-time, awareness-building programs for school groups to an in-depth program where middle school students attend school daily at this NWRS site. We encourage discussion regarding the way environmental education is approached within the NWRS and other natural resource management agencies.

Introduction and Conceptual Background

The role of environmental education and outreach in conserving natural resources is well-rooted in the history of United States federal land managing agencies. The National Park Service (NPS), for example, has used education to foster resource stewardship from the time the first NPS Office of Education was established in 1917. Since then, education has played an integral role in the management of parks, and the "park ranger in a Smokey Bear hat leading a bird walk through the forest" has become the respected image of the National Park Service (Huggins, 1995, p. 2). The United States Forest Service has used a range of educational strategies to promote forest conservation dating back to early efforts to replant over-harvested private lands in the east ("Penny Pines") and encourage citizens to prevent forest fires ("Smokey Bear") and reduce pol-

lution (“Woodsy Owl”), to more recent efforts to deliver conservation education to urban youth (“Urban Treehouses”).

Environmental education has a more recent history within the U.S. Fish and Wildlife Service’s (USFWS) National Wildlife Refuge System (NWRS). Although a handful of USFWS employees, including environmental pioneer Rachel Carson, wrote conservation pamphlets and radio scripts for informing the public during the agency’s early decades, it was not until the 1997 NWRS Improvement Act that environmental education and interpretation were officially recognized among the six priority wildlife-dependent recreational uses of the Refuge System. In 1998, the Fish and Wildlife Act of 1956 was amended, subsequently requiring the development of refuge education programs that “provide outdoor classroom opportunities for students to promote understanding of the NWRS and to improve scientific literacy in conjunction with both formal and informal education programs” (Public Law 105–242).

Many refuges have responded to these directives by developing a range of education and interpretation programs, such as field trips and tours, in-class presentations, educators’ guides, classroom kits and traveling trunks, and teacher workshops. Prairie Wetlands Learning Center (PWLC), located within the Fergus Falls Wetland Management District of the NWRS, followed a similar menu of day and residential programming in environmental education and interpretation. The majority of their educational efforts focused on day-use programs, where teachers brought their students to the PWLC for two- to four-hour programs led by PWLC staff. Programs focused on topics relating to the prairie wetlands environment, such as invasive species, aquatic invertebrates, migration, and prairie restoration, and were developed to support national and state science education standards. These programs used a variety of common environmental education strategies, such as hikes, ecology games, and hands-on activities.

There is research to support the effectiveness of non-formal environmental education programs in building knowledge and awareness. For example, Ryan (1991) suggests a link between attending a conservation program and environmental awareness and knowledge relating to the program site. Keen (1991) also indicates a link between direct exposure with the natural resources at the program site and knowledge of the site. An evaluation of the National Park Service “Partners for Education Parks as Classrooms” program found participants scored higher than non-participants on field trip–specific, content questions and were more confident in their ability to explain this content to others (Monroe, Washburn, Goodale, & Wright, 1997). Although the day-use programs at the PWLC have not been formally evaluated, it is likely they served their purpose in raising awareness of and knowledge about the prairie wetlands environment. Informal assessments during the programs suggest that most students learned the PWLC is part of the NWRS and could list, for example, reasons wetlands were important or provide examples of native and non-native prairie species.

But beyond knowledge and awareness, it is difficult to link these short-term, one-time

visits to refuges to changes in scientific or environmental literacy and the conservation of fish, wildlife, plants, and their habitats—key outcomes specified in the amended Fish and Wildlife Act. Awareness and knowledge serve an important role in environmental education, but research shows they are not the only variables at play when working toward the goal of responsible environmental behavior (and in the case of the NWRS, conservation of fish and wildlife resources). Although behaviors are supported by awareness and knowledge, there is not the linear, cause–effect progression from awareness and knowledge to attitudes to behaviors, as once assumed (Monroe, Day, & Grieser, 2000). Other important variables that contribute to responsible environmental behavior include attitudes, a sense of personal responsibility, locus of control, values and beliefs, environmental sensitivity, and knowledge of and skill in using action strategies (Hines, Hungerford, & Tomera, 1986; Hwang, Kim, & Jeng, 2000; Kollmuss & Agyeman, 2002; Marckinkowski, 2005).

Unlike awareness and knowledge, these variables are difficult to influence through infrequent, short-term environmental education programs. Research in environmental education suggests frequent and sustained experiences in nature are integral to developing responsible environmental behavior (Chawla, 1998; Corcoran, 1999; Palmer, 1993).

Research also suggests a number of more specific instructional strategies for environmental education programs when responsible environmental behavior is the goal, such as collecting and analyzing information; participation in project-based environmental problem solving; partnerships with experts, mentors, older students, and community leaders; and investigating issues and working on their resolution (Monroe, 2003). As Hungerford, Bluhm, Volk, and Ramsey assert in an editors' note following Marckinkowski's article on predictors of responsible environmental behavior and their implications for environmental education, "The research is very clear on the matter. The challenge lies in a willingness to do things differently than we have in the past" (2005, p. 291).

Researcher Doug Knapp provides further impetus for re-thinking the way environmental education is commonly approached within the NWRS. He describes how many institutions and agencies have taken the "easy way out," producing countless activity packets and curriculum guides that do not represent a sequential learning order based on a sound educational philosophy. The brief duration of activities in such activity guides result in smaller gains than the more significant gains associated with long-term experiences (Marckinkowski & Iozzi, 1994 in Knapp 2000). "Those short-and-sweet strategies have negated the use of more substantial models that encourage long-term issue investment and, most important, long-term thinking and responsible citizenship behavior on the part of the students" (Knapp, 2000, p. 34). To address these concerns, Knapp (2000) suggests focusing on partnerships, finding new and better ways for school districts and nonformal environmental education sites to work together to provide the in-depth sequential learning that quality environmental education needs.

This research base, along with a growing desire to think about program outcomes in ways other than counting the number of students who participate in programs, led to the

development of an idea for a school where children learn about the natural environment through an integrated study of the basic subject areas. After several years of building the interest and support of key players and a summer of intensive planning, the idea was transformed into the Prairie Science Class (PSC), a formal partnership between the NWRS' PWLC and the Fergus Falls Independent School District 544 (ISD 544). The mission of this PSC pilot program was to use the local prairie wetlands ecosystem as an integrating and motivating context to engage fifth-grade students in science, math, and writing through real world, field-based learning experiences. Program goals included: (a) developing knowledge and skills in math, writing, and science; (b) increasing motivation toward learning; (c) developing technology, problem solving, and communication skills; and (d) fostering character skills and a stewardship ethic. The unique aspect of the PSC was that it was based at the PWLC, not at the middle school with occasional or even regular visits to the PWLC.

Program Description

During the 2003–2004 school year, the first year of implementation, 50 fifth-grade students were involved in the PSC, spending 2 hours each day at the PWLC studying science, math, and writing. One section of 25 students spent the morning at the PWLC, and the second section spent the afternoon at the PWLC. The remainder of the students' school day was spent at the Fergus Falls Middle School, where they received instruction in reading, social studies, physical education, and health.

The PWLC and its 325 acres of prairies and wetlands became the students' primary classroom. The PWLC contributed indoor classroom space in the visitor center, access to the 325 acres of prairie wetlands field sites, field equipment, and approximately 25 hours per week of an environmental education specialist's time. It also contributed a wealth of resources in the biological sciences, including wildlife biologists' expertise, as well as books, slides, maps, and databases of wildlife and prairie wetlands information. ISD contributed the salary for two teachers, one stationed at the PWLC and the second stationed at the Fergus Falls Middle School, who was responsible for teaching the PSC students when they were not at the PWLC. ISD 544 provided the bus transportation to the PWLC, classroom equipment and supplies, computers, and custodial services. The program also received support from a variety of local, regional, and national organizations, which provided handheld computers for each student, additional field equipment, and classroom resources.

While at the PWLC, a series of seasonal, integrated units based on the prairie wetlands ecosystem was used to teach the curricular areas of science, math, and writing. For example, the school year began with a month-long unit on migration. Students were involved with field-based activities, including tagging monarch butterflies and banding mallards, thus incorporating the study of migration patterns, habitat needs, and the scientific process of answering questions through data collection and interpretation. Students built math skills as they measured and weighed their mallards and studied fractions and

percents in the context of prairie wetland habitat loss. Students reflected on their learning through writing assignments, such as postcards written to the students who live near the monarchs' wintering range in Mexico and scientific reports on the process of capturing and banding ducks. The migration theme and the authentic, field-based experiences were the context for integrating learning in the traditional subject areas.

The integrated unit on migration was followed by units on tallgrass prairie, seasons and cycles, winter ecology, wetlands, and amphibians. With each unit, students were involved in field-based, authentic projects and investigations, such as predicting weather through animal behavior, baseline monitoring of amphibians, and restoration of farmland to tallgrass prairie. Students worked alongside USFWS employees, asking scientific questions, collecting data, and making decisions, using science, math, reading, writing, and other skills as tools. This approach can be described as interdisciplinary, experiential learning through authentic, field-based experiences. Thus, at the heart of the PSC is an experiential learning philosophy, not a series of lesson plans, activity packets, or curriculum guides.

Program Evaluation

Although the NWRS and PWLC strongly value partnerships, they needed to ensure the PSC furthered their mission and that the PSC was "worth" pulling resources away from more traditional environmental education and interpretation programs. The decision to implement the PSC was a significant commitment of ISD 544 staff and resources. Given their primary responsibility of ensuring learning in core subject areas, ISD 544 wanted to make sure the PSC provided an appropriate, alternative learning environment. Thus, both the PWLC and ISD 544 were in strong agreement regarding the need for a formative evaluation to assess program outcomes, identify areas for improvement, and guide decisions relating to future implementation of the PSC.

Stakeholders of the PSC met to identify the questions to guide the evaluation. Their evaluation plan included four questions: (a) Have the students attained grade-level proficiency in science, math, and writing? (b) Have the students' science process, problem solving, and technology skills and their skills in working cooperatively and communicating with others increased? (c) Do the students have a more positive attitude toward learning and the prairie wetlands environment and a stronger stewardship ethic than their peers in traditional classrooms? and (d) Did the PSC meet the needs of the students and parents, the Fergus Falls Independent School District 544, and the U.S. Fish and Wildlife Service?

Stakeholders selected the following data collection tools to address the four evaluation questions and meet the specific needs of the evaluation users:

1. Minnesota Comprehensive Assessments in Math and Writing (standardized tests that are part of the educational accountability system in Minnesota);
2. Affective Self-Report (a 20-item survey developed specifically for this evaluation mea-

suring attitudes toward learning, attitudes toward the prairie wetlands environment, and stewardship ethic);
3. Skills Self-Report (a 14-item survey designed to measure science process skills, problem solving skills, technology skills, and skills in working and communicating with others);
4. Parent Survey (a 13-item survey developed specifically for this evaluation to measure parents' perceptions of cognitive and affective program outcomes and satisfaction with the program); and
5. Stakeholder Interviews (personal interviews with PSC students, parents, PWLC director, NWRS project leader, and ISD 544 principal and superintendent).

The primary participants in this evaluation were the 50 fifth-grade students in the PSC. Forty fifth-grade students (two classes from ISD 544) receiving traditional classroom instruction served as the control group; their participation was limited to the affective pre- and post-survey and the state tests in reading, math, and writing. Parents of the PSC students and stakeholders of the PSC were also participants in this evaluation. A USFWS environmental education specialist was responsible for administering the evaluation tools over the 2003–2004 school year. Transcripts from stakeholder interviews were transcribed and analyzed. The data from the parent surveys were analyzed using descriptive statistics. The data from the Minnesota Comprehensive Assessments, the affective self-report, and the skill self-report were analyzed using inferential statistics and a combination of dependent-samples t tests and multiple linear regression. A complete description of the evaluation design, methods, instruments, and results was published in the Journal of Interpretation Research (Ernst, 2005).

The following provides a summary of key findings from this evaluation:

1. PSC students' scores on the Minnesota Comprehensive Assessments in reading and writing were significantly higher than their peers in traditional ISD 544 classrooms (hr $p = .03$); PSC students' scored above the state average on the Minnesota Comprehensive Assessments in reading and math.

2. The results of student interviews indicated PSC students perceived they learned science, math, and writing and described this learning as stronger than in previous school years; this is supported by results of the parent surveys, as 98% of the parents completing the survey felt their children learned science, math, and writing better than they would have in a traditional classroom, attributing this to the hands-on and interdisciplinary instructional strategy and the real-world applications using the prairie wetlands Environment.

3. All 14 items on the student skill self-report showed a positive, statistically significant increases in students' assessments of their science process, problem solving, and technology skills, as well as their skills in working and communicating with others (hr $p < .01$);

this was consistent with the results of student interviews, which also suggested increases in these skill areas as well as in students' observation skills and in their ability to "read the land."

Although the affective self-report did not show the PSC improved students' attitudes toward learning, an emergent theme from the student interviews was the PSC helped them become more interested in school and learning, improved their classroom behavior, and promoted a sense of belonging. This is consistent with results of the parent survey, as 98% of parents felt their children were more excited about school because of the PSC and 100% felt their children expressed a positive attitude toward the PSC; attendance data showed students' with previously low attendance had higher attendance during their year in the PSC.

When controlling for initial attitudes toward the prairie wetlands environment, there was a positive, significant difference between the PSC students' attitudes toward the prairie wetlands environment and those of their peers receiving traditional instruction, (hr p = .02). This is consistent with the results of the student interviews, which suggested the PSC had a positive influence on their attitudes and intended behavior toward Wildlife.

Although the affective self-report did not show an improved stewardship ethic, an emergent theme from the student interviews indicated a positive influence of the PSC on their actions in the environment.

Parents were overwhelmingly positive about their children's experiences with the PSC; 100% of survey respondents had a positive impression of the effects of the PSC on their children, felt their children benefited in ways that could not be achieved through a traditional program, and felt the program should be continued.

According to the parent survey, 98% of the respondents agreed that their children's participation in the PSC motivated them to visit the PWLC.

Discussion of Findings

The findings from this evaluation are consistent with research on other formal educational programs that use the environment as an integrating context for learning. Lieberman and Hoody (1998), for example, suggest students learn more effectively within environment-based programs than within a traditional education framework, with outcomes that include improved performance on standardized tests, reduced classroom management problems, and increased enthusiasm for learning. Our findings also are consistent with the State Education and Environment Roundtable's study of California schools (2000) and the National Environmental Education and Training Foundation's Environment-based Education: Creating High Performance Schools and Students, studies further supporting the use of environmental-based education to improve academic performance across the curriculum

(NEETF, 2000). Other studies (Athman & Monroe, 2004; Ernst & Monroe, 2004) further support the educational relevance of environment-based education, with positive student outcomes in critical thinking skills, disposition toward critical thinking, and achievement Motivation.

The evaluation findings related to improved attitudes toward the prairie wetlands environment and positive influences on students' actions in the environment, although not conclusive, are encouraging. As Monroe (2003) points out, "To date much of the research on education using environmental projects has focused on the development of scholastic skills, not on conservation behavior" (p. 122). The PSC's positive influence on students' attitudes toward and actions in the environment is consistent with the literature linking attitudes to environmental behavior (Sia, 1985; Marckinkowski, 1989), an evaluation finding that should not be surprising, given the PSC's use of instructional strategies suggested by the literature for influencing responsible environmental behavior. The possible connection between the PSC's positive influence on achievement motivation and responsible environmental behavior is also worth noting. Achievement motivation relies in part on academic self-efficacy. Self-efficacy "may be an important ingredient of environmental literacy, through a connection to perceived ability to reduce a threat or through locus of control" (Monroe, 2003, p. 122). Monroe continues, self-efficacy, the belief about one's capabilities to exert influence over events that affect one's life, "is such a broad concept that, when strong, it enables people to approach challenges with purpose and resolve, recover from failure quickly, and to maintain a positive attitude and well-being" (p. 122). Thus, the PSC may be building a "can-do attitude that may enable youngsters to rise to future challenges" (Monroe, 2003, p. 122).

The results of the program evaluation weighed heavily in the decision to continue to program into the 2004–2005 school year and expand the number of participants from 50 to 100 students. The PWLC Director and the Fergus Falls Wetland Management District Project Leader felt the daily exposure of PSC students to the prairie wetlands environment and the time spent in field-based learning experiences supported the mission of the USFWS and NWRS. They also felt the partnership with ISD 544 was a cost-effective way to gain maximum environmental education outcomes. In addition, the PSC supported outreach into the local and regional community through PSC families visiting the PWLC, communication with and support from community members, and positive media Coverage.

Despite these positive findings, consistency with the mission of the USFWS, and commitment by the ISD 544 to continue support for the program, there were several considerations that had to be addressed before expanding the program. One of those was physical space. Even though the majority of the learning experiences took place in the field, the PSC required indoor classroom space and storage areas, so that students and teachers had a "permanent" space for desks, computers, outdoor clothing, and equipment. As a result, there was one less space for teaching other school groups visiting the PWLC for traditional programming. If the PSC were expanded from 50 to 100 students, the use of

both indoor classrooms would be needed. This raised the concern of declining access to schools participating in traditional day-use programs. The PWLC Director anticipated being able to address this concern by adjusting scheduling and building use and through a deliberate attempt to ensure traditional day-use programs centered on teaching students outdoors, not in the indoor classrooms.

Another consideration was impact on the outdoor environment at the PWLC. To address this, PWLC and PSC identified outdoor teaching sites that were used on a routine basis. Because the PSC tended to use more remote field sites throughout the 325 acres that were less accessible to traditional school groups, sites used most often by the traditional day-use programs did not overlap with sites used by the PSC. It was determined the PWLC staff would monitor site conditions, rotating use of more environmentally sensitive areas as needed. Further, the PWLC Director felt the positive impact the PSC was having on the outdoor environment through their stewardship projects outweighed the potential negative impact of daily field study at outdoor sites.

A final consideration was the amount of PWLC staff time required for implementation of the PSC. During the first year of the program, the PWLC environmental education specialist spent approximately four hours per week instructing PSC students and four hours per week on curriculum planning and other administrative responsibilities, such as grant writing and program documentation and communication. With expansion of the program, it was anticipated that the amount of time the environmental education specialist would need to spend on the PSC would increase from eight to twelve hours a week. The PWLC Director determined this would not significantly affect the PWLC's ability to meet the demand from other school groups, and that outcomes of the PSC were worth these hours of staff time.

While plans are underway to continue the PSC into future school years, program capacity will stay at 100 students, due to availability of space at the PWLC. Stakeholders are exploring the possibility of building a facility connected to or adjacent with the PWLC to accommodate all of the approximately 200–250 fifth grade students in ISD 544, thereby allowing the PSC to be a part of every student's school experience. Other plans include adding a reading component to the PSC, where students can build literacy skills through scientific investigations, and exploring how this program could grow into a comprehensive school reform model to advance district and state education reform goals. Future plans also include exploring avenues for replication at other sites. Key to program replication is professional development opportunities for teachers and agency educators in the areas of experiential, integrated, field-based teaching methods. Thus, the PSC has the potential for growing into a site for student teaching and internship experiences and in-service professional develop opportunities, helping this program model become more accessible to others.

Managerial Applications

The success of the PSC has potential regional and national applications. As other refuges and natural resource agencies express interest in implementing a similar program for their students, it is helpful to consider what made this partnership work.

Stakeholders of the PSC identified the following characteristics, which they believe played a role in the success of the partnership:

1. Strong cooperation and solid commitment to the program by the superintendent, principal, and school board of the partnership school and by the refuge manager and regional office of the USFWS;
2. Teachers who are dedicated to the program and have the skills and motivation to implement nontraditional teaching methods;
3. Agency personnel with strong backgrounds in education, environmental education, and the biological sciences, who can commit to four to eight hours of instructional time weekly per class;
4. Adequate on-site facilities to accommodate daily attendance by a class (classes) of students, including classroom and/or lab space, rest rooms, and storage;
5. Field sites that can accommodate student use on a daily basis with acceptable levels of impact to the environment; and
6. Close proximity of the school and refuge so that traveling time is minimized.

A program like the PSC may not be feasible at all refuges, nor may it be desirable at all refuges. However, if environmental education in the NWRS is going to play a role in improving scientific and environmental literacy and fostering the responsible environmental behavior that leads toward conservation of wildlife resources, programs other than the traditional day-use programs are needed throughout the Refuge System.

There are several recent efforts within the NWRS that support this program model and increase its feasibility for refuges. In 2004, Congress provided the NWRS with money to hire an environmental education specialist for each of the seven regions throughout the country. These individuals are unique to the NWRS and its environmental education program, as in years past, the role of providing environmental education fell to the general visitor services staff, whether or not they possessed the skills to deliver an effective program. By hiring these education specialists, the NWRS now has staff with the educational background and skill to work closely with local schools in developing effective environmental education programs that meet the educational needs of the schools and the goals of the USFWS and NWRS. This ability to partner effectively with local schools is critical for building successful environmental education programs across the NWRS and for establishing programs similar to the PSC at other refuges.

Further support for this shift in programming stems from the 2004 Conservation in Action Summit, where NWRS employees and partner organizations met to determine major goals of the NWRS for the near future. A finding of this summit was that environ-

mental education should be a primary focus for the Refuge System. Since that time, there has been an increased effort to hire additional environmental education specialists at refuges where the refuge's program warrants such an individual and the opportunity presents itself. Refuges that have the potential to develop programs based on the PSC model have been focal points for this hiring effort.

Although the PSC model may not be applicable at all refuges, there is still a need to provide guidance for developing educationally sound environmental education programs, as the goal is for all refuges, regardless of their size and resources, to provide environmental education programs that support science/environmental literacy and resource stewardship behaviors. Although refuges may not have the physical space or staff to implement a program like the PSC, they can at least infuse some of the sound educational strategies upon which the PSC is based, so that their programs better support the in-depth understanding, scientific thinking, and stewardship activities that resource conservation requires.

Examples of these sound educational strategies include:
1. Frequent and sustained exposure to the natural environment. Repeated encounters with the natural world facilitate the familiarity and provide the time required to develop in-depth understanding and influence one's values, beliefs, and sense of responsibility that can lead to responsible environmental behavior.
2. Interdisciplinary learning based on the local natural environment. As course content is connected to the local environment, the traditional lines between basic subject areas are blurred and a complexity develops that is not often found in discipline-bound textbooks or learning activities.
3. Project- and issue-based learning experiences. Students are actively engaged in the learning process, posing and solving problems, investigating issues, making decisions, and performing stewardship projects. There is an audience beyond the teacher for students' work, assuring students' their work is needed and worth doing.
4. Learner-centered instruction. The central focus of the learning experiences grows out of students' interests and questions, and students have a voice in deciding what is needed and how to carry out their work. Students receive feedback and assistance not only from their teacher, but also from their peers, older students, and content experts in the field.
5. Constructivist approaches. New learning activities stem from previous activities, building on skills and understandings learned from past experiences. Students have opportunities to practice and apply skills in new situations. Reflection takes place throughout the learning process, helping students absorb and process what they have experienced and generalize this newly acquired knowledge and skill to other experiences (Chawla, 1998; Hines, Hungerford, & Tomera, 1986; Hwang, Kim, & Jeng, 2000; Lieberman & Hoody, 1998; Monroe, 2003; NEETF, 2000).

Implementing programs that are built on such educational strategies may likely require a shift in thinking and a shift in what is valued, not only within the NWRS, but

also in the education community. By placing value not just on the number of students reached, but also on the quality and impact of each visit, it will be easier for refuges to at least consider implementing these more in-depth, long-term educational strategies.

Conclusion

Refuge managers are often faced with tough decisions regarding the amount of time, staff, and resources to devote to environmental education efforts, as they strive to balance responsiveness to immediate public desires, long-term public good, and the conservation of fish and wildlife resources. These decisions are complicated further when they weigh the need to provide access to the refuge and educational opportunities to broad sectors of the public with the desire to provide in-depth, sound educational programs that have research-based links to responsible environmental behavior.

Raising awareness of the mission and exposing students to their local refuges through traditional, day-use programming has its place. In A Sense of Place, author Daniel Kriesberg (1999) writes about a phenomenon called the “extinction of experience,” resulting from a loss of wild spaces for kids to come in contact with nature. Traditional, day-use programming can provide opportunities for refuge staff to reintroduce students to their local area by exploring, experiencing, and learning about it. By doing so, refuges help students develop a sense of wonder, fostering the knowledge and awareness that may motivate them to further questioning, better understanding, and appropriate concern and action later in life. However, improving scientific literacy and fostering a stewardship ethic are difficult through a one-time visit to a refuge. The solution, perhaps, is moving beyond focusing only on the short-term, knowledge and awareness programs that refuges have traditionally offered, striving for a balance across the Refuge System of short-term traditional programs and sustained, in-depth educational experiences. By doing so, the NWRS can better contribute to environmental education’s efforts to ensure a sustainable future, of which fish and wildlife resources are an integral part.

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