

Improving Eco-literacy through Service Learning: A Natural History Service Project Case Study

CHRISTOPHER R. COLLINS,
LYNN DONAHUE



ABSTRACT

Eco-literacy (knowledge of natural history, and direct observation of the natural world and the organisms it contains) is critical to a holistic understanding of biology. Many undergraduate biology students lack this knowledge and experience, often because of a lack of engagement with the environmental science curriculum. The effectiveness of service learning is well established, but few examples of service-learning projects in the context of natural history education have been published. We describe how we used best practices for the development of a field-based service-learning project in a college-level natural history course. The project was built around established learning goals and was conducted through a partnership with a local state park. Students worked in groups to conduct bird biodiversity surveys and prepared a printed bird-watching guide, which was presented to park staff. The project was linked to a series of assignments intended to maximize academic and personal growth, including a project plan, progress report, and reflection paper. Students reported increased engagement in the course curriculum and an increased sense of the relevance of the course content.

Key Words: Service-learning; outdoor; environmental; ecology; natural history; community engagement.

○ The Problem of Eco-illiteracy

Knowledge of natural history is an important component of a balanced science education and is essential for a successful career in conservation (McGlynn, 2008; Pearson et al., 2011). Unfortunately, many undergraduate biology students lack basic “eco-literacy” (Pilgrim et al., 2007). Natural history is distinct from ecology in its emphasis on observation, identification, and description of organisms and their niches and life histories. It is possible to pass an ecology course at many schools and still be unable to identify common species. Studies have shown that

Because service projects are local, the focus on flora and fauna located close to home helps students relate to an otherwise abstract discipline.

even high-achieving students are often unable to name common plants and other organisms they encounter on a daily basis (Bebbington, 2005). Our primary, secondary, and undergraduate education systems are currently turning out biologists strong in theory but weak in ability to apply their knowledge to organisms and the natural world (Hammond & Herron, 2012; Middendorf & Pohl, 2014).

○ Service Learning, a Pathway to Eco-literacy

Service learning incorporates service projects within academic courses to enhance student learning, civic responsibility, and professional development, while simultaneously meeting organizational and community needs (Jacoby, 1996; Butin, 2005; Bringle et al., 2006). The power of service learning lies in the partnerships that link the community with educational institutions, and in the intentional design of these collaborations to achieve shared goals (Desmond & Stahl, 2011; Kalles & Ryan, 2015). Service learning, by definition, simultaneously benefits the community, meets the learning goals of the course, and should result in reciprocal benefit to both students and the community (Desmond & Stahl, 2011; Jacoby, 2015; Stoecker, 2016).

Natural history and environmental science courses are an obvious fit with service learning and have been shown to have lasting positive impacts, even years after the project ends, including enhanced course knowledge and increased pro-environmental attitude (MacFall, 2012; Knackmuhs et al., 2017). Because service projects are local, the focus on flora and fauna located close to home helps students relate to an otherwise abstract discipline.

The benefits of service learning for students are numerous and well documented (Eyler & Giles, 1999; Astin et al., 2000). Service learning builds the proficiencies needed for entering the workforce

through the application of disciplinary knowledge to project-based community work (Rutti et al., 2015). A meta-analysis of 62 studies involving 11,837 students found that service learning improved attitudes toward self, attitudes toward school and learning, civic engagement, social skills, and academic performance (Celio et al., 2011). Brail (2013, 2016) found a relationship of service learning to deepened disciplinary expertise and increased grade achievement in an urban studies course.

○ Creating a Customized Bird-Watching Guide

To accomplish academic and community goals, we integrated a service-learning project into an animal natural history course, an upper-level undergraduate elective for biology majors. Students created a bird field guide as the “deliverable” to address eco-literacy goals and provide a tangible, sustainable benefit to the community partner, its staff, and park visitors.

We developed a cyclical process for continuously assessing and improving service-learning projects, as described in Figure 1. This process captures the essential elements for developing a project of quality and impact, assessing the effectiveness of the project, and improving future projects.

Our first step, even before choosing a community partner, was to define and clearly articulate the academic learning goals that service learning can accomplish, both disciplinary and professional/personal. While developing our project, we considered how the service-learning work could address major or college-wide goals, as well as the specific goals of the course (see Supplemental Material with the online version of this article).

We are fortunate enough to have a dedicated Center for Service-Learning and Civic Engagement, which has developed broadly focused “civic engagement learning goals,” applicable to a wide range of course subjects (see Supplemental Material). These goals were guided by the AACU Civic Engagement VALUE rubric (Association of American Colleges and Universities, 2009). These goals, along with course-specific goals (see Supplemental Material), were used as the foundation for the project goals.

We decided that a field-based service project in a natural history course would align best with three of our six civic engagement learning goals: intellectual engagement, application of knowledge, and communication. Furthermore, we felt that several of the course learning goals could be addressed effectively with such a project: identification of local species, biodiversity survey techniques, experimental design, and communicating scientific data.

With our learning goals formulated, we were ready to seek an appropriate community partner whose mission and goals fit with the subject matter and who had an identified need that translated well into a service project (Figure 1, step 2). Fitting partners for natural history courses are typically nonprofits or other NGOs, but they can also be local or state park agencies, zoos, museums, schools, or conservation programs. First, begin by making a list of potential organizations. We recommend inquiring about existing partnerships between your school district or administration and local organizations. You may be surprised to find they already have a list of partners. Utilize your own personal contacts and network to seek recommendations. Finally, local outdoor or environmental events

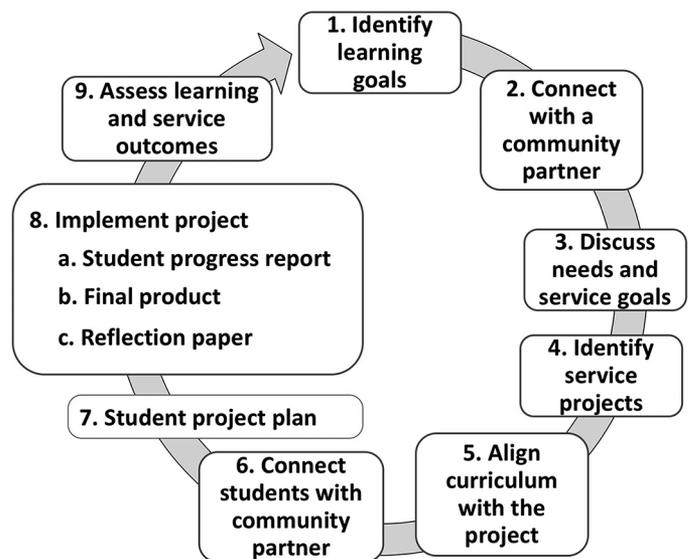


Figure 1. Cyclical process for developing a service project.

and festivals often invite organizations to set up outreach tables or activities and are a great way to discover potential partners.

We partnered with Ganondagan State Historic Site, located in Victor, New York. It’s Environmental Field Office, which manages the site, served as an ideal community partner for this course. They were located within a short drive, and the staff were highly knowledgeable about the flora and fauna of the site. They also had a strong education and outreach focus, in addition to their environmental stewardship mission.

Our association with Ganondagan began through existing research partnerships. During the summer prior to the course, we approached park staff and proposed a service project. We met with them and discussed the mission of the Environmental Field Office, which is to “preserve, restore and enhance natural resources . . . by aiding state parks and historic site in meeting commitments to responsible stewardship of natural resources for current and future generations as laid out by the mission statement of OPRHP” (Ganondagan, n.d.).

Our next step was to discuss the goals and needs of both the community partner and the course (Figure 1, step 3). We began these discussions well before the start of the course. Our goal during the initial meeting was to listen to our partner organization and understand its needs, while acknowledging the assets of the partner and its capacity for self-sufficiency when provided with needed resources. Service learning must be rooted in mutual cooperation and collaboration (Desmond & Stahl, 2011). Shared decision making and goal accomplishment results in meaningful, genuine, and sustainable relationships (Tinkler et al., 2014).

Our initial meeting with the partner organization was focused on discussing the needs of the park and helped us better understand their long-term environmental protection and habitat restoration plan as well as their education and outreach goals. We considered gaps in resources that may have affected the feasibility of potential projects. We learned that their primary goal was to better understand the biodiversity within the park. Together, we decided that our field observations would be used to generate educational and interpretive materials as the deliverable product of the project.

During subsequent meetings, our focus was on choosing a specific project (Figure 1, step 4). We created a project plan that helped clarify and document expectations and desired outcomes, as well as the roles and responsibilities of the instructor, the community partner, and the students. In subsequent semesters, we have used these meetings to incorporate feedback from prior-semester partnerships into our project plans. The project plan included a project summary, course and community partner goals, faculty and community partner roles, and a tentative schedule with benchmarks. Certain details of the project, such as the exact dates and times of field visits, were the responsibility of students to communicate directly with the park staff.

The bird field guide project that we ultimately chose addressed four of the main learning goals of the course (for sample pages, see Supplemental Material). Students would conduct bird biodiversity surveys. The species identified would be added to an existing list of species known to inhabit the park, and this list would be used to write a customized bird-watching guide.

Once a project had been identified, we adjusted the curriculum to include material that would align with the project (Figure 1, step 5). Lectures, class activities, homework assignments, and quizzes established familiarity with the natural history of the organisms, ecosystems, and techniques the students would be working with. We spent a significant amount of time in class discussing the organisms, their ecology, how to identify them, and other relevant information.

Our introduction of students to the project started even before the course began. We emphasized the service component of the course as early and often as possible: in the course description (prior to registration), prior to the start of the course, and during the first week of the semester. The syllabus provided a definition of service learning and clearly described the project and the time commitment involved. This is especially important in a college-level course, where students may be expected to schedule their own site visits and provide their own transportation.

During the first week of class, we invited representatives of the partner organization to speak to the class and organized a field trip to orient the students to the project site. Environmental Field Office staff presented students with an overview of the program's mission during the first week of class and led a class discussion of expectations and desired outcomes. Students were also shown an orientation video that overviewed principles of the college's service-learning program, followed by the signing of a student agreement form (see Supplemental Material) confirming their participation in the orientation. The student agreement form contained a list of project parameters and expectations and served as a release form. Students also received a list of tips to make the most of the experience (see Supplemental Material).

For our project, we organized the class into groups of three or four, but this could vary depending on the nature of the project. Groups met and prepared a project plan (Figure 1, step 6) detailing how they would meet their goals. Students were required to research their community partner and their needs and summarize the project goals and deliverables. Groups assigned each group member specific roles and tasks and developed a timeline of the project, including field visits and assignment deadlines.

The project plan specified roles for each group member. One student in each group was a communication coordinator responsible for relaying questions to the staff and course instructor (this avoids a deluge of emails from every group member). A record keeper was responsible for recording notes during meetings, managing data sets,

and uploading group assignments. (Depending on the amount of gear and instrumentation required for a project, an equipment manager might also be assigned.) Because our students were responsible for their own transportation, we ensured that at least one group member had a vehicle and was willing to drive.

During the implementation of the project, communication was critical (Figure 1, step 7). Although we frequently discussed the project with students, we never relied entirely on these discussions when monitoring the status of the project. Direct communication with the community partner helped identify gaps between the project plan, reports by the students, and actual events. While site visits can be time intensive, student observations and on-site communication with community supervisors provide a wealth of information.

Well-designed service-learning projects contain structured and rigorous course assignments that link course content with service, foster critical analysis of the experience, and then connect conclusions to broader learning goals (Kalles & Ryan, 2015). Our project incorporated four assignments (Figure 1, step 8) designed to guide our students as they planned, implemented, and reflected on their project. These course assessments were built around learning objectives and connected the service work with the course content: a project plan, due before the start of the project (Table 1); a progress report, due at the midpoint of the project (Table 2); the final product (the bird field guide in our case); and finally, a reflection paper, due after the completion of the project (Table 3). These accounted for 40% of the total class grade (10% per assignment).

The field guide progress report was due approximately halfway through the semester. Students compared the actual progress of the project to the goals described in the proposal, evaluated their group progress and their own role in the group, and, if necessary, revised goals and plans. This assignment was a chance for students to take a step back and reflect, remind themselves of the big picture, and make course corrections. Students reported that this was a helpful checkpoint, and several groups made modifications to their plan based on their progress report.

Students conducted bird surveys, as groups, under the guidance of the instructor and park staff. Student observations were then combined with data from previous surveys, and a list of bird species was assembled. The species on the list were divided among the students, and each produced an equal number of bird species profiles (six per student), which were assembled as a customized bird identification guide (for sample pages, see Supplemental Material). Because the guide was compiled from contributions from the entire class, one group's job was to gather the pages produced by each student and assemble the guide. They acted as editors and were responsible for maintaining consistent formatting, spelling, and grammar. Because of the scope of this task, this group only wrote three pages per student.

Students were given the option of applying for a Civic Engagement Grant, a competitive grant sponsored by our college's Center for Civic Engagement, open to students enrolled in service-learning projects. This was an optional "above and beyond" part of the project. Several students worked together to write the application, and they were awarded \$107 to fund printing of the bird guide. The end result was a spiral-bound, laminated booklet with pictures and information about birds that had been identified at the site (see Supplemental Material). Several physical copies were printed and delivered to park staff, and the files were made available so that park staff could add pages as additional bird species were identified.

Table 1. Project plan assignment rubric.

Assignment Component	Point Value
Project overview (written individually):	6 pts
Describe client assets and needs.	1
Describe study site and its history.	1
Explain our project goals and outcomes.	1
Explain how our project will meet the client's goals.	2
Explain your own, personal goals for this project.	1
Project logistics plan (written as a group):	4 pts
List the roles and responsibilities of each group member in your group.	1
Describe the role of your group, within the overall project.	1
Describe the specific steps required for your group to complete its task.	1
Include a timeline, with due dates and deadlines.	1
Total	10 pts

Table 2. Progress report assignment.

Assignment Component	Point Value
Describe the status of each item on the project plan's timeline up to this point.	2
Describe any challenges you have faced, and how you handled them or plan to handle them.	2
How do you see your role, as a group member, developing?	2
Have you been able to identify any particular weaknesses or strengths you have?	2
Will your group need to adjust your project plan, and if so, why and how?	2
Total	10

Table 3. Reflection paper assignment rubric.

Assignment Component	Point Value
How did the implementation of the project compare to the project plan?	2
How did the experience compare with your expectations?	2
What would you do differently if you could?	1
What feedback or suggestions do you have for future projects?	1
What did you learn about natural history?	1
What did you learn about yourself?	1
In what ways did your group work well together?	1
In what ways did your group not work well together?	1
Total	10

○ Assessing Effectiveness & Outcomes

Following the completion of the bird guide, each student wrote a reflection paper. The goal of this was to provide students with an opportunity to evaluate the outcomes of the project, as well as their

own experiences. The assignment also served as a valuable source of student feedback. Students were asked to write an overview of the project, describe their own role in the project, and assess their own performance (Figure 1, step 9). They also reflected on what they had learned and on their personal and professional growth.

Comments from students' reflection papers confirmed that the project helped them connect with the course material. One student wrote: "Being able to go and see local bird species was valuable and gave more perspective than learning about the birds secondhand through research alone." Another commented: "This service-learning project was a new and unique experience for me and I really enjoyed it. I learned about other careers and opportunities in biology. I also found that a lot of what we learned in class applied to Ganondagan." A third wrote: "From this project I learned a lot about the bird species described in the book. I also improved my time management skills as well as professional and communication skills."

We used several tools to assess and compare service learning on an institutional scale, and across departments and disciplines. These included student reflection papers, a student impact assessment, a community impact assessment, and a faculty impact assessment. The director of the Center for Service-Learning and Civic Engagement distributes a common student impact assessment survey to all service-learning faculty. A community impact assessment and a faculty impact assessment were administered online to obtain data on faculty perceptions of students' learning and the impact of their work on meeting community needs (these assessment surveys are available in the Supplemental Material).

Responses to the student impact assessment survey indicated that students accomplished our three civic engagement learning goals: intellectual engagement, application of knowledge, and communication (Table 4).

To better assess the impact of our particular project, the student impact assessment also contained open-ended questions. For the complete list of questions, see Supplemental Material). Examples include

- How did the service-learning project help you understand the course content?
- What was the biggest growth area as a result of service learning?
- What impact do you feel your work had on meeting the needs of your community partner?
- What suggestions do you have to improve this experience?

Answers to these questions were generally positive and consistent with comments in the reflection paper:

- "The content we learn in class about invasive species and other ecosystem disruptors like human activity can be seen at the park and made me realize the significance of conservation efforts."
- "Being able to go out into the field and survey [wildlife] for this project helped me to apply knowledge of their behavior learned during the course."
- "I enhanced my communication skills since we were always communicating with our instructor, group members, other classmates, and the professionals at the park."
- One student (out of how many?) said she is now considering a career in conservation.

The community partners also indicated on the community partner survey that the professionalism of the students was high and that they valued the students' work. For example: "These students were professional and driven. The work they produced rivals what I would expect from a hired company to create what we wanted." The community partners stated that the students' work met an identified need, will be used by the organization, and would not have been completed without the support of the students: "The products the students created will be used in almost all of our outreach and events that we host throughout the summer months."

To close the loop, suggestions for improvement will also be taken into consideration for the next iteration of the course. Some students were less clear on the relevance of the project to course goals, and others suggested increased organization of the experience and a greater number of visits. Even though the project plan provided academic benchmarks, arranging mid-semester meetings with the community partners before the semester begins could enhance organization, and more frequent on-site visits could increase engagement. Clearly communicating the connection between the service-learning experience and academic content could reinforce the centrality of the experience for meeting course goals.

Table 4. Student impact assessment results. Students were asked questions on the items *added meaning* ("I gained knowledge, skills, or awareness that has added meaning to this course"), *initiative* ("Service learning strengthened my ability to be accountable and take initiative for my assigned work"), *cooperation* ("Service learning strengthened my collaborative skills as a team member and taught me how to work together with supervisors and clients"), *communication skills* ("I was able to effectively express, listen, and adapt to others when communicating with clients and supervisors"), *project support* ("I received the support I needed to complete the service-learning project"), and *future community service* ("I plan on doing further community service work on my own in the future").

Item	Not Applicable	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
Added meaning	0.00%	21.43%	64.29%	7.14%	7.14%	0.00%
Initiative	0.00%	42.86%	42.86%	14.29%	0.00%	0.00%
Cooperation	0.00%	35.71%	50.00%	7.14%	7.14%	0.00%
Communication skills	0.00%	42.86%	42.86%	7.14%	7.14%	0.00%
Project support	0.00%	21.43%	35.71%	42.86%	0.00%	0.00%
Future community service	0.00%	7.14%	50.00%	28.57%	7.14%	7.14%

○ Conclusion

Service learning is an effective way to engage students in natural history and ecological courses and develop an environmental ethic of caring. Applied ecology experiences like the one described can enhance problem-solving and communication skills, technical skills like surveying and analysis, and a commitment to environmental concerns. According to Russo (2010), service learning “can take students out of their academic shelter and help them begin to develop a sense of place – something that is particularly important for developing the stewardship needed to protect environmental quality.” Putting students in the role of environmental consultant increased eco-literacy and fostered application of course content, exploration of disciplinary knowledge, and development of communication skills.

This project enabled students to gain knowledge of ecological theories through articles, lectures, and discussions in class (intellectual engagement). Students also applied course-generated knowledge and skills and developed solutions in order to address identified community issues (application of knowledge). Lastly, students developed their oral and written communication skills through translating academic theory into meaningful dialogue with others.

References

- Association of American Colleges and Universities (2009). Inquiry and analysis VALUE rubric. <https://www.aacu.org/value/rubrics>.
- Astin, A., Vogelgesang, L., Ikeda, E. & Yee, J. (2000). How service learning affects students. *Higher Education*, 144. <http://digitalcommons.unomaha.edu/slcehighered/144>.
- Bebbington, A. (2005). The ability of A-level students to name plants. *Journal of Biological Education*, 39, 63–67.
- Bringle, R.G., Hatcher J.A. & McIntosh, R.E. (2006). Analyzing Morton's typology of service paradigms and integrity. *Michigan Journal of Community Service Learning*, 13(1), 5–15.
- Brail, S. (2013). Experiencing the city: urban studies students and service learning. *Journal of Geography in Higher Education*, 37, 241–256.
- Brail, S. (2016). Quantifying the value of service-learning: a comparison of grade achievement between service-learning and non-service-learning students. *International Journal of Teaching and Learning in Higher Education*, 28, 148–157.
- Butin, D. (2005). *Service-Learning in Higher Education: Critical Issues and Directions*. New York, NY: Springer.
- Celio, C.I., Durlak, J. & Dymnicki, A. (2011). A meta-analysis of the impact of service-learning on students. *Journal of Experiential Education*, 34, 164–181.
- Desmond, K.J. & Stahl, S.A. (2011). Implementing service learning into human service education. *Journal of Human Services*, 31, 5–16.

- Eyler, J. & Giles, D.E. (1999). *Where's the Learning in Service-Learning?* San Francisco, CA: Jossey-Bass.
- Ganondagan n.d. <http://ganondagan.org/environmental-team>. Accessed February 19, 2018.
- Hammond, S.W. & Herron, S.S. (2012). The natural provenance: ecoliteracy in higher education in Mississippi. *Environmental Education Research*, 18, 117–132.
- Jacoby, B. (1996). Service-learning in today's higher education. In B. Jacoby & Associates, *Service-Learning in Higher Education: Concepts and Practices*. San Francisco, CA: Jossey-Bass.
- Jacoby, B. (2014). *Service-Learning Essentials: Questions, Answers, and Lessons Learned*. San Francisco, CA: Jossey-Bass.
- Kalles, S. & Ryan, T. (2015). Service-learning: promise and possibility in post-secondary education. *International Journal of Progressive Education*, 11, 132–148.
- Knackmuhs, E., Farmer, J. & Reynolds, H.L. (2017). Student outcomes of eco-restoration service-learning experiences in urban woodlands. *Journal of Experiential Education*, 40, 24–38.
- MacFall, J. (2012). Long-term impact of service learning in environmental studies. *Journal of College Science Teaching*, 41(3), 26–31.
- McGlynn, T.P. (2008). Natural history education for students heading into the century of biology. *American Biology Teacher*, 70, 109–111.
- Middendorf, G. & Pohlad, B.R. (2014). Ecoliteracy for ecology and ecologists: eroded underpinnings. *Frontiers in Ecology and the Environment*, 12, 194–195.
- Pearson, D.L., Hamilton, A.L. & Erwin, T.L. (2011). Recovery plan for the endangered taxonomy profession. *BioScience*, 61, 58–63.
- Pilgrim, S., Smith, D. & Pretty, J. (2007). A cross-regional assessment of the factors affecting ecoliteracy: implications for policy and practice. *Ecological Applications*, 17, 1742–1751.
- Russo, R. (2010). *Jumping the Ivory Tower: Weaving Environmental Leadership and Sustainable Communities*. Lanham, MA: University Press of America.
- Rutti, R.M., LaBonte, J., Helms, M.M., Hervani, A.A. & Sarkarat, S. (2015). The service-learning projects: stakeholder benefits and potential class topics. *Education & Training*, 58, 422–483.
- Stoecker, R. (2016). *Liberating Service Learning and the Rest of Higher Education Civic Engagement*. Philadelphia, PA: Temple University Press.
- Tinkler, A., Tinkler, B., Hausman, E. & Strouse, G.T. (2014). Key elements of effective service-learning partnerships from the perspective of community partners. *Partnerships: A Journal of Service-Learning & Civic Engagement*, 5, 137–152.

CHRISTOPHER R. COLLINS is an Assistant Professor at St. John Fisher College, Rochester, NY 14618; e-mail: crcollins@sjfc.edu. LYNN DONAHUE is Assistant Director of the Institute for Civic and Community Engagement at St. John Fisher College; e-mail: ldonahue@sjfc.edu