EDUCATION

Restoring Degraded Objects: The Next Best Thing to Teaching Ecological Restoration in the Field

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ABSTRACT

It is often difficult or impossible to take conventional academic students into the field to observe and participate in real world ecological restoration projects. Consequently, many educators attempt to simulate these experiences by incorporating more active learning, non-lecture activities into their classes. In this paper, I share the results of, and what I have learned from, years of tinkering with a hands-on "degraded objects" activity for undergraduate students first presented in a 2004 paper by Lundholm and Larson. I have discovered that this activity is most effective when students select degraded objects that they care deeply about, bring their restored objects to class, and are free to present their work in whatever manner they think best. Although every class and every project has been unique, some common themes have emerged: 1) Restoring their objects turns out to be far more complex and interesting than the students thought it would be; 2) They demonstrate an impressive amount of perseverance, creativity, and resourcefulness; and 3) They meaningfully connect their projects to the individual components and overarching themes of the class as a whole. In conclusion, this can be a remarkably effective activity for simulating the experience of ecological restoration that simultaneously provides a concrete, achievable assignment and a holistic, open-ended challenge. It also helps the class develop a spirit of camaraderie and learn more about each other. This in turn helps us better understand, appreciate, and respect people whose values and perspectives may be radically different than our own.

Keywords: active learning, experiential education, pluralism, teaching project implementation, values

Ecological restoration can be incredibly complex, inspiring, and frustrating. The most effective way to convey this richness to the uninitiated is undoubtedly to take them into the field and have them observe and participate in real world restoration projects. Unfortunately, this is often logistically difficult or impossible to do within the confines of conventional academic classes and schedules (Lundholm and Larson 2004, Bakker and Howell 2011). Indeed, a recent analysis of post-secondary restoration courses in North America (Bakker and Howell 2011) found that most such courses were taught in a classroom setting during the academic year, and focused primarily on theory and concepts (but see Aronson 2010 for a review of some exciting alternative educational programs).

However, in an effort to engage their students and simulate the experience of doing real restoration, educators have effectively utilized numerous classroom-based, non-lecture activities such as problem-based learning modules (e.g., Schaefer and Gonzales 2013). I have also had good luck with these kinds of more experiential, active learning techniques, and have devoted an increasing proportion of my classes to implementing them. Nevertheless, in my experience, these activities have rarely managed to emulate the richness and intensity of doing ecological restoration in the field. In addition, I rarely felt that these activities effectively bridged what at least some of us (e.g., Cabin 2007a, 2007b, 2011, 2013b, Cabin et al. 2010, Dickens and Suding 2013, DeSimone 2013) believe is an important gap between researching, planning, and analyzing ecological restoration and actually doing it.

Thus when I came across Lundholm and Larson's (2004) excellent paper describing their method of using "degraded artifacts" as a hands-on exercise for teaching restoration ecology, I eagerly tried out their ideas in my own classes. In a nutshell, these authors had their students: 1) select a severely degraded object; 2) attempt to restore this object by utilizing the principles of ecological restoration; and 3) analyze and discuss how their project was similar to and different from "real" ecological restoration.

Right from the start, I had great success with Lundholm and Larson's activity. But after several subsequent

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iterations of tinkering with it, I was able to modify and incorporate this project into my undergraduate classes in an even more effective manner. Because to my knowledge no other studies have tested or expanded upon the ideas presented in Lundholm and Larson's (2004) original paper, here I share the results of, and what I have learned from, years of using their activity to simulate the experience of doing ecological restoration. Just as Lundholm and Larson's article inspired me to tailor their activity to my particular pedagogical needs and interests, I hope this paper may inspire others to adapt and modify my experiences to best serve their specific situations.

Methods

I have incorporated this "degraded artifacts" activity into all of the conservation biology classes I have taught since 2005 (five classes, with 8–15 students per class). I begin by asking my students to choose a degraded object that they would like to physically restore. I have repeatedly found that the more they truly value, or, ideally, love their objects, the better this activity works. Next, they give a brief oral presentation to the rest of the class in which they provide preliminary answers to the following questions:

1. Why do you want to go through the trouble of restoring this object, rather than simply getting a new one, leaving your object in its present degraded state, or just throwing it away? In other words, why do you care about this particular object?
2. How does the structure and function of your degraded object differ from what it was in its "pristine" undegraded state?
3. What specific sources of information might help you learn more about your object and how to restore it?
4. Which aspects of your object's degraded structure and/or function might you choose to restore, and which aspects (if any) might you choose not to restore? Explain the reasoning behind these choices.
5. In what ways are the above aspects of restoring your degraded object similar to and different from the theory and practice of ecological restoration?

After each presentation, we provide constructive criticism to help each student refine his or her conceptual ideas and technical plans. I strongly encourage students who do not appear to have a feasible restoration plan, and/or do not seem to be emotionally invested in their objects, to start over again. I also urge them to choose objects that they can physically bring to their final presentations. This is because, much like the difference between showing students pictures of ecological restoration projects versus physically taking them into the field, viewing photographs of the students' work has generally proven to be a poor substitute for the richness of seeing and touching the objects themselves. Moreover, students that bring their restored objects to class tend to put substantially more pride and effort into their work.

Because students often do not have the most suitable degraded objects with them at college, I schedule this initial presentation so that it occurs shortly before our fall or spring semester break. This way, students have an opportunity to collect these more desirable objects while visiting their families and friends during these breaks. This scheduling also gives students who can't get these objects themselves time to have them mailed to them at school.

Next, they decide whether they want to physically restore their objects or simply research and design a theoretical restoration plan. Because I have found that this activity is far more effective when the students do the actual restoration, I have devised increasingly strong incentives for them to do so. However, because I have encountered students that were unable or unwilling to do the physical work, I have also found it best to offer these relatively few students an alternative pathway that is not excessively punitive (e.g., they have to write a longer accompanying paper that synthesizes substantially more relevant scientific literature and/or write an additional paper on some aspect of the theory and practice of ecological restoration).

I regularly check in with the class as a whole and with the students on an individual basis to assess their progress, provide guidance, and offer encouragement. At the end of this activity, I require all students to provide written answers to the above questions, and to devote proportionally more time and effort to question number five. I make this written assignment due at the same time they give their final presentations so that they are as intellectually prepared to share their work as possible. However, I have learned to give the students the freedom to decide how they want to convey their work to the rest of the class. Most wind up giving demonstrations, showing PowerPoint slides, and/or giving some form of show-and-tell.

I have also become increasingly relaxed about establishing and enforcing time limits for these final presentations. This is because some of these projects, and the discussion they generate, are so compelling and informative that I hate to cut them off prematurely. Consequently, I create a staggered schedule so that only a few students present on any given day, and there is enough time to let the ones that warrant it run longer. This also helps maintain the freshness of each project, and enables us to connect new material covered during this unit of the course with previously presented student projects.

Results and Discussion

The diversity of my students' degraded objects, restoration procedures and outcomes, insights, and implications rivals the diversity of ecological restoration itself (Table 1). Yet much like the real thing, while every class and

Table 1. Ten examples of Brevard College student "restoring a degraded object" projects. For brevity, and to avoid redundancy, only one insight and implication are listed per project. See text for further discussion of these and other student projects.

Object	Degradation	Restoration	Insight	Implications for Ecological Restoration
Childhood tree house	Rotted and unsafe	Install new lumber and other building materials	Much of the value of my tree house stems from our shared history and interactions.	Incorporating cultural history and involving people throughout the process adds value.
Cross section of white oak stump	Cracked and blemished	Sand and stain	How many times can we "sand down" ecosystems before we break the ecological crucible?	Nature has limits; problems such as extinction may be difficult or impossible to solve.
Childhood basketball trophy	Missing parts	Purchase and install cheap replacement parts	"Cheap" restoration can lead to hollow, trophy-like projects.	It takes more than money to solve problems and foster better human/nature relationships.
Old family photograph	Scratched and faded	Scan and restore electronically	I was only willing to try electronic restoration because it didn't affect the original photograph.	It's important to maintain functional "copies" of the "original" species and ecosystems.
Deceased relative's World War II jacket	Badly damaged and missing pieces	Selectively mend and install new parts	Even though my restoration was only partially successful and somewhat 'inauthentic,' I'm still glad I did it.	Doing the best we can and accomplishing something is far better than doing nothing and losing everything.
Brother's backpack	Torn and battered	Patch and sew	Because the professionals didn't really value my pack, I decided to fix it myself.	Locals may be wary of "expert" outsiders who don't understand and value their relationships to nature.
Grandfather's banjo	Missing parts no longer available	Modify banjo to utilize modern parts	When new parts don't fit the original instrument, we may need to change the parts, the instrument, and/or our thinking about music.	When new (alien) species do not fit the original (native) ecosystems, we may need to change the species, the ecosystems, and/or our thinking about nature.
Bottle tree sculpture	Dirty and rusty	Clean and remove rust	After much tedious and inefficient manual labor, I gratefully switched to chemical cleaners and power tools.	It's easy for those with no experience to criticize practitioners for using herbicides and other "blunt tools".
Army medals	Scattered and disorganized	Organize and mount	To my pleasant surprise, my parents and army buddies got deeply involved in this project.	Who this work is really for is a deceptively complex but critically important question.
Old deer skull with large antler rack	Falling apart and abandoned	Repair and mount	This mounted skull symbolizes a lost world, because not many deer live that long anymore.	This work can show us how things used to be, and maybe how they could be again.

every project has been unique, some common themes have emerged.

First, many students initially have trouble connecting their projects to ecological restoration. Yet as their work progresses, most eventually became almost overwhelmed by the similarities. As one student wrote, "I was racking my brain at the beginning to come up with just one parallel between what I was doing and what happens in restoration. But now, after all the work I have done, I am struggling to fit all of the parallels into this paper!"

A second common theme is that restoring their objects turns out to be far more complex and time-consuming than they thought it would be. Indeed, the above student continued her essay by pointing out that "The first and most humbling parallel is the amount of time it actually took to complete this project, as opposed to the time that I hypothesized it would take."

Another parallel noted by many students was that few people outside our class would probably ever appreciate how much time and effort their seemingly simple restoration projects had required. As one student wrote, "Most people will have no idea how good it [her skirt] looks now because they didn't see it before I restored it. This is like how people from the outside world are usually unaware of the prior condition of restored land, and how much hard work it took to restore it. They might be totally oblivious to the fact that they were beholding, in a sense, a masterpiece."

As they dove into their projects, the students faced many of the same kinds of technical, economic, aesthetic, and philosophical challenges that restorationists encounter. Here's a representative excerpt from an international student's paper:

"A small color photograph of my parents has been with me for the full twenty-one years of my life. This photograph has very high intrinsic value to me . . . it reminds me of who my parents are and that they are never far away from me. It was the very first thing I packed when leaving to study in the United States. I chose this object because I believed that restoring it would renew the symbolism . . . I originally thought this [restoration process] would be a simple task, but the more I thought about it, the more I began to wonder and worry: 'Which parts of the object did I want to restore, and to what degree?' 'Would it still hold the same intrinsic value to me?' 'What would my parents think?' On several occasions I thought I had finally found the perfect answers, but ended up reconsidering almost every time."

As they struggled to solve their intellectual and technical problems, most were able to meaningfully connect their experiences to ecological restoration. A student veteran observed that "I never realized just how proud I was of all my military service awards until I finally got them all together for this project. Then I quickly changed my mind and decided that I wanted to restore and preserve them all! But then I realized I was going to need a much bigger budget and a lot more time. Kind of like trying to decide which species and ecosystems to restore, when we really want to save everything."

A student restoring an old bicycle wrote that "The most difficult part was removing the crankset that was rusted in place; this one task almost made me quit the project. But I knew without removing this part, the bicycle would never be functional again. This was just like how unless restorationists removed some dominant invasive species, the original native ecosystems will never be functional again."

Students were also able to effectively relate their projects to our course readings, discussions, and other activities. For example, a student restoring a torn bag realized that ". . . a weakness in any of the strands could cause the entire bag to fall apart. This is a perfect parallel to the important role of keystone species; when the starfish *Pisaster ochraceus* was removed from the tidal environment [a reference to Paine's 1966 classic paper we read earlier], the entire ecological foodweb eventually collapsed." A student restoring his grandfather's banjo wrote that "I thought about Aldo Leopold's concept of a land ethic, as detailed in *A Sand County Almanac* and the *Green Fire* movie we watched, and tried to apply his ideas to my project. But as we've discussed with ecological restoration, I struggled to figure out exactly what I was restoring this banjo for. Its beauty? Its sound? Its integrity? Its historical relationship to me and my family?"

Perhaps because we spend a substantial amount of time in my classes exploring the different ways individuals, stakeholders, and special interest groups may perceive, value, and interact with nature (e.g. Cronon 1996, Gobster and Hull, 2000, Cabin 2013a), my students tend to notice and discuss such differences in their projects as well. For example, a student restoring an old family backpack observed that "The value people place on a backpack is highly variable, in the same way people value ecosystems differently. Some essentially ask 'how does it benefit me?' But others might also value a backpack or an ecosystem's function, history, or appearance."

Several students concluded that one of the biggest differences between their projects and ecological restoration was that they were the only "special interest group," and thus had the luxury of doing whatever they wanted. Yet in some cases, other people did become involved in their work. For example, one student wrote that "Just like we've seen in some ecological restoration projects, I was blown away by the number of people who provided unsolicited opinions about my project. These ranged from 'you're wasting your time' to 'that would look a lot better if you just . . .' to 'what an awesome project—can I help?'"

When the students' families got involved, this occasionally generated some complex and emotional conflicts that simulated what can happen in contentious ecological restoration

projects. As illustrated with the above international student's photograph, some also took it upon themselves to wonder and worry about how their parents, friends, and other "stakeholders" (living, dead, and yet to be born) might react. These kinds of questions in turn often led to insightful discussions about whose interests are and are not being served by different ecological restoration projects and programs.

Many students seemed to enjoy viewing their work as extended metaphors of ecological restoration. Some focused on what they saw as procedural similarities. For instance, the above student veteran wrote that "In addition to securing funding and focusing scope of work, another important piece of my project was interagency cooperation. The processes of getting my vision approved by the funding agency (my mother), expressing my desires to the project manager (Rob at MMM), ordering additional supplies from vendors, and meeting intermediate and final deadlines was exactly like some ecological restoration projects."

A student who restored an old hunting bow (and demonstrated his success by taking us out into the woods, shooting several bulls'-eyes, then serving us venison snacks from a deer he had recently killed) wrote several pages about the metaphorical implications of his project. Here's a brief excerpt:

> The bow is a microcosm for a functioning ecosystem . . . each component can be related to actual ecological restoration projects. The limbs represent funding agencies;behind every restoration project is a source of money that allows the project to happen. The string can be correlated to people that do on-the ground work; without them, ecological restoration would simply be a concept or an idea. The target represents what we are trying to fix; which might be an entire ecosystem or the population of a given species.

During their final presentations, the rest of us would occasionally join in to see how far we could collectively take the metaphors. For instance, at the start of his presentation, the student who restored his grandfather's banjo showed us how he had enlarged the holes in his instrument's neck to accept the new tuning pegs. Another student then suggested that the pegs were species and the banjo was the ecosystem. Someone else added that the new pegs were like alien species that provide ecosystem services once performed by native species that had since become extinct. A third student pointed out that to make things work more "harmoniously," we often must alter both the "pegs" and the "banjo" itself. After the presenting student concluded by playing an old song on his newly restored banjo, we all agreed that this once silenced ecosystem was now capable of making beautiful music again.

Of course, not all of the students' projects turned out so well. In truth, many experienced the kinds of false leads, dead ends, and painful compromises that occur in ecological restoration. There have also been a few students who did not appear to get as much out of this activity as I would have liked. In the great majority of these cases, this was primarily a consequence of their simply failing to devote sufficient time and effort towards researching and/or restoring their objects.

Nevertheless, to my knowledge, there has not been a single student who regretted taking on his or her project. On the contrary, even the most frustrated students have appreciated how much they learned in the process. Moreover, these students have also realized that what they did accomplish was, like the partial restoration of degraded species and ecosystems, far better than doing nothing at all.

However, I believe it is incumbent on me as the instructor and an experienced restorationist to point out that even the most ambitious and meaningful restored object projects are no substitute for the "real thing." Consequently, I provide numerous examples of ways in which the restoration of inanimate objects is *not* analogous to the complexities associated with living species and dynamic ecosystems. I also encourage the students to come up with their own such examples, and better yet, to observe and participate in real world ecological restoration project.

Conclusions

I enthusiastically recommend Lundholm and Larson's (2004) "restored artifacts" activity to anyone interested in simulating the joys and frustrations of doing ecological restoration within a classroom setting. Over my years of tinkering with this activity, one of the things that I have come to love most about it is that it simultaneously provides a concrete assignment and a holistic, open-ended challenge. Students with more interest and training in the sciences can take a more quantitative, model-and-data-driven approach. Students with different interests and backgrounds, such as in the arts or humanities, can utilize their knowledge and skills in these other areas. Those who excel in more intellectual, academic areas are forced to use their hands, a task many have rarely if ever had to do before in college. Students whose more vocational or artistic skills may be stronger than their academic ones get a rare opportunity to show off and get credit for these talents, but must also analyze and present their physical work through more intellectual channels.

Even normally apathetic students often demonstrate an impressive amount of perseverance, creativity, and resourcefulness to complete their projects. Many interact with people outside of the academic community, such as a seamstress, woodworker, or knowledgeable employee at the local hardware store or machine shop. These experiences, which also are something

most have rarely if ever done before in college, tend to be highly informative on multiple levels.

Yet another valuable attribute of this exercise is that it helps students appreciate and understand aspects of restoration that might otherwise seem esoteric and dull. For example, attempting to apply relatively abstract theories and models to their work can effectively bring the power and limitations of these ideas to life. Similarly, students often wind up having much more to say about restoration's more philosophical issues, such as how "pure" can we and should we be when attempting to restore highly degraded ecosystems (Cabin 2011, 2013b).

Finally, perhaps one of the most unexpected yet important outcomes of this activity is that we tend to develop a spirit of camaraderie, and to learn more about each other. While hearing about, say, the process of mounting an old deer skull, we also learn what it was like for this student to kill that deer with his father when he was a little boy, and why he is so passionate about hunting today. While admiring the handiwork of a student who restored her grandmother's old shawl, we learn how that remarkable old woman inspired this student to become a die-hard conservationist. Such stories also help us better understand, appreciate, and respect people whose values and perspectives may be radically different than our own.

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