Using music to teach ecology and conservation: a pedagogical case study from the Brazilian Pantanal

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Abstract
The Pantanal Sonora Project is an ongoing outreach project that unites music and environmental education and highlights the simultaneous promotion of musical development, empowerment, interest in science, as well as the conservation agenda of a natural heritage region. Interdisciplinary projects of this nature are soundly rooted in theory, but have not been thoroughly described in the literature, which instead focuses on infusing song lyrics with images of nature to promote conservation. Here we provide a concise review of the literature on music education to promote empowerment and conservation, and justify our method of uniting the two seemingly separate subjects. We then describe the curriculum and materials from the Pantanal Sonora Project, which is based in the Pantanal region of Brazil, a priority area for conservation. We set out empirical goals for future projects and describe limitations to the method we employed, suggesting that these limitations can be overcome in future projects. We further contend that this type of music and environmental education project has the potential to empower rural community members, increase interest in science, and may be used in introductory music teaching in addition to work with more advanced students.

Keywords
Environmental education, nature, composition, birdsong, empowerment

Introduction
Throughout history, the natural world has inspired our arts and rituals (Gray et al., 2005). Like language, music is something that distinguishes humans from other animals; however, a deeper look at the natural world reveals animal communications exhibit many of the hallmarks of music (Turner & Freedman, 2004; Gray et al., 2005). The connections between humans and nature are the subject of numerous areas of research, and, collectively, they attempt to answer the question of what truly makes us human as well as define how human society will conserve and coexist with nature in the future.

Music and nature present special challenges to educators because they must go beyond mere teaching of facts to students. Music education involves teaching fundamental skills such as reading notation and following rhythm, but must also foster creative expression. Teaching improvisation, especially, serves to promote autonomy and strengthens content connections. Environmental education, meanwhile, requires shaping values and attitudes in addition to learning the scientific method and facts. Among the principal means of observing nature is through listening to and
interpreting complex sounds. The strengths of music education and the opportunity provided by nature’s complex sounds complement each other (e.g., Turner & Freedman, 2004).

This work describes a new way of uniting environmental and music education that enables each of their strengths to overcome respective challenges in teaching and learning. We address advantages to using nature for music instruction, and using music for instruction about nature. Previous work on teaching about the environment through music has focused primarily on using lyrics in song (Turner & Freedman, 2004). In addition to presenting opportunities to infuse songs with messages, music education presents a means of empowerment, and the natural world presents unparalleled inspiration and challenges for aspiring musicians. Our discussion begins with a review of the difficulties and the positive outcomes associated with musical and environmental pedagogy. We then outline a case study exemplifying the advantages to teaching music in tandem with nature. We conclude with a discussion about empirical directions and future implications.

**Pedagogy: the strengths and challenges of music and environmental education**

**Music Education**

Music education is recognized as an important means of empowerment for underprivileged or underrecognized groups, providing an avenue for individuals to develop skills that are inherently rewarding while also creating opportunities for groups to produce art that communicates their shared experiences. A well-known example is the El Sistema program, which began working with youth in Venezuela, and now has spread as an educational philosophy across the world (Uy, 2012). In Bolivia, hip-hop music is a means of giving individuals a voice (Tarifa, 2012), and throughout the world it is a powerful tool of social engagement and advocacy (Terkourafi, 2010). In the United States, the Sphinx Organization provides music education to people of color to give voice through music. Collectively, these examples and others worldwide demonstrate the importance of music as a means of promoting social justice and equity in society.

Beyond empowerment, music is a creative outlet for individuals who otherwise may feel restricted by rote learning in modern schools. However, the way music is taught in many areas does not permit the development of creativity, focusing instead on technique and ability. Authors have suggested shifting music education back to creativity—or rather, focusing simultaneously on musicianship and creativity (e.g., Elliot, 1995). While some authors have critiqued this sort of shift (see Silverman et al., 2014), it is in line with educational psychology as it relates to supporting intrinsic motivation. Intrinsic motivation, or individuals’ own desire to learn music, requires that students feel control over the direction of their learning, competence in playing music, and personal connection to the content (Ryan & Deci, 2000). A teaching style that encourages composition and improvisation boosts competence, control, and personal connections, but is substantially more difficult to implement on a large scale with numerous students than other music teaching methods.

**Environmental Education**

The empowerment of people and communities in ecologically at-risk regions is an important aspect of modern theories of conservation of nature (Berkes, 2004). Without its own voice, nature requires people who value it to advocate on its behalf, and environmental education is more difficult than
other forms of education specifically because it seeks to promote these values and attitudes (Hines et al., 1987; Bamberg & Möser, 2007). One of the keys to promoting these values is physical interaction with nature (Hungerford & Volk, 1990). Empirical tests of songs with lyrics about nature have shown potential to supplement interactions with nature to build values and knowledge (Breuer & Mavinga, 2010). However, in spite of general agreement on the idea that music can promote interest in conservation (Turner & Freedman, 2004), there is sparse literature about how nature can be directly involved in music learning. Furthermore, employing song lyrics to teach about conservation does not take full advantage of the ability of music education to empower students, nor does it take advantage of the inspirational power of nature to allow students to create their own music. Our project harnesses the potential of music to empower individuals using the inspirational qualities of nature in a conservation priority region of Brazil.

**Case Study: the Brazilian Pantanal and the Pantanal Sonora Project**

The Pantanal sits on the border of Brazil, Paraguay, and Bolivia, and as one of the world’s largest wetlands and a home to numerous threatened species and migratory birds, it is recognized as both a conservation priority region and natural heritage site (Junk et al., 2012). The largest part of the Pantanal sits in Brazil, where people of the Pantanal, *pantaneiros*, live on low-impact silvopastoral cattle ranches, in small riverside fishing communities, and in larger cities on the periphery.

Brazil is renowned for its music and numerous musicians have used music in Brazil to further political and social revolutions (Araújo, 2010). In the Pantanal, however, access to music education has historically been reserved for those who live primarily in cities, who have little experience in the ecologically-important natural area that surrounds them (Shirley et al., 2012; Carney et al., 2012). Our case study project focuses on a group of intermediate-level music students who are primarily from a large city, Cuiabá, on the periphery of the Pantanal, most of whom had not spent significant time in nature. These students already possessed skills with musical notation and playing on their instruments.

The goal of the Pantanal Sonora Project (in English, “Pantanal Sounds”) is to unify music and environmental education. It was executed in three major phases: a classroom phase, a field phase, and a performance phase. The field phase took place in early July of 2017, and lasted three days. We worked with a total of 20 students between ages 10 and 24 of varying ability levels. A biologist accompanied students to help in identifying birds, their songs, and provided instruction more generally about ecology and conservation in the region.
### Table 1. Outline of phases, specific activities, and learning objectives.

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<tr>
<th>Phase</th>
<th>Component</th>
<th>Objectives &amp; Details</th>
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<tbody>
<tr>
<td>Classroom</td>
<td>Science behind sound, sounds of nature and sounds of man</td>
<td>Learn what timbre, pitch, and volume are in relation to sound waves</td>
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<td></td>
<td>Listening to other composers’ works inspired by nature</td>
<td>Understand that people perceive nature differently and that there is no right answer</td>
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<td></td>
<td>Transcribing in the classroom</td>
<td>Practice using musical notation to express sounds heard</td>
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<tr>
<td>Field</td>
<td>Nature walks and recording</td>
<td>Better understand biodiversity and diversity of sounds in nature; obtain material recorded for transcribing later</td>
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<td></td>
<td>Jam sessions</td>
<td>Bounce musical ideas off other people; share what was heard</td>
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<tr>
<td></td>
<td>Transcribing sessions</td>
<td>Write down what was heard in nature, with older students helping younger ones, based on students’ choices of specific birdsongs to transcribe</td>
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<td>Performing in nature with nature</td>
<td>Perform with real instruments in nature, adding color to the world around and having the world add color to music</td>
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<tr>
<td>Performance</td>
<td>Composition and arrangement, preparation</td>
<td>Arrange students’ compositions into a coherent piece; create student presentations about chosen animals</td>
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<td>Presentation to other students</td>
<td>Present to peers in classroom setting about Pantanal ecology and conservation using music</td>
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<tr>
<td></td>
<td>Presentation in concert</td>
<td>Share ecological, conservation, and music experience in a concert setting to the general public</td>
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The project began with a classroom experience in preparation for the trip into the more natural areas of the Pantanal. There were three main focuses of this classroom experience. First, we addressed the nature of sound itself, describing the physics of what sound is and asking fundamental questions of
what music is, and how sound and music are related. Students then learned how sound has inspired musicians, focusing on composers who used nature in their compositions and exploring the differences in how those compositions were shaped by nature. For example, Beethoven has woodwinds play melodies imitating cuckoos in his “Pastoral” symphony. Villa Lobos’s “Uiara puru” sounds different, but also takes inspiration from the call of a rainforest bird. Prokofiev’s “Peter and the Wolf,” on the other hand, uses both the sounds animals make and the way animals act to tell his story. The bird, for example, is played by a flute that tweets a melody, whereas the cat is played by a clarinet in the low part of its range, not imitating a meow, but rather imitating cats’ mischievous, playful, and stealthy nature. The classroom session ended with short exercises in transcription of basic melodies and birdsong in order to give students an idea of what they would be asked to do in the Pantanal itself.

The second phase of the Pantanal Sonora Project was the field phase, and consisted of four distinct activities. First, students went into the forest, into the savanna, and near creeks to observe different types of wildlife. While observing nature, students recorded different bird calls, and later picked one or several calls to transcribe. Second, students and locals participated in evening jam sessions singing old folk songs and showing off instruments that locals had never before seen played. These jam sessions served as an important bridge between the students, who were predominantly from the city, and local pantaneiros. Music served as an effective introduction, but discussions about conservation-relevant topics such as fishing and jaguar populations soon emerged. Third, students worked in a group to transcribe their recordings of bird songs into musical notation, with older students helping younger students. Finally, students performed their compositions in the midst of the Pantanal, adding their instrumental sounds to the symphony of natural sounds surrounding them. At the end of the field phase, all students identified, recorded, and transcribed at least one animal, and students expressed a strong interest in wanting to do a longer field component in the future.

Figure 1. Interpretations of bird calls in the Pantanal as represented in the final composition and their educational potential. A. The striped cuckoo (*Tapera naevia*; locally, *saci*) is hard to see, but has simple and commonly heard ascending two-note call. The rhythm of the call is even, but the rest between notes is irregular, which makes the two-note call difficult to transcribe. B. The great
kiskadee (*Pitangus sulphuratus*; locally, *bem-te-vi*) can be heard throughout the day near bodies of water. This bird is ubiquitous across Brazil, and has a more complex rhythm, with its final note beginning slightly higher than it ends. C. The undulated tinamou (*Crypturellus undulatus*; locally, *jaó*) has a deceptively difficult song to transcribe, because its final note is not quite a half-step down from the previous note. D. The Chaco chachalaca (*Ortalis canicollis*; locally, *aracuã*) has perhaps the most common song in the early hours of dawn, loudly trumpeting even before the sun rises. It presents a complex problem to interpreters: individual birds are typically in chorus with other individuals, and while rhythmically and melodically each song is similar, there is tension created by dissonance. The song itself is not in any recognizable key, going up six half-steps (an augmented fourth) before going a full-step down.

The final phase of the project is the performance phase, in which student interpretations of natural birdsongs are used to communicate musical and conservation ideas to the wider public. First, we worked to weave students’ interpretations of birdsong into a short piece that could be played in a concert. Next, students present at schools to groups of their peers about the birds that they chose to interpret, their interpretation of the song on their instruments, and the importance of conservation in the region. The last part of the project is a concert open to the public, in which students’ musical work will be performed alongside multimedia presentation showcasing images and recordings from the field and ideas about the ecology and conservation challenges of the Pantanal in the students’ own voices.

**Discussion**

Students demonstrated significant engagement with the environment and local culture of the Pantanal, and with their own music education beyond what might occur in standard classroom-based listening and transcription exercises. Many expressed enthusiasm, to repeat this experience and to spend more time in the Pantanal. Several suggested including more unstructured time at the beginning of the field phase to simply listen to the sounds of nature before trying to focus in on a specific species, demonstrating that students did view this as more than just musical notation practice. These qualitative results suggest that the project did have an impact on environmental values and attitudes as well as musical ability. The project can be looked at through the concept of “co-creation,” which suggests that science and culture develop in tandem (Jasanoff, 2004). Music is an established avenue of co-creation (Pinch & Bijsterveld, 2012; Carney 2014), and the Pantanal Sonora project demonstrates this: students use their musical background and intuition to access further understanding of ecology and conservation, while simultaneously shaping their musical growth through inspiration from scientific and natural sources.

A second important question we seek to address here is one of age and ability. As designed, the themes and educational possibilities that we present here are difficult for beginning musicians and music students. Indeed, interpreting complex birdsongs in nature and transcribing them using the framework of modern musical notation is a challenge for even experienced musicians. However, listening to birdsong is accessible to all ages, and the importance of listening to musical development is well documented (Reimer, 1970). We expect that listening to nature in a musical mindset has similar effects. Loane (1984) suggests that listening should be thought of in much broader terms than just traditional music settings. Perhaps the greatest potential is using locals’
interpretations of birdsongs on local instruments to teach the next local musicians and perpetuate their own cultures.

In order to further develop and clarify these ideas and the results of our project, more empirical work is needed. Our preliminary results, including observations and reactions during and after our project was implemented, suggest that this was a productive experience for music education and for building environmental attitudes and values. Students returned with new respect for the complexities of birdsong, and with a new understanding of the culture of the Pantanal, its conservation importance and challenges. Interviews and surveys of participants during and after the project, in addition to collection of reactions and feedback from audience members at the final presentation, are essential paths of future research. We expect that students participating in this program will show improvements in listening and improvisation as well as in empowerment and interest in nature. Our program offers one way of connecting individuals to the sciences through nature, but we believe its impact may go beyond conservation biology. Music education has been correlated with success in math and science in school (Majno, 2012), and fomenting interest in these areas may be an incidental effect of such a field-science-based project. While it will be difficult to quantify the educational value of the project, students’ own descriptions of what inspiration they took from nature and what the Pantanal now means to them are valuable and useful for encouraging more music and conservation collaboration.

Conclusion
We have presented the theory and implementation of a program uniting music and environmental education. Teaching about music and the environment in tandem has tremendous potential because it takes advantage of one of the strengths of teaching music, empowerment, to build environmental values. Simultaneously, nature presents inspiration and challenges to music students’ creative thinking and musical possibilities that otherwise might be absent in their traditional music education. While the Pantanal Sonora project is a start, much work is needed to better understand the effects of such a program, and to expand programs to more rural communities that stand to benefit greatly from these possible effects.

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References


