



## The Three-Wattled Bellbird: Corridor, Conservation, and Costa Rica

### Introduction: What is that sound?

Emily awakens to a shrill, mechanical, high-pitched sound. It's loud, but at the same time, seems very far away. It's 5:45 am. She arrived to Santa Elena, a small town located near the cloud forest in Costa Rica, late last night after a long, winding bus ride from San Jose. Still, she's wide-awake. She's ecstatic. This is her first time out of the United States. It's the first time she's traveled by herself. And it's to Costa Rica! She's dreamed of visiting a tropical forest since she saw the puma in the Maryland Zoo when she was eight, where she first was intrigued by the adventure, the mystery, and the beauty of such a magnificent animal. So, she saved up some money, and with a little help from her parents, booked her reservation at an eco-lodge in Costa Rica during Spring Break.



Photo courtesy of Peter Gess.

Emily jumps out of bed and quickly dresses so that she can walk to breakfast at a local spot recommended to her by the receptionist. She had arrived late last night when it was dark, so she can't wait to get outside to see what was sure to be a fantastic view of the mountains. On her way out she sees vibrant colored hummingbirds fluttering like confetti around the bird feeder. As she steps quietly out onto the winding, gravel road, she is surprised to find that most of the mountains she had been waiting to see are covered in a thick, smoky, cloudy fog. She immediately misses the expected sense of majesty that often comes with being in the mountains. When she had visited the Colorado Rockies with her parents on vacation a few years

earlier, the tall, jagged, dry, uplifted rock walls that dotted the vast Rocky Mountain landscape had piqued her interest in geology and reminded her of the age and strength of the earth. Here now in Costa Rica, Emily is standing on the very same mountain range that runs like a spine throughout the Americas, dividing the snow and ice melt into water that runs east or west. Yet her experience of the mountains here is entirely different. Even though Emily is standing at 1200 meters above sea level, surrounded by some of the highest mountains in Central America, the dense ocean of clouds yield a view of only pockets of the rolling mountains, and the mountain patches she can see are covered in a rich protective canopy of fig and avocado trees that lay like a warm blanket on the volcanic rock beneath. The clouds and canopy conceal and protect the incredible diversity of animals and plants that Emily is dying to see. The mystery of what lies beyond and beneath and the unexpected beauty comes as a pleasant surprise to Emily and only piques her curiosity and excitement about the cloud forest.

She picks up her pace.

There was that loud shrill sound again...what was that? It becomes clear to Emily that she will need to embark on a search to discover this mysterious animal.



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Emily reaches the Treehouse, a restaurant in the center of downtown Santa Elena. Its name comes from the restaurant's scaffolding—a huge, twisted, thick-trunked, ficus tree, around which the second-story restaurant had been built. Andres, the owner, gives her a menu.



Downloaded from: <http://www.treehouse.cr/> (Jan. 9, 2017).

Andres: “Buenas Dias! Que queres esta manana?”

She is a little nervous. She hasn't brushed up on her Spanish as much as she would have liked. The Spanish classes she took in high school don't really cut it, but she gives it a try.

Emily: “Un café por favor? Y un plato de frutos?”

Andres: “Don't worry! I speak English. The coffee comes from my sister's farm an hour from here. The pineapple comes from the coast of Costa Rica. I highly recommend!”

Andres tells her that his sister's coffee farm is only an hour from here, and asks if she is interested in a tour. Before she can respond, they are again interrupted by the loud piercing call.

Emily: “What is that sound? I've been hearing it all morning.”

Andres: “That's the Pajaro Campano, the bellbird—my favorite bird of the forest.”



Photo courtesy of Matthew Moran, Hendrix College.

Andres explains to Emily who the bellbird is—a large, loud, mahogany-colored bird (at least the males are mahogany—females are a more conspicuous green) with a white head and three dangling "waddles" that hang from the male bird's head. The bird only "charms" people once a year, in the breeding season from March to June, with ear-piercing "Boink" calls from high, exposed perches. Both the waddles and the loud call, which can be heard for miles, are used to attract females. Andres explains that, while in the past, bellbirds were rarely seen or heard, now they are more common.

He explains the role of farming in the deforestation of the bird's forest habitat—deforestation that led to a decrease in the bellbird population. For the bellbird, much of the habitat loss is due to cattle ranching on the Pacific slope. But fruit farms are also to blame. Andres looks at the fresh, aromatic pineapple he just delivered to Emily's table moments before. He explains how some fruit is farmed as a monocrop or single plant crop. This form of farming is especially problematic, because monocrop farming destroys habitat and reduces diversity by eliminating all other plants that might naturally grow in the area—plants that would otherwise serve as a source of food or habitat for native animals. Pineapple farms, which are grown as a monocrop, are one of the country's largest agricultural exports, and are increasingly under fire for their negative impact on the environment; not only are pineapples grown as a single-plant crop without rotation, they are also not



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very efficient plants, with a single large plant producing only one or two fruits a year, and usually requiring heavy pesticide use to maintain even this small yield. Andres continues to describe how other fruit crops, like coffee, can be grown more sustainably. For instance, farmers like Andres' sister and her husband, who farm shade-grown coffee, harvest their beans from plants that are shaded from the sun by a variety of other native plants—a technique that arguably produces better coffee, preserves more natural habitat, and can even attract natural insect-killers in the form of birds!

Their conversation is interrupted—again—by a few short whistles and then the now-familiar loud “boink”.

Andres: “Ah...the bird is close now. When you hear the quiet whistles that come before the loud sound, you know he is near.”

Emily: “You said before that the bellbird used to be rare but now is more common. So what explains the comeback?”

Andres: “We don't know exactly why the bellbird population is growing, but we think that one reason is the Bellbird Biological Corridor Project. My sister is a member.” He goes on to describe how the project workers are trying to partner with farmers and other community groups to restore habitat for the bellbird and other animals. Some of their efforts have resulted in farmers adopting more sustainable forms of agriculture that benefit both the farmers and the wildlife of Costa Rica.

Emily: “That sounds like an easy solution that is good for the people and the bellbird!”

Andres: “Well....not everyone thinks so. Cattle-ranching and fruit-farming help farmers care for their families. Sometimes, it is difficult for them to see why they should change their farms to provide for a bird, when they need to provide for their families.”

Emily: “Hmmm....I guess I never thought about where my pineapple or coffee comes from or how they are grown...and how they might affect the animals and people that live there.”

Andres: “If you would like to learn more, why don't you come out to my sister's farm? She has tours every day. You can see with your own eyes how the coffee is grown. And, you'll get some fresh roasted coffee. You might even see the bellbird. I recommend it!”

Emily: “I would like that very much. Gracias!”

Andres: “Mucho gusto. And enjoy your time in Costa Rica.”

Emily swallows the last few drops of her coffee, finishes her plate of juicy pineapple, and sets out to find her binoculars to see for herself the three-waddled bellbird.



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### **Introduction to Biological Corridors and Costa Rica**

#### **What is a biological corridor and why should you care?**

Most animals require a broad range of resources to survive and reproduce. These resources can include food, protection from predation, nesting sites, and mates, among many others. For many animals, these resources are not contained in a single, isolated location. Consequently, animals may defend large territories to ensure they have the resources they need. In addition, animals may move away from their natal site to reproduce (i.e., they disperse) and/or often move seasonally to resource-rich regions during the breeding season (i.e., migration). In other words, to survive and reproduce, animals often move within a large, contiguous area of natural habitat through the year and throughout their lives. Thus, when large swaths of habitat are divided into smaller fragments and/or reduced in size, animals are forced to move longer distances, often across unknown or even impossible terrain to find resources, or they are constrained to smaller areas that lower their probability of survival and reproduction. This increased burden on animals can lead to lowered survivorship and reproductive rates and ultimately reduced population sizes and even extinction (Haddad et al., 2015).

The central problem is that the habitat fragments created by human activity (usually urbanization and agriculture) are often relatively small and therefore have fewer resources, and fragments are often isolated from each other and exist in a matrix of less suitable or inhospitable habitat (Haddad et al., 2015). Fragments usually have more edges, and these edges have modified environmental conditions, with increased light, more wind, and drier soils, compared to the interior of the fragment (Sih, Jonsson, & Luikart, 2000). Not surprisingly, small fragments sustain smaller animal populations that can be susceptible to lowered genetic diversity and extinction (e.g., Delaney, Riley, & Fisher, 2010).

As a conservation tool, biological corridors connect habitat that has been fragmented by human activity. When done effectively, and especially when they make use of naturally existing stretches of habitat (Gilbert-Norton, Wilson, Stevens, & Beard, 2010), corridors can facilitate the movement of organisms within otherwise fragmented landscape (Beier & Noss, 1998). If a corridor effectively promotes movement across habitat fragments, it can promote gene flow and the dispersal or migration of species from one patch to another (Gilbert-Norton et al., 2010), ultimately reducing extinction risk and supporting genetic diversity within populations and diversity of species.

Corridors differ in shape, size, and purpose. Some corridors are preserved from existing habitat. For instance, preserving existing streams or terrestrial habitats can sustain a corridor that animals are already using. Other corridors are man-made; constructing overpasses or underpasses across a highway or other busy thoroughfare allows animals to move safely between habitats without risk of being hit by automobiles.

To learn more about the science of corridors and its application in conservation, see:  
<http://conservationcorridor.org/>



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### Why establish a corridor in Costa Rica?

Costa Rica is uniquely positioned geographically, biologically, and culturally for a biological corridor because of the rich and diverse habitats it contains. Approximately three million years ago, tectonic shifts resulted in the formation of a land bridge, now known as Central America, that connected the continents of North and South America. Over time, the land bridge was colonized with animals and plants from both North and South America during the Great American Interchange, leading to a high diversity of flora and fauna. The tectonic movement also created the mountain range which runs down the spine of North, Central, and South America. In Costa Rica, the mountain range created a geographic barrier between the east and west sides of the country as well as a variety of elevations, both of which have led to an amazing number of diverse habitats for animals and plants, including the latticework of mangrove swamps that occupy coastal regions, the tropical wet and dry forest, and the cloud and dwarf forests. Costa Rica, and Central America more generally, therefore, house a large and diverse number of plants and animals, including many endemic species—species that exist nowhere else in the world. For instance, while the United States is home to eight to ten species of hummingbirds, Costa Rica sports 52 different species. This high level of diversity makes Central America, including Costa Rica, a biodiversity “hotspot”. Importantly, the recent and significant reduction in habitat due to human activity, has led scientists to classify Central America, including Costa Rica, as an area of concern. Thus, biological corridors here have the potential to have an enormous impact—more “bang for the buck”.

### What is the Three-Wattled Bellbird Biological Corridor Project?

The Three-Wattled Bellbird Biological Corridor (BBCP) initiative began in 1992 as an effort to establish a corridor to protect the three-wattled bellbird (*Pájaro Campana*). The bellbird is a large, iconic bird (*Pájaro Campana*) that attracts attention for its size, call, and unique morphology. Thus, the bellbird is culturally and economically significant, and it attracts ecotourists and other birders from across the world. The species is endemic to Central America and moves seasonally throughout Costa Rica and neighboring countries along both sides of the Continental Divide. Since the bellbird migrates seasonally to or through unprotected areas, it has suffered significant reductions in population size that is presumably due to recent habitat fragmentation. Most of the loss is a consequence of agriculture and tourism development along the Pacific Slope (Allen, Lines, & Hamilton, 2008). The primary focus of the Bellbird Corridor Project is to connect a patchwork of natural and protected areas on the Pacific Slope of the Tilarán Mountains, which run down the spine of northwest Costa Rica. The aim is to connect habitat ranging from the high-elevation (1850 m) cloud forest located on the Continental Divide in the Monteverde Cloud Forest Reserve, through seven life zones, all the way down to the coastal mangrove swamps of the Gulf of Nicoya. The Corridor covers an area of about 67,000 hectares (close to 165,000) and includes the watersheds of three rivers (Monteverde Institute, 2017). The initiative has been or is currently under the supervision of seven different organizations that span the academic, nonprofit, and international sectors. While the project began as an effort to monitor, protect, and sustain bellbird populations, its wide-ranging effects led to an expansion in 1997 to encompass species throughout Costa Rica and Panama.

Thanks to the strong ecotourism sector of the economy, Costa Rica houses many protected areas in the form of parks and preserves. However, these areas are often isolated, fragmented by patches of land that have been deforested due to farming and tourism development. Over the past two decades, BBCP members have worked to increase connectivity between fragments by working to improve the



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management of current protected forests, acquiring new protected habitat, reforesting habitat that is currently deforested, and increasing the incentive to farmers, members of the travel industry, and other community members to reforest their land (Allen et al. 2008).

The BBCP governance structure consists of three types of members: founding, associate, and ally. Founding members are individuals or institutions in the region committed to conservation, environmental management, applied research, education, and sustainable community development. Original members include the Arenal-Tempisque Conservation Area, the Costa Rican Conservationist Foundation, the Monteverde Conservation League, the Monteverde Institute, the Monteverde Reserve-Tropical Scientific Center, the Santa Elena Reserve and the University of Georgia-Costa Rica. Associate members share the same conservation and environmental commitments, and affiliate to support the work of the BBCP. Finally, allied members support specific efforts of or provide resources for the BBCP (Corredor Biológico Pájaro Campana, 2016).

The decision-making body for the BBCP is the General Assembly; it consists of the founding and associate members, and gives rise to the organizing council. The council employs an operations coordinator, and oversees the work of four committees: biodiversity, conservation and use of natural resources, local management and environmental education, and administrative management and coordination. Each committee works to build partnerships and commitments among public, private and nonprofit entities to achieve conservation goals (Corredor Biológico Pájaro Campana, 2016).

For example, the Biodiversity Committee's goal is to promote the conservation of biodiversity and restore connectivity among ecosystems in partnership with local and institutional actors. To do this, it establishes joint action plans for conservation and restoration with private individuals and firms, nongovernmental organizations, local organizations and public bodies located within the BBCP. The Committee then performs research and implements an action plan to close conservation and habitat gaps in the Corridor (Corredor Biológico Pájaro Campana, 2016).

### **Social, Cultural, and Political Factors**

Costa Rica is often celebrated as a conservation and tropical paradise. National Parks and other protected areas conserve nearly 25% of the land, with another 25% in commercial timber. Its rich biodiversity make it a key destination for tourism, with over 2.5 million foreign tourists generating more than \$2.8 billion in revenue in 2015 (Dyer, 2016). This is impressive for a country slightly smaller than West Virginia and a population of 4.8 million.

But Costa Rica has not always been so progressive. Environmental protection and conservation laws date back to the colonial period and proliferate through the first half of the twentieth century; however, such laws often lacked teeth and were seldom enforced. In fact, prior to the 1960s, Costa Rica had the highest deforestation rate in Central America. The frontier economy in Costa Rica followed a familiar pattern: commercial loggers would take the most valuable timber, small subsistence farmers would follow and burn the land for monocropping, and soil degradation and erosion would result. Once the shallow topsoil was lost—a minister of environment once joked that topsoil was Costa Rica's leading export—small farms would give way to large cattle ranches. The Institute of Lands and Colonization often cleared land for farmers; land was often worth more if so "improved." In 1987, forest cover in Costa Rica reached an



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all-time low of just 21%. Much of the remaining forests existed in small, noncontiguous parcels resulting in fragmented habitat (Wallace, 1992).

It would take time to restore forests to their current coverage. An important political moment occurred in 1948, when Costa Rica became the first nation in the western hemisphere to do away with its armed forces, instead opting to commit national resources to social services, including health care and education. Conservation would quickly follow, with a combination of monetary support from the global north (including the Philadelphia Conservation League, Sierra Club, The Nature Conservancy and Friends of Nature), local interests, and international and local scientists. Eventually three national parks were established in 1970. In 1977 an independent park service was created, and by 1978 the park system had grown to include 17 protected units. The first director of the national parks, Mario Boza, had witnessed ecotourism successes first hand when visiting the US national parks as a student a decade before; now he successfully “sold” the need for the parks by linking resource sustainability to economic prosperity (Wallace, 1992).

Ecotourism continues to be the most important foreign exchange earner in the country; the total contribution of travel and tourism was 12.6% of GDP in 2015, and is expected to continue to rise. Further, the industry supports 12.2% of total employment (World Travel & Tourism Council, 2016). Conservation areas in Costa Rica protect twelve out of sixteen life zones and 5% of the world biodiversity (about one half million species). As ecotourism presents opportunities, there are also related challenges. For example, how to increase eco- or green tourism and prevent more destructive forms of tourism? How to protect local customs and traditions, as well as local labor and profits against multinational corporations? As the economy develops, how to develop in a sustainable way? How to respond to competition from other industries, including commercial agriculture and timber? And how to ensure that governmental policies are clear and enforced?

Ecotourism is also very important economically in the region of the BBCP. Allen and his team (2008) studied the types of ecotourists visiting the Monteverde area in 2004-2005. In the dry season, from November to May, older, more affluent tourists visit the area, primarily for birdwatching. In the green season, June to October, younger, less affluent tourists visit; these tourists come to experience nature, but also adventure tourism options such as ziplining. The researchers found, in 2005, that tourism equated to nearly a \$63 million economic value (direct economic impact only, and does not consider indirect or nonmarket effects). Further, a full 28% of tourists responded that if the bellbird and resplendent quetzal (*Pharomachrus mocinno*, another iconic and protected bird) disappeared from the area, they would not visit, which would result in a loss of more than \$17.5 million (Allen et al., 2008).

The Monteverde Cloud Forest Reserve is the gem of ecotourism in the region. But there are other resources as well, such as additional forest reserves. Further, the University of Georgia operates a research, education, and ecotourism center in the area. Many local farmers and cooperatives in the area are cultivating using sustainable techniques and providing eco- and agri-tourism opportunities (authors' personal observations).



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### **Module 1: Socio-Environmental Systems Mapping**

#### **Module Overview:**

You will work with a group of students to develop a concept map that details the factors that contribute to the success of the BBCP and explains how the factors are related to each other and the success of the BBCP.

#### **Learning Goals & Objectives:**

- Understand the structure and behavior of the human and nature systems within the Bellbird Corridor by identifying the components in the Bellbird socio-environmental system and the dynamic relationships among them.





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- Value collaboration among interdisciplinary and transdisciplinary team-members in developing solutions to S-E challenges by evaluating the socio-environmental considerations from the perspectives of the different groups of people who impact and are impacted by the Bellbird Corridor.

### Activities:

You will be led through a practice concept map on campus recycling. Then, with your group, you will develop your own concept map that addresses the Bellbird Biological Corridor. To build your concept map, work with your group on the following steps:

1. Brainstorm with your class the elements/nodes of the concept map:

Biophysical/Environmental	Social

2. It may be helpful to also brainstorm with your class about the human actors that might be involved in the corridor project. How might the project affect each of these actors?
3. You will now be assigned to a group to concept map either the Biological/Environmental elements or the Social elements. Based on your assignment, build a concept map that details how the elements are connected. You will be asked to explain your concept map to the class, so be sure your group understands the complexity of the map.
4. Now, work with the other group in the class to build a comprehensive concept map that encompasses both Biological and Social elements.



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## Module 2: Jigsaw: Understanding the Corridor as a Conservation Tool

### Module Overview:

You will work with a group of students to explore the perspectives of various stakeholders in the BBCP.

### Learning Goal and Objectives:

Value collaboration among interdisciplinary and transdisciplinary team-members in developing solutions to such problems by: identifying the benefits and challenges of inclusive participation in addressing Corridor issues, listing the contributions of important disciplines, and evaluating the socio-environmental considerations from the perspectives of the different groups of people who impact and are impacted by the Bellbird Corridor.

### Activities:

#### 1. Expert Stakeholder Groups:

You will be assigned to a stakeholder group such as: farmers, environmentalists, tourism workers, government officials. Work with other members of your group, who represent the same stakeholder, to explore the role of this particular stakeholder group in the BBCP. Your goal as a group is to become experts so that you can later represent and advocate for your particular stakeholder role. As you discuss your answers to these questions, you may want to consult and even modify the concept map you developed in Module 1.

- a. What exactly is at stake for me with the implementation of the bellbird corridor?
- b. What are my basic needs? My more advanced needs?
- c. What do I do and how do I make a living? What is my daily routine like?
- d. What issues are the most important to me?
- e. What is my connection to the natural world around me? To other stakeholders and community members?
- f. What might my role be as a family member, community member, and citizen of Costa Rica?
- g. What is my economic situation? Is it easy or difficult for me to support myself and my family?
- h. How do I weigh the present and the future?

#### 2. Developing a Management Plan

Now you will leave your expert stakeholder group and move to a new group comprised of individuals from different stakeholder groups. Your instructor will assign you to your new group. Here, your goal will be to develop a management plan for the bellbird corridor that balances the needs of different stakeholder groups. Ultimately the plan should address the following issues/questions. As you discuss your answers to these questions, you may want to consult and even modify the concept map you developed in Module 1.

- a. What are the goals/aims of the corridor?
- b. What will the Corridor look like? Consider the shape and borders of the area.
- c. How will the Corridor work? What is the organizational and management structure? Who is in charge? Who has a voice?
- d. What are the rules governing the corridor? What are the enforcement mechanisms?



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- e. How will you know if the corridor is working? Is there a plan for gathering data and assessing progress?
- f. How much will the plan cost? Who pays for it? Where does the funding come from?

### **Module 3: Biological Corridors in a New Location: Does Scale and Context Matter?**

#### **Module Overview:**

By working with a group of your peers to examine and develop a corridor and management plan at a new location, you will demonstrate your appreciation of different stakeholder perspectives, your ability to consider biological and social factors, your mastery of concept-mapping, and your understanding of biological corridors as a conservation tool.

#### **Learning Goal and Objectives:**

Recognize the importance of scale and context in addressing socio-environmental problems by explaining the value of the corridor as a conservation tool that can be used in other geographic locations with different cultural, historical, economic, and political factors.

#### **Activities:**

Your instructor will assign you a location or offer you instructions about how to go about selecting a location. Once you have decided on a location, you will apply the activities of Modules 1 and 2 to the new location. Steps will include:

1. Develop a concept map for the new location.
2. Identify key stakeholders, their roles, and their motivations.
3. Create a management plan for the new location that addresses issues presented in Module 2 (as well as any additional components you find relevant).

In addition, consider how scale and context play a role in the development, management, and success of a biological corridor by answering the following questions:

1. What new or different challenges were created by this location, compared to the Costa Rica Bellbird Corridor Project?
2. Does the set of stakeholders vary, and if so, how does this affect the management plan?
3. What are the unique aspects of this location's culture, politics, and economy, and how do they influence the management plan?



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