

# 10

## Conservation in the Monteverde zone: contributions of conservation organizations — Update 2018

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The Monteverde conservation organizations documented in 2000 have matured and evolved, joined by additional organizations that developed in new niches. Their primary focus has moved beyond talking about sustainability to practicing it, though there is not yet consensus on how to define sustainability and what measures to take (Burlingame 2000, Gora 2013).

More publications and theses/dissertations related to the chapter topic are now available, but most sources are still "grey literature," though much has been posted on the Internet. I have carried out interviews in annual two-week visits to Monteverde, with frequent follow-up e-mail contacts. Updates to essays that were at the end of the chapter are included in the text below as (essay).

### **10.1 Socio-Economic Developments in the Monteverde Zone**

#### **A. General Developments**

Population in the Monteverde zone has increased since 2000 to about 6500; an estimated

250,000 tourists visit each year (J. Welch, F. Burgos, pers. comm.). This rapid growth put pressure on local institutions and resources and increased socio-economic problems. Years of effort led to the emergence of a local district government in 2003; it works with local organizations and the provincial and national governments to provide services, improve infrastructure, and confront environmental problems (Ewing 2007). Cooperating with local conservation organizations, it created commissions to deal with the area's solid waste (COMIRES) in 2010, water problems (CEGIREH) in 2014, climate change (CORCLIMA) in 2016 (see section 10.6), and Environmental Education (CEAM) in 2003 (see section 10.8). The area sustained major damage from Tropical Storm Nate in 2017; roads and bridges were washed out, electricity, phone service, and water lines were cut. The local government and organizations, individuals, and the national government came together in

remarkable ways to help people and restore services. Radio Zona Alta Medios, the local radio station, was a major means of communication, broadcasting and posting live videos on its Internet and Facebook sites for those who still had working cell phones; the MCFP offered their radios for emergency communications (Cobb 2017; MVI Newsletter 10/20/17; radiozona.alta.com; R. Guindon, pers. comm.). Three Monteverde researchers have analyzed the impact of Nate on the landscape, habitat restoration, and the community, all of which showed resilience in the wake of the severe storm damage (Hamilton, Chinchilla and Zuñiga 2018).

The Coope Santa Elena, which dominated so many aspects of life in Monteverde from the 1970s to the 1990s, faced bankruptcy in 2001. It closed or sold its credit union, grocery store, hardware, and agricultural supply store; private businesses replaced these entities (Guindon, et al. 2001, McCandless 2008). Coope Santa Elena continued as a coffee co-op until 2014, when it was dissolved. Some growers kept producing coffee on their own. A group of families (Union Varsan, established 1990) developed their own coffee processing and exporting system for coffee grown sustainably on their farm, Life Monteverde. The farm also became an educational center (in 2008), teaching about 1000 national and international students each year about sustainable farming. The trademark registration for the original Café Monteverde logo (with the quetzal and the coffee branch) had lapsed, so the corporation was able to register it for themselves under the new brand of "Café de Monteverde," and open a Coffee Center in Monteverde (G. Vargas, pers. comm.; cafedemonteverde.com). Two Coope-affiliated organizations survived in altered form: Comité de Artesanías Santa Elena-Monteverde (CASEM) and Finca La Bella.

CASEM (essay), like La Campesinita (essay), has empowered women and opened educational and economic opportunities for them since the 1980s (Stocker 2013). It became a completely independent cooperative in 2001 (Cooperativa de Comercialización de Artesanías de Santa Elena de Monteverde or CASEMCOOP R.L.). They currently have more than 70 active members producing handmade crafts featuring local plants and animals (N. Gómez, pers.

comm.). In 2010, they added a restaurant that serves "typical" Costa Rican food. They face two main challenges: recruiting younger members and competing with more than a half dozen other art and craft stores that have grown up, many run by former CASEM members (P. Jiménez, pers. comm.). CASEM has added monthly training workshops to improve the skills of its members. By 2017, CASEM had a website (casemcoop.com), on-line blog (casemcoop.blogspot.com), and Facebook page (Casemcoop RL) that give the history of CASEM, illustrated biographies of the members, photos of crafts the members have created, and links to videos about CASEM (P. Jiménez, pers. comm.).

Finca La Bella's (essay) trusteeship was "transferred to the Institute in 2003 when there was concern that the bank might take it when [the Coope] ... could not pay their debt" (K. VanDusen, pers. comm.). In 2013, representatives from La Bella, MVI, the San Luis Development Association, and the Monteverde Monthly [Quaker] Meeting agreed to transfer land ownership to the farmers of La Bella but to place ecological easements on certain forested areas in the name of the Asociación Finca La Bella. Finally in 2017, after complicated land title issues, MVI turned the Finca over to the Association; the Tropical Science Center agreed to be the partner organization responsible for guaranteeing the conservation of the forested areas (Cresson 2013, MVI Annual Report 2018).

El Buen Amigo (essay) was a second experimental co-op located in San Luis (update by E. Vargas):

"...Around 2004 the remaining five families stopped individually managing the dairy operation of the farm. ... They sold the 10+ ha of pastureland that had been bought through the work and effort of the ... members of the group and other support (MCL). ... With the sale income, the families were able to buy or construct another home in San Luis (two families moved to another community). The original farm (131 ha) was not sold; it continued to be a property under the care of one of the Leitón brothers and his family. I still see many reasons to think that this project had a positive impact on the lives of the participants. When I talk with the young people, now adults, that were the small children during

the BA farm years I can clearly see how they were proud of themselves and empowered to pursue different or new life projects."

### **B. Growth of Tourism**

Tourism has grown rapidly in Costa Rica since the 1990s. The government's Costa Rican Tourism Institute (ICT), which has been promoting tourism aggressively, reported an increase of almost one million international arrivals in the 10 years from 2007 (1,979,789) to 2017 (2,959,869) (Instituto Costarricense de turismo (ICT) 2018). Many of these arrivals were tourists who headed to the beaches and non-sustainable mega-developments primarily owned by foreign investors, but many visited more sustainable smaller scale ecotourism venues with local owners in less accessible places such as Monteverde (Honey 2008). Guidebooks and on-line sources (especially Trip Advisor) continue to cite Monteverde as a must-visit location. Monteverde and Santa Elena ranked number 1 of 25 "Top Experiences" in the Costa Rica *Lonely Planet* (2012); by 2016, however, *Lonely Planet* ranked the Monteverde Cloud Forest number 11 of "Costa Rica's Top 20" as other experiences and locations moved up in the listing. The local Chamber of Tourism (Cámara de turismo Monteverde) whose motto is "Monteverde: Authentic and Sustainable," promotes all aspect of tourism in the area from its Sta. Elena office and on its extensive website (exploremonteverde.com); there it quotes National Geographic saying "the Monteverde Cloud Forest Preserve is the jewel in the crown of cloud forest reserves." No accurate data on the annual number of visitors to Monteverde exist, but most estimates for 2017 were in the 250,000 range. When the rest of the road to Monteverde is finally paved, there will certainly be more visitors, though they may not stay as long. Tourism has become Monteverde's primary source of income, replacing the agricultural sector (the iconic Cheese Factory was sold in 2013 to a large Mexican company).

Facilities for tourism have expanded, especially those linked to adventure tourism, including numerous canopy tours with zip lines, hanging bridges, "sky trams," "Tarzan" swings, and bungee jumps. One hotel owner estimated that about half of his guests booked both an adventure tour and a visit to a reserve, with a

quarter each on just one type of tour (P. Belmar, pers. comm.).

There are more than 20 larger hotels and many smaller types of lodging, including inns, pensions, cabins, and even one small hotel with rooms built up in trees. Accommodations range from luxury to budget (see Trip Advisor for Monteverde). In the last few years, following a trend that started in California in 2007 and that has gone viral worldwide, many Monteverde residents have started listing a wide range of houses, cabins, and rooms for short-term rental online at VRBO (Vacation Rental by Owner) and Airbnb (see their websites for Monteverde listings). Many people are borrowing money to build rental properties, seen as a lucrative (currently untaxed) source of income in the low wage climate of Costa Rica. In 2018, one study found 300 available short-term rentals in the Monteverde zone (GCMHC 2018). Trip Advisor has even started listing some of the rentals (58 in 2018). Conversely, some boutique hotels are listing their rooms on Airbnb, whose commission is much less than the large on-line hotel booking agencies such as Trip Advisor. These rentals are very popular with tourists for their ease of booking, lower rates, interesting options, and amenities (such as kitchens). However, these short-term rentals have hurt occupancy rates at traditional taxed lodgings (especially the budget ones) and have eliminated most affordable long-term rental housing for local residents, researchers, teachers, interns, and volunteers (P. Belmar, pers. comm.; GCMHC 2018).

Restaurants (some organic and farm-to-table), cafes, art and craft shops, and souvenir stores have proliferated. Many educational exhibits have developed, including the Bat Jungle, the Ranario (Frog Pond), Butterfly Gardens (essay), Serpentario (Serpentarium), hummingbird gardens, and orchid gardens. Several private farms offer tours, and almost everyone runs a night tour. Chocolate, sugar cane (the Trapiche), and coffee tours include tastes and the option to buy these goods (R. LaVal, pers. comm.).

ICT developed a Certification for Sustainable Tourism (CST) in 1997; hotels have to meet extensive criteria in four different categories to receive ratings (visitcostarica.com/ict/paginas/sostenibilidad; Honey 2008). The owner of the

first hotel in Monteverde to receive the highest CST rating said "Our hotel was always developed in a sustainable way...CST was a way to show the world what we did in a way that could be measured... Our guests do very much appreciate the fact that we run an eco operation" (P. Belmar pers. comm; hotelbelmar.net, agrees with Gora 2013). In 2016, that same hotel, including its farm Madre Tierra, was the first in Monteverde (and the second in all of Costa Rica) to be certified officially as carbon neutral by INTECO, one of two certifying entities in the country. The hotel's website has information about its extensive Sustainability Program (P. Belmar pers. comm.; hotelbelmar.net; inteco.org). Several other CST rated hotels stress their strong sustainability philosophies and practices on their websites. Some tour agencies highlight CST certified facilities. ICT developed a separate certification system, the Blue Flag (Bandera Azul) for beach communities, nature reserves, and ecologically managed land (Honey 2008; visitcostarica.com/ict, turismo-sostenible.co.cr); the two largest Monteverde Reserves (MCFP and CER), one sustainable farm, schools, and hotels fly the Bandera Azul. ICT also certifies naturalist guides trained by INA (Instituto Nacional de Aprendizaje), a national vo-tech training institute that provides classes in guiding and English in Monteverde about once a month and more frequently in the Central Valley (R. Vargas, pers. comm.).

The Center for Responsible Travel (CREST) stresses another international approach to ethical tourism, which encourages tourists to support sustainable environmental, economic, and social development of the area they visit. CREST and MVI sponsored an International Travelers' Philanthropy Conference in 2011, which led to a 3-year pilot project (funded by the Inter-American Foundation) that became the independent non-profit Monteverde Community Fund (MCF, Fondo Comunitario Monteverde, FCM) in 2013 (Wilkins 2011; monterdefund.org):

"The Monteverde Community Fund ... is dedicated to mobilizing resources that bolster the work of our engaged citizenry and community organizations around themes of sustainability. Among its varied fundraising strategies is the Monteverde Traveler's Philanthropy Program,

which seeks to more effectively capture resources from the influential tourism sector and equitably channel them into priority initiatives identified by the community. MCF currently provides small grants for projects related to environmental conservation, social and cultural development, as well as sustainable economic practices. Other service offerings include training and technical assistance with project proposal development and facilitating spaces where residents, businesses and non-profit organizations can benefit from peer exchanges. The organization ... operates as an independent entity with 2 staff members, approximately 400 associates and a growing network of local and national business collaborators" (J. Welch, pers. comm.). MCF has awarded environmental grants for water conservation through reforestation to protect springs and recharge areas and for rainwater catchment systems at one school. They funded studies of community wastewater management and *Pathways toward Climate Change Resilience in Monteverde, Costa Rica* (Brenes, et al. 2016). Other grants went to the Recycling Center, the on-line non-profit Monteverde Community Radio (Monteverde. FM), the Santa Elena Library (a solar panel), the Santa Elena high school (a biodigester), and the local animal spay/neuter program (MCF, Extraordinary Assembly Feb. 2017; J. Wilkins and N. Solano, pers. comm.).

While tourism has brought many benefits to the Monteverde area, it also has had negative effects (Chamberlain essay), especially water and waste problems, pressures on protected areas, and strain on infrastructure from unregulated development. Social and health problems include poorer nutrition and obesity (junk food replacing home grown food), drug use, and thefts. Although natural history guiding has provided many well-paying jobs and financial opportunities, economic inequality has increased; many jobs are in the low-paying service sector, and the cost of living has increased (R. LaVal, pers. comm.). Land prices have skyrocketed, and adequate near-by housing is unaffordable for most. Tourism has become a sort of monocrop vulnerable to environmental and economic changes. The worldwide recession that started in 2008 had serious negative impacts as tourism and international donations dropped. Effects rippled through the Monteverde economy; several

businesses went bankrupt (P. Belmar, R. LaVal, pers. comm.). A hotel owner stated: "For the moment, the market is keeping new development at bay, but if we were to experience another boom, the risk of overdevelopment is high" (P. Belmar, pers. comm.). Fortunately, numerous groups and individuals are aware of these problems and are trying to solve them (Honey 2008, Koens et al. 2009, Stocker 2013, Burlingame 2018).

### **10.2 The Quakers and Bosqueterno, SA (BESA)**

In 2001, Quakers in Monteverde and other community members celebrated the 50th anniversary of the Quaker's arrival in Monteverde. They published an illustrated collection of original documents and essays on life in Monteverde over the 50 years, including material on the history of many of the organizations discussed in this chapter (Guindon, et al., 2001; see also Chornook and Guindon 2007, Davis 2007).

BESA, the organization that they established in 1974 to protect 554 ha of their watershed, continues to be managed by BESA's Board and protected by the Monteverde Cloud Forest Preserve (MCFP), owned by the Tropical Science Center (TSC) in San José. In 2006, negotiations with TSC produced a new rental agreement for the continued protection of Bosqueterno's land and for managing leases on telecommunication towers on its Cerro Amigos (R. Guindon, pers. comm.). These funds, plus new income from Costa Rica's Environmental Service Payments, allowed BESA to start a small grants program in 2008 to support "projects having to do with protection of springs, including reforestation; education focused on water quality and river ecology; prevention, elimination, or treatment of contaminated waters; general education regarding freshwater conservation; education regarding climate change" (bosqueternosa.wordpress.com; see for detailed history). They have funded projects for local conservation organizations and schools, and Santa Elena's ASADA. BESA also made grants for: biodigestors (for wastewater treatment) and raingardens on local farms; the protection and reforestation of springs and riparian buffer zones (CRCF); and research on bird populations,

dragonflies, and damselflies in cloud forests and biological corridors (Bosqueterno poster 2014). BESA contributed funding to baseline studies on wastewater problems in the Monteverde District and a three-year project on the creation of a stream water quality index for Monteverde and adjacent watersheds (L. Camacho, pers. comm.). In 2018, they provided grants for assessing carbon offsets (CORCLIMA), for Environmental Education promoting watershed protection (MCL), and for protecting the buffer zone of a spring supplying Santa Elena's drinking water (R. Guindon, pers. comm.). BESA shareholders voted in 2018 to form a new non-profit Asociación del Bosque Eterno de Monteverde that would be more in keeping with the non-profit way BESA has been operating for some time. The shareholders are still looking for consensus on the goal of dissolving BESA and transferring all its assets to the new Association (R. Guindon, pers. comm.).

### **10.3 The Monteverde Cloud Forest Preserve (MCFP)**

The MCFP remains the most visited private reserve in the area, welcoming about two million visitors since its founding (Báez and González in Molina-Murillo 2017). From 2007-2017, an average of 83,563 visitors came per year, with a record of 96,296 in 2016 and 94,843 in 2017 (C. Hernández, L. González, pers. comm.). The Preserve has 45 employees and creates about 600 jobs directly and indirectly in the area (reserva monteverde.com). In 2017, TSC celebrated its 55th and the Preserve's 45th anniversaries in a 15-article issue of the journal *Ambientico* (Molina-Murillo 2017).

The Preserve's size is 4100 ha, less than previously because of the 2007 settlement of the dispute with the Monteverde Conservation League (MCL) involving land purchased in the initial Peñas Blancas campaign (1986-1989). MCL kept the 5300 ha from its campaign, and some horse-trading of land parcels smoothed out the border between the CER and the MCFP (B. Law, pers. comm.).

The Management Plan of 2005 reaffirmed land use zoning: 97% of the Preserve has absolute protection; 1% is zoned for special use (by researchers and students); and 2% is for public use in the "Triangle" (13 K of trails for tourists).

Several new trails have been built and most existing ones have been widened and re-hardened. A hanging bridge was added; viewing platforms at La Ventana and the waterfall, the restaurant deck, signs, bridges, benches, and trail edges were rebuilt with boards made of recycled plastic. In 2017, MCFP had four of its own naturalists for tours; many tourists continued to arrive with outside guides.

Most buildings have been remodeled with a focus on sustainable construction and practice. The Casona's "rustic" lodge, with its solar hot water system and beds for 43, and its restaurant have been certified at the highest level of sustainability (5 leaves) since 2009 by the CST Program. Three years later, MCFP began flying the ecological Blue Flag with the highest level of 5 stars; this is a national award for the protection of natural areas including water and waste management (M. Díaz, pers. comm.). The Preserve's web page features a tab for "Sustainability" that lists its practices ([reservamonteverde.com](http://reservamonteverde.com)).

The Environmental Education Program (EEP) has two staff members who work with 1st-6th grade students and teachers in 12 local schools, all of which are in the Bellbird Biological Corridor. Students and teachers also visit the Preserve for workshops and guided tours (see Díaz in Molina-Murillo 2017). EEP has broadened its focus on the Preserve's forest to deal with global climate change, endangered animal species, and water and waste (Blum 2012). By 2018, the Reserve funded weather stations in 10 of the schools; students collect and enter data on tablets daily and learn about climate change (M. Díaz 2018). In 2015, the Preserve built a new office for EEP next to the remodeled classroom in the forest now reached by a "Pollinator Trail" (M. Díaz, pers. comm.). Since 2015, staff and volunteers have created nature guides and booklets for students, including a coloring book of the Preserve's amphibians with small photos, text, and conservation status (Zamora 2015). Another booklet illustrating a child's adventures in the Preserve contains an introduction to climate change (Díaz 2017). In 2018, as MCFP focused on quetzals, EEP produced interpretative guides for students of different ages (Díaz 2018). The EEP staff has also made a number of educational videos, many

of which are available on their Facebook page. One video focuses on a group of women in the Bellbird Corridor town of La Guaria who make soaps from medicinal plants with support from EEP and funds from the MCF (M. Díaz, pers. comm.). The Preserve continues to work with students from all Costa Rican high schools that have ecotourism programs and universities with biology and applied science programs (M. Díaz, pers. comm.). They have also offered special workshops for teachers and scientists from the whole country. The Program has provided leadership in community activities related to recycling and COMIRES, the annual Environmental Fair, and Earth Day celebrations (M. Díaz, pers. comm.). EEP's important role in the Comisión de Educadores Ambientales de Monteverde (CEAM) is discussed in section 10.8.

There have been significant developments in MCFP's support for scientific research and its applications. The Alexander Skutch Laboratory opened in 1999 as the Monteverde book went to press. The 200 m<sup>2</sup> building has two labs, offices, and a classroom. Some basic lab equipment is provided, but researchers are expected to bring most of their own equipment. The Research Program has a Director and two assistants; its goal is to "generate information and technical and scientific knowledge that will help make management decisions relevant to the protected resources in the area..." (Y. Méndez, pers. comm.). The 2009 Plan Estratégico de Investigación contains data from 1979-2009 showing that 20% of the studies were done by Costa Rican researchers and students; researchers and students from the U.S. did most of the other studies. Chapter 1 of *Monteverde: Ecology and Conservation of a Tropical Cloud Forest* had shown a decline in the number of researchers as tourism increased; however, there was a jump in the number of MCFP projects in 2000 and 2001, followed by a decline until 2006, increasing to a high point in 2009, when there were 31 studies; a subsequent document shows the 2009 level continuing and even increasing in 2012 (Programa investigación, RBNBM, CCT 2014). The subject matter of studies from 1979-2009 was on: plants (41%), arthropods (21%), birds (18%), and the remaining 20% on other animals. Registers of Research projects for 2014-2016 show an average of 27 researchers per year (Y.

Méndez, pers. comm.). From 2006 to 2016 there were 298 research projects, nearly half of which were done by Costa Ricans or residents (Méndez and Pounds in Molina-Murillo 2017).

More individual researchers have been investigating the effects of climate change on various organisms. Alan Pounds, known for his research on amphibian decline and climate change in Monteverde, was hired as "Resident Scientist" in 1999 to study climate change in the Preserve and monitor specific animal groups. Costa Rican researcher Luisa Moreno studied the distribution, abundance, and composition of avifauna in the MCFP from 2012-2016 and compared her data with Ana Pereira's 1994 data; the differences showed the effects of climate change (L. Moreno, pers. comm.). Canopy researcher Sybil Gotsch (Franklin and Marshall College) began a study in 2012 of the vulnerability of epiphyte communities to changes in climate by examining the ecophysiological responses of selected common epiphytes to water loss (S. Gotsch, pers. comm.). "In 2016, Gotsch in collaboration with Todd Dawson (Univ. of California, Berkeley) and long-term Monteverde researcher Nalini Nadkarni (Univ. of Utah) received an NSF award to intensify this research program" (S. Gotsch, pers. comm.). Nadkarni, continuing her "long-term studies on the effects of disturbance on the ecology of epiphytes in the Monteverde landscape," is "studying the dynamics of regrowth following epiphyte disturbance at the branch level (leaf removal and root trenching) in the primary forest and on isolated trees in pastures. Her collaborations with Gotsch and Dawson involve comparing the microclimate and distribution and physiology of epiphytes at the landscape level, measuring composition and water use of canopy communities in primary forest and isolated pasture trees. Nadkarni's graduate student, Autumn Amici, has been carrying out her dissertation research on the species diversity and community composition of forest and pasture trees, as well as documenting differences of population genetics of bromeliad species in forest vs. pasture locales" (N. Nadkarni, pers. comm.). Emily Hollenbeck Heyne completed multi-year dissertation research in 2018 on predicting the responses of selected epiphytes at different elevations to climate change (Y. Méndez, pers.

comm., [brown.edu/Research/Sax\\_Research\\_Lab](http://brown.edu/Research/Sax_Research_Lab)). In 2018, naturalist guide Ricardo Guindon was completing a data base of 31 years of his observations on birds in the Preserve and surrounding area; he has seen changes in all the main groups of birds which seem to be linked to climate change. Guindon is working with Alan Pounds, who has long-term weather data, to search for correlations between the two data sets (R. Guindon, pers. comm.).

The Preserve has also established its own projects in cooperation with Costa Rican Universities. In 2007, they established "Permanent Monitoring Plots" (1 ha each) in seven locations. This work built on previous projects by B. Haber, who "established long-term phenology plots around the community, with a few trees marked in the reserve." Starting in 1987, N. Nadkarni "was the first to put in hectare plots that have been continually re-measured every 5 years, with marked and measured trees (about 2500 in 5 ha, 4 in the primary forest, 1 in the secondary forest within the Research Area of the Reserve" (N. Nadkarni, pers. comm.). The Preserve completed its second set of tree measurements in their parcels in 2016 and is in the process of publishing the results (Y. Méndez, pers. comm.). In 2010, MCFP set up meteorological stations, and they began a five-year Amphibian Monitoring project under the direction of A. Pounds. Five-year monitoring projects also track quetzals nesting in artificial nest boxes (since late 2014) and reptiles (starting 2016). Other projects include monitoring orchids and a census of dragonflies and damselflies. About 15 camera traps in the Preserve monitor animal movements; their sightings are recorded in a database, and some of the videos are posted on the web page. In 2015, one of the cameras recorded the first video of a jaguar in the Preserve (Méndez and Pounds in Molina-Murillo 2017; W. Haber, pers. comm.). Every year, Preserve personnel participate in a bellbird census for all of Monteverde that is part of a national count (Y. Méndez, pers. comm.).

The idea of a corridor to connect the conserved areas in Monteverde to the Gulf of Nicoya had been discussed for years. TSC had taken the lead with the purchase (1995) of the largest remaining forest patch on the Pacific side, a 251 ha farm subsequently called the San Luis

Biological Reserve, and developed a Management Plan that includes natural forest regeneration (Méndez 2009). This Reserve flies the Blue Flag with 5 stars in the category of Natural Protected Spaces. In 2017, TSC remodeled the San Luis facilities for use by the EEP and some university courses (Y. Mendez, pers. comm. and in Molina-Murillo 2017). MCFP has played an important role in planning the new Bellbird Biological Corridor (BBC) (Section 10.6. E).

#### **10.4 The Monteverde Conservation League and the Children's Eternal Rainforest (MCL/CER)**

At 22,600 ha, MCL's CER is the largest private reserve in Costa Rica. MCL has continued to pursue its mission "to conserve, preserve, and rehabilitate tropical ecosystems and their biodiversity" through forest protection, environmental education, reforestation, sustainable development and eco-tourism, and scientific research. MCL has been recognized nationally and internationally for its successful conservation efforts, most recently including the Costa Rican Blue Flag award (Bandera Azul) for protected natural areas. CER has been supported for many years by sister organizations in Sweden, the United States, the United Kingdom, Japan, and Germany (acmcr.org; Burlingame 2016). "MCL collaborates extensively with other conservation organizations ... this includes participation in inter-institutional committees with SINAC, police, Red Cross, firefighters, other conservation organizations, community groups, and volunteers" (L. Stallcup, pers. comm.).

The League's financial difficulties in the 1990s made additional land purchases a low priority until 2002, when Rachel Crandell, a teacher, founded the Monteverde Conservation League US (MCLUS) in Missouri. In consultation with MCL's leadership, in 2004 Crandell launched a new Land Purchase and Protection Campaign, using 50% of each donation for Land Purchase, 40% for protection (which includes the operation of MCL and MCLUS), and 10% for endowment. MCL established a prioritized list of properties to buy, focusing on filling out the borders of CER to natural boundaries and blocking points of easy

entrance, buying land to connect pieces of CER, and buying inholdings. In a return to the original vision for the MCL, they also wanted to extend CER on the Pacific slope to help create a corridor for animals with altitudinal migrations. MCL sister organizations in the U.K. and Germany and others also contributed to the land purchases. After Crandell's death in 2009, U.S. supporters continued MCLUS, renamed Friends of Children's Eternal Rainforest (FCER) in 2012. Two years later, they broadened their mission to include other conservation efforts in Monteverde and became Friends of the Rainforest (FR) (Burlingame 2016; friendsoftherainforest.org). Since 2016, the US based Engage Globally has also raised funds for EE in CER.

Following the 2007 Peñas Blancas agreement between MCL and TSC, MCL had an additional 5300 ha to protect in CER. Squatters are no longer much of a problem, but MCL's forest guards face serious challenges (especially on the Atlantic side) from illegal poaching, logging, capture of live animals, and removal of plants. MCL and MCFP staff can communicate on radios that operate on the same frequency "to carry out joint forest protection actions and facilitate communication in case of emergency" (L. Stallcup, pers. comm.). MCL's guards also monitor endangered species; there was great excitement in 2013 when camera traps first recorded videos of a jaguar and tapirs. MCL personnel also help researchers. The important Land Ordering Project, which began in 2006, uses GIS and GPS to produce surveys of CER's borders that can be used in legal defenses of those borders and in pursuit of legal titles (MCL Annual Reports, Burlingame 2016).

Major improvements to CER's infrastructure (buildings, trails, signage, road, electricity, and internet access) have been made since 2000 with attention to environmental sustainability. The two biological stations (San Gerardo and Pocosol) have sleeping, eating, and working spaces powered by renewable energy and they have greywater treatment plants. Storm Nate did major damage to the road into San Gerardo and its trails in October 2017, requiring extensive repairs. The Pocosol station, completely rebuilt by 2010, suffered serious earthquake damage, forcing its closure from November 2016-April 2018; FR raised \$60,000 for slope stabilization and



building repairs (MCL Annual Report 2017), which were completed in 2018. Offices of the MCL on both the Monteverde and Atlantic sides of CER were consolidated; they and structures at Bajo del Tigre have all been remodeled. The Bajo del Tigre sector is the only part of CER that is easily accessible from the Monteverde area; it receives nearly 75% of the visits to CER (MCL Annual Report 2017). Night walks started at Bajo del Tigre in 2003 have become a significant source of funds for MCL. A native plant greenhouse, constructed in 2005, was rebuilt in 2018, and a labeled native plant demonstration garden was replanted around the Visitors' Center. In 2012, MCL added an observation platform overlooking a regenerated forest, a meeting/picnic area, and greywater treatment system. The following year, they built a classroom adjacent to the greenhouse (MCL Annual Reports, B. Law and W. Zuchowski, pers. comm.).

MCL has long wanted to have more researchers in CER. They hired a research coordinator in 1994 to promote and facilitate research in CER, whose 7 life zones hold an abundance of biodiversity. That person did research on bare-necked umbrella birds in 1997-98 with funding from the British Embassy, but his position was cut as financial problems grew. Biologists directing US undergraduates from the University of California's Education Abroad Program (given through MVI) and CIEE have encouraged their students to do short-term research projects in CER's Bajo del Tigre. These projects contribute to CER's goal of finding out "what's there"; CER is in the process of compiling a fauna list for each sector. Bob Law compiled an extensive bird list for Bajo del Tigre based on years of observation (Law 1993, rev. 1999, 2002). Camera traps have been helping Matthew Moran (Hendrix College, Arkansas) and MCL staff construct baseline studies of mammals in CER. Several researchers, such as David Ribble (Trinity Univ., Texas) who studies small non-flying mammals, and Cody Cox (UGA) who studies birds, have worked in CER and the BBC. Two researcher projects in CER and MCFP examining climate effects are being conducted by Fern Perkins and Luis Beltrán Lacouture ("Lichens as bio-indicators of air quality and climate change") and Sarah Amundrud ("Effects

of climate and elevation gradients on bromeliad fauna") (MCL "Research" in Annual Reports 2015, 2016, 2017; Zamzow, et al. 2018).

Although MCL's economic difficulties ended the Environmental Education (EE) Program in 1995, most of MCL's personnel continue involvement with some EE activities, including leadership roles in community environmental festivals, recycling, roadside and stream cleanup, and in CEAM. Since 2007, FR and BESA have made grants for EE, including field trips for local children to Bajo del Tigre and to the Finca Steller Education Center on the Atlantic side of CER. In 2012, a five-year grant provided for an environmental educator to work with 16 schools on the Atlantic side of CER on such topics as recycling, biodiversity, reforestation, climate change, animal welfare and abuse, water resources and the importance of wetlands. This educator, now working with 17 schools, is continuing her EE thanks to new funding from Engage Globally and FR. In 2018, she added a new project (with a grant from BESA): "Protecting water resources through environmental education in the Peñas Blancas watershed" for communities along the eastern side of CER (MCL Annual Report 2017).

The League's tree nurseries have produced 1.6 million trees (B. Law, pers. comm.). Most of these were planted in MCL's windbreak project and persist, as do others planted under special projects. Finca Steller has a small native tree nursery that produces a few thousand native tree species per year for reforestation there and in surrounding communities. The CRCF and MVI tree nurseries (see 10.6.A and 10.7.A below) raise native species that MCL has used for reforestation of degraded pastureland on the Pacific slope. Zuchowski's ProNativa organization promoting the use of native plants, which began with the greenhouse and demonstration project at Bajo Tigre, has expanded (Burlingame 2016).

MCL's financial deficit, incurred when the Debt-for-Nature-Swaps and grants ran out in the mid-1990s and contributions were still earmarked for land purchase, was at its worst in 2001. Gradually, MCL's finances began to improve. The most important new source of income was payment for environmental services (PES) by the government program FONAFIFO (Fondo

Nacional de Financiamiento Forestal) and two private hydroelectric companies. MCL's Annual Reports document the dramatic increase in the areas of CER included in PES and an equally dramatic increase in income for the MCL, going from no income in 1996 to an average of 62% of MCL's operation's income from 2009 to 2011 (MCL Annual Report 2013). Other income comes from fees for entry to trails, mainly at Bajo del Tigre; unrestricted donations for operations; the sale of merchandise in MCL facilities; and net income from the biological stations. Donations for specific projects, including land purchase, are an important source of income. Another source of funds is interest on investment, including a growing endowment fund; Rachel Crandell had made MCL the beneficiary of her substantial life insurance policy (B. Law, pers. comm.).

In 2012, the Costa Rican government changed its policies on PES, deciding to help small landholders with 50 ha or less. MCL and several other conservation organizations in Monteverde saw their incomes drop dramatically as land under PES phased out. By 2013, inflation and increased expenses (including legal costs) had raised the estimated amount needed to run MCL to a half million dollars per year (MCL Annual Report 2013). MCL and several other conservation organizations successfully lobbied the government, which in 2017 made an exception to PES limits for "non-profit organizations that make important efforts in the conservation and care of forested areas in especially biodiverse and fragile areas" (MCL Annual Report 2017). The new limit for each NGO is 300 ha/Conservation Area. The other good financial news in 2017 was the settlement of a legal case in MCL's favor with one of the private hydroelectric companies that had objected to its contract for continued PES payments; they will pay MCL \$47,800/year for the next 28 years (MCL Annual Report 2017). Legal disputes continue with the second private hydroelectric company.

MCL is exploring other ways to raise income. One is to increase the number of visitors to CER; in 2013 there were about 7000; by 2017, that figure had grown to 9302 (with no contribution from the closed Pocosol, which had visitors as soon as it opened in May 2018) (MCL Annual Report 2017). A promising option for new

funding is carbon offset payments for forest protection and reforestation; MCL will need to get legal title to all the land in CER it wishes to include. Increasing the endowment and donations can be another source for funds. The League has improved contacts with current and potential donors (and visitors) through more personal attention from the Director, a new website (2016), enhanced Facebook pages that include many videos and photos, and the 2017 revival of the newsletter Tapir Tracks (L. Stallcup, pers. comm.). Tapir Tracks had been published from 1986-1995; the new newsletter is digital (acmcr.org). There are even live tapirs in CER now. Their return, that of all 6 wild cat species of Costa Rica, two frog species (*Isthmohyla tica* and *Lithobates vibicarius*), and other endangered animals are testimony to the success of MCL's conservation efforts (L. Stallcup, pers. comm.).

### **10.5 Santa Elena Cloud Forest Reserve (SECFR)**

SECFR is achieving its goals of sharing "the benefits of tourism and using them as a tool for [sustainable] development where entrance fees are employed for the protection and management of the Reserve and to provide a better quality of education in the Colegio [Sta. Elena high school] and some schools of the zone" (Y.M. Arias, pers. comm.). From 2009-2014 there were about 30,000 visitors per year, more than double the highest number in the 1990s; by 2017, there were 47,744 visitors and 22 employees (Y.M. Arias, pers. comm.). These visitors provide indirect economic benefits to tourism businesses in the community and employment as Reserve staff and guides, primarily graduates of the Colegio, thus fulfilling another goal of SECFR (W. Bello, pers. comm.). There are special programs in environmental education, reforestation, and species monitoring. The new bilingual website, launched in 2017 for the 25th anniversary of the Reserve, provides information about these programs, a detailed history of the Reserve, and many photographs (reservasantaelena.org).

The road to the 310 ha Reserve was improved, thanks to adventure tourism sites just below. The electrical needs of those attractions made the electrification of SECFR possible in 2006. In 2012, the Visitor's Center was rebuilt; it and a new half k of hardened trail are

handicapped accessible, making the SECFR the first reserve in the area to meet the requirements of Law #7600 for equal access. An orchid garden whose plants were rescued from the forest floor, a small medicinal plant garden, and other native plants attract butterflies and hummingbirds. The 12 km of the four original trails and their signage have been improved. If the weather is clear, spectacular views of Arenal Volcano and Lake, the Gulf of Nicoya, and the Lake of Nicaragua await those who scale the 12 m high metal observation tower on the Youth Challenge trail. In 2016, SECFR built a large Information Center attached to the entry reception building. The following year saw the addition of a conference room (with a capacity for 80 people) to the Visitor's Center and a major remodeling of the Reserve's office next to the Colegio in Santa Elena (Y.M. Arias, pers. comm.; [reservasantaelena.org](http://reservasantaelena.org)).

SECFR's environmental education coordinator worked closely with the Colegio students and teachers in the Ecological Tourism degree program. Blum (2012) stressed the broader definition of EE, including environmental ethics and values, used by SECFR and the national high school curriculum compared to MCFP's more biological approach to EE. However, Blum's research was conducted in 2003 just as EE approaches in the two organizations started to converge. Both include more attention to water and waste problems in the area, habitat destruction and endangered species, and global climate change. The Commission on Environmental Education of Monteverde (CEAM; see 10.8 below) began in 2003 under the leadership of the heads of EE at SECFR and MCFP. Also in 2003, SECFR started working with 5 primary schools around the Reserve and secondary students in the Colegio in ways similar to MCFP, providing programs at the schools, workshops for teachers, and engaging students and teachers in activities in the Reserve. The theme of EE in 2017 was climate change; each of the now 6 primary schools and the Reserve used new meteorological stations to record weather data daily, entering it in a Google Docs database weekly (W. Bello, pers. comm.).

The EE program also works with the Grupo Amigos del Ambiente (Friends of the Environment), a group of Colegio students that

that formed in 2011. The group, which has 32-40 volunteer students per year, set up a recycling program in the Colegio and at SECFR. They have been the most active members of the Adopt-a-Stream Program run by MVI. Amigos became involved in fieldwork with researchers from four Costa Rican universities monitoring amphibians, birds (especially nesting quetzals and bellbirds), water and air quality, and climate data. Amigos also monitor mammals with 12 donated camera traps that had recorded 30 species of animals by 2015, including tapirs, pumas, and ocelots; some of the photos are posted on the website. That website added bird and mammal lists in 2017 (W. Bello, pers. comm.; [reservasantaelena.org](http://reservasantaelena.org)). The group joins visitors and other students in reforestation projects in buffer areas around the Reserve using donated native tree seedling. Since 2011, 1500 to 5000 trees have been planted per year (Y.M. Arias, pers. comm.).

The Administrative Board of the Colegio continues to manage SECFR and has signed new leases every 5 years (most recently in 2017) with ACAT-MINAE (Area de Conservación Arenal-Tempisque/ Arenal-Tempisque Conservation Area and the Ministerio del Ambiente y Energía/ Ministry of the Environment and Energy). Reflecting its historical origins, the Reserve is officially classified as a Farm of the State (Finca del estado).

SECFR is an active member of other environmental groups in the area such as COMIRES, CEAM, and the Bellbird Biological Corridor. They also have special international agreements with Rocky Mountain National Park and neighboring sister city Estes Park in Colorado. One agreement (in 2012) established exchange visits of department heads through ACAT, and another (in 2014) established annual exchanges of students to study scientific monitoring (Y.M. Arias, W. Bello, pers. comm.).

## **10.6 New Conservation Organizations:**

### **A. Costa Rican Conservation Foundation (CRCF)**

In 2002, local residents, including biologists, established the CRCF to protect, connect, and restore "tropical habitats with a special emphasis on the deforested Pacific slope of Costa Rica ... [in] areas critical for the survival of the Three-wattled Bellbird (*Procnias tricarunculata*)"

(fccmonteverde.org). CRCF grew out of George Powell's 1990s discovery that the endangered Bellbirds rely on the wild avocado fruit trees that grow in Pacific slope forests, during their post-reproductive period. Although the breeding grounds of the Bellbird and Resplendent Quetzal are well protected on the Caribbean slope of Monteverde, the decline in Bellbird numbers after 1998 was traced to habitat loss in the Pacific Rain Shadow Forest.

CRCF planned to create a 7 k biological corridor to link the protected Monteverde Reserve Complex with a lower protected zone, Cuenca Abangares, creating the Bosque para Siempre (The Forest Forever). They developed strategies to create the corridor: land purchases, conservation easements, cooperation with landowners, and pasture restoration. CRCF owns four wildlife reserves and has two other privately owned areas under conservation easements, providing successful protection to 77.5 ha (D. Hamilton, pers. comm.). Working with farmers and other landowners, conservation organizations, students, and volunteers, they reforested CRCF properties and many others. Their main tree nursery is at La Calandria, a private reserve and biological station in Los Llanos. CRCF subsequently added a tree nursery at MVI, with whom CRCF signed an agreement in 2016, passing reforestation operations to MVI. MVI also signed an agreement with National Geographic's G Adventure Travel Program that provides 500 visitors/year to work in CRCF's nurseries and contribute money for reforestation, producing more than 12,000 seedlings in 2016 (MVI Annual Report 2016). Since 2011, CRCF and MVI have jointly owned and administered the 14 ha Crandell Memorial Reserve adjacent to MVI. Research projects include experiments with seedling propagation, survival, and growth rates, and the most effective and cost-efficient restoration practices (fccmonteverde.org; monteverde-institute-blog.org/environmental/2013...). In 2017 and 2018, MVI's Duke Engage Program conducted a forest integrity study at La Calandria, comparing an area there that was reforested 14/15 years earlier with primary forest (D. Hamilton, pers. comm.; MVI Annual Report 2018). CRCF produced and distributed about 220,000 free native tree seedlings of 93 species

for the Bellbird Corridor by 2018 (D. Hamilton, pers. comm.).

CRCF continues to monitor bellbird populations. Many other birds depend on the corridor, including Neotropical migrants, such as scarlet tanagers, rose-breasted grosbeaks, wood thrushes, Baltimore orioles, and several migrant warblers. The U.S. Fish and Wildlife Services' Neotropical Migratory Bird Conservation Program has provided several grants to the CRCF. BESA and FR (see above), along with the British Embassy, GEF from the UN Small Grants Program, and several U.S. zoos also supported CRCF with grants. Many donations and work efforts have come through a student organization, The Change the World Kids (a US non-profit), and researchers, interns, and students (fccmonteverde.org). The CRCF joined other conservation organizations in the creation of two larger projects that include the Bosque para Siempre: the Bellbird Biological Corridor and the Monteverde-Arenal Bioregion Initiative (see E and F below).

#### **B. ProNativas-Monteverde (ProNativas)**

Reforestation with native rather than fast-growing introduced tree species had gradually become accepted as the norm, but it took a new organization to convince people in Monteverde of the many environmental advantages of planting native ornamental plants and the environmental threats from invasive exotic plants. Willow Zuchowski, author of *Tropical Plants of Costa Rica*, founded the non-profit organization ProNativas in 2004 with the support of local conservation organizations and outside funding. She had to collect seeds and cuttings, have greenhouses built (at MCL's Bajo Tigre, CFS, and MVI), and then plant gardens with help from volunteers and one half-time employee. The Bajo Tigre greenhouse was expanded and partially rebuilt in 2018 with funds from a donor. Zuchowski created demonstration gardens with signage around these organizations and at the Biological Station, Monteverde Centro, local businesses, and private yards. At CFS, she helped establish gardens featuring specific plants to attract bats, birds, butterflies and bees. In 2007, she developed an illustrated Electronic Field Guide to Native Ornamental Plants of Monteverde (efg.cs.umb.edu/efg2/TypePage.jsp) with the Electronic Field Guide Project at U.

Mass. Boston. These activities led to the formation of a ProNativas Network in 2008 with workshops, conferences, and a website ([pronativas.cr.org](http://pronativas.cr.org), W. Zuchowski, pers. comm.). In 2015, she and volunteers created the New Forest Park in a strip of land between the MVI and the road after non-native trees had been cut. The Park, a memorial for scientific illustrator and photographer Turid Forsyth, features native plants and trees (W. Zuchowski, pers. comm.).

### **C. Arenal Tempisque Conservation Area (ACAT)**

Most of the Monteverde zone was in the national Conservation Area called ACA (Area de Conservación Arenal). In 2007, this Conservation Area was reorganized to include territory down to the Tempisque River (adding the protected areas of Palo Verde and Lomas Barbudal, previously part of ACT or the Tempisque Conservation Area). This new area became ACAT (Area de Conservación Arenal Tempisque), with a main office in Tilarán. Arenal National Park was put in a new 11th conservation area, Huetar Norte (ACAHN), although Arenal Lake and the Miravalles and Tenorio volcanoes remained in ACAT. ACAT's 387,000 ha contain 8 life zones and 36% of Costa Rica's biodiversity and are crucial to the country's renewable energy production (40% of hydroelectric and 90% of wind and geothermal energy); about 25% of the area is under strong conservation protection (CREA-ACAT 2017). ACAT has several regional offices, including one in Santa Elena within the SECFR office. A team from ACAT has been setting up camera traps (donated by JICA, the Japan International Cooperative Agency) in all its protected areas (W. Bello, pers. comm.). The Conservation Areas are administered by SINAC (Sistema Nacional de Areas de Conservación/National System of Conservation Areas), a part of MINAE (Ministerio del Ambiente y Energía/Ministry of the Environment and Energy ([sinac.go.cr](http://sinac.go.cr))).

### **D. Curi-Cancha Reserve (Curi-Cancha)**

The 83 ha Curi-Cancha opened in 2011 on property owned by the Lowther family, which they purchased in 1970 from Hubert Mendenhall, one of the original Quaker settlers. It forms a corridor linking BESA on the north and east down to land owned by MVI and CRCF and has a "mix of virgin forest [50%], secondary growth

of varying ages [45%] and some pasture [5%]" (J. Lowther, pers. comm.; [reservacuricancha.com](http://reservacuricancha.com)). CRCF has planted many native trees bearing fruits favored by bellbirds and quetzals, but the Reserve is maintaining some open pasture for habitat diversity. Seven km of interlocking trails have been improved since the Reserve opened; in 2018, some of these trails were modified for handicap access in a rechargeable electric vehicle. The reception center was expanded in 2014 to include a large area for talks to groups; in 2018, it added 10 solar rooftop panels and a storage battery; all lights are LEDs. The property has its own spring that provides potable water for the Reserve. Reserve personnel work with several biologists doing research, students, and visitors; they also monitor four camera traps and update the website's Checklist of Birds (M. Ramírez, pers. comm.).

Curi-Cancha is legally recognized as a Refugio de Vida Silvestre Privado by MINAE and aims to be an "economically and environmentally sustainable business" ([reserva curicancha.com](http://reserva.curicancha.com); J. Lowther, pers. comm.). It has become popular with guides and tourists because it is less crowded than MCFP, has more open areas for animal viewing, and a lower admission cost. In 2013, 10,000 people visited the reserve; that increased to 17,000 in 2014, 22,000 in 2015, and 30,000 for both 2016 and 2017; visitors provide economic benefits for more than 25 guides and for taxi drivers (M. Ramírez, pers. comm.).

### **E. Bellbird Biological Corridor (BBC)**

The Three-wattled Bellbird Biological Corridor (88,456 ha) aims to connect the Monteverde Reserve Complex through three watersheds and two subwatersheds and 11 life zones down the Pacific slope to the mangrove forests of the Gulf of Nicoya (H. Villalobos, pers. comm.). In 2008, building on earlier corridor proposals to protect such altitudinal migrants as the Bellbird and the Quetzal, a local Council formed to make the corridor a reality. The seven founding members of the BBC were: the Arenal-Tempisque Conservation Area (ACAT-MINAE), CRCF, MCFP, MCL, MVI, SECFR, and UGACR). In 2009, these groups agreed to pay for a part-time Coordinator for the Project. With funding from the GEF-Small Grants Program of the United Nations, they developed a Strategic

Plan with a mission to reestablish and maintain: biological connectivity, conservation of natural resources, and the well being of local communities (Corredor Biológica Pájaro Campana, Plan Estratégico 2011-2016). This Corridor is part of the National Program of Biological Corridors, (established in 2006 under SINAC) which in turn is part of the larger Mesoamerican Biological Corridor Project.

The local Council had many meetings and workshops with Corridor inhabitants and civic and community organizations to educate them about the project and learn about their concerns, to point out benefits they could receive, and to solicit their feedback and proposals for local projects. In 2017, communities bordering the lower western edge of the Corridor asked to join because they saw economic advantages, including the ability to receive Payments for Environmental Services from the government and access to the Corridor's developing Green Seal certification program giving them direct access to markets in BBC towns for such products as sustainably sourced seafood. Addition of this area increased the size of the Corridor to 88,456 ha from 66,000 (H. Villalobos, pers. comm.). Also in 2017, the Council decided to divide the Corridor into 5 sub-corridors that could focus on their specific circumstances and needs. Two of the sub-Corridors had completed Strategic Plans by mid- 2017.

Using satellite images and GIS, MVI's GIS expert has created maps of the physical, biological, and land-use features of the Corridor and its extension (R. Chinchilla, pers. comm.). Maps showing locations of springs and riparian zones and forest cover and fragments have become the basis for extensive reforestation projects, primarily by CRCF/MVI with their two native tree nurseries. UGACR with its native tree nursery has been the next largest contributor to reforestation. Reforestation has been funded by grants and donations and carried out by volunteers and students. By 2018, about 290,000 trees had been distributed for reforestation at all levels of the Corridor (H. Villalobos, pers. comm.). In 2016, two Master's theses evaluated reforestation efforts in the northern part of the Corridor and suggested ways to improve conservation outcomes (Gómez-Parra; Silva-Morales 2016). Two biologists have built on

Monteverde's history of reforestation and agroforestry to propose new priorities for reforestation that would produce a latticework corridor; it could promote greater biodiversity conservation in a time of climate change (Townsend and Masters 2015).

Scientific research in the Corridor has been growing; local and international researchers, college and university students and interns connected with UGACR, MCFP, MVI, and CIEE have been conducting more investigations (see: ugacostarica.org under Research and MCFP's Registers of Research Projects). A baseline study (2012-2013) monitored bird populations along 16 transects in 8 of 10 life zones in the Guacimal watershed of the Corridor; the data from the first year has been analyzed, but there was no funding to continue (R. Guindon, pers. comm.). Another project tracked the movement of bellbirds and quetzals "in a Fragmented Landscape to inform conservation planning" in the Corridor (ugacostarica.org). In 2018, the BBC led several conservation groups and ornithologists in expanding bellbird counts down into the Corridor during breeding season (June) and then in August, when the birds start moving down the Pacific Slope, to locate migration paths and determine the prime areas for reforestation (H. Villalobos, pers. comm.). Preliminary findings from the June 2018 census indicated about 67 bellbirds (BBC Bulletin, August 2018). Two researchers have been studying mammals in the BBC: David Ribble has continued long-term monitoring of the "abundance, biodiversity, and distribution of non-volant small mammals," and Vino De Backer has been mist netting for bats down to Guacimal (L. Moreno, R. LaVal, pers. comm.). Carol Yang is studying freshwater crabs and their effects on the decomposition of leaf litter in streams in the upper part of the BBC, and William Haber has been surveying dragonflies and damselflies in the BBC (C. Yang, W. Haber, pers. comm.).

There have been a number of studies documenting water abundance and quality. A major project (started in 2013) led by researcher T. Shahady, his students and interns, has been sampling three river systems at 18 sites from their unpolluted headwaters down through the Corridor to the Gulf; UGACR actively supports this work and provides laboratory facilities, and

BESA has provided grants. They have been measuring physical, chemical, and biological parameters at each site four times a year and relating findings to GIS studies of land use practices. The research has documented a variety of pollution problems, including high *E. coli* levels in some sites. Shahady has developed a pollution scale based on the presence of different aquatic invertebrates. This method can be used for citizen science studies of local pollution and can inform decision-making by the local water committees (ASADAS) (T. Shahady, pers. comm.; ugacostaricablog.com for March 2017).

The promotion of community-based rural tourism is an example of a project that offers economic benefits; it began in 2014 with a grant from the InterAmerican Foundation and an expert from the Fundación Neotropica who produced a strategy for sustainable tourism throughout the Corridor (González 2015). The proposals were based on extensive consultations with local residents and an inventory of existing businesses and attractions. Three years later, students developed a "Strategic Marketing Plan," researching 12 businesses, now listed on the BBC's web page with an interactive map (Bhatia, et al. 2018; [bbc.org/programas/rural\\_tourism](http://bbc.org/programas/rural_tourism)). Rural tourism is also connected with the development of the Pacific Trail (Sendero Pacífico) that will eventually go within the corridor from the Monteverde Reserve Complex down to the Gulf of Nicoya. While some landowners have decided to give free access through their land, the rest of the trail follows small public roads; this trail thus differs from all the trails in Monteverde reserves that charge admission. By 2017, five communities were involved, and an improved trail extended down to Guacimal, which is about 1/3 of the way to the Gulf; Nat Scrimshaw has spearheaded the project, working with landowners, and organizing volunteers to construct and repair the trail. The San Luis Development Association and the Guacimal Sustainability Demonstration Center have been promoting sustainable rural tourism, including the trail ([sanluis.or.cr](http://sanluis.or.cr); [sustainablecostarica.org](http://sustainablecostarica.org)); a new hostel opened in San Luis in 2018. It is possible to hike all the way to the Gulf in several days with a guide; some hostels and places to eat are already in place. Plans include working with landowners to

develop buffers by reforesting along the trail ([senderopacifico.net](http://senderopacifico.net)).

The Coordinator said in 2017 that the original Strategic Plan was seriously out of date. The following year, the German Development Agency (GIZ) provided financial and technical help to create new GIS maps based on satellite photographs that will be compared to the original maps to measure changing land use and reforestation's successes, as well as temperature changes. The new Plan will also evaluate changes in research, environmental education, interactions among stakeholders, and the promotion of the responsible use of natural resources in the BBC (H. Villalobos, pers. comm.).

#### **F. Monteverde-Arenal Bioregion Initiative (MABI)**

MABI, a cooperative conservation, research, education, and sustainable development project, was launched at a Feb. 2014 conference at the Monteverde Institute. P. Raven, in his welcoming remarks, framed the focus of the conference: "How can the talents and activities of the many organizations who have permanent facilities in this region or visit it repeatedly become a conceptual entity with more facilities, educational opportunities, more extensive conserved and restored areas, an enhanced contribution to sustainable tourism, and lasting value...[that is] fully integrated with the welfare of all the people who inhabit the region" (MABI 2014)? The Bioregion included the Monteverde Reserve Complex, the Arenal Volcano National Park, the Alberto Manuel Brenes Biological Reserve, and substantial buffer zones.

The Initiative grew out of a symposium organized by N. Nadkarni at the joint 50th anniversary meeting of the Association for Tropical Biology and Conservation (ATBC) and the Organization for Tropical Studies (OTS) held in San José, Costa Rica in June 2013. Entitled, "The Perfect Storm: Educational, Conservation, and Community Synergisms for Tropical Ecology Research in Monteverde, Costa Rica," the session included presentations by six Monteverdians with different institutional perspectives (ATBC Online Web program for S-11, 25 June 2013). They examined the special interactions in Monteverde of "conservation, education, ecotourism, civic awareness, and

spirituality" that made Monteverde such a productive location for scientific research even though it had no major biological research station (N. Nadkarni, pers. comm.; see Nadkarni and Wheelwright 2000). How could Monteverde's success be improved and how could it serve as a model for nearby and other tropical areas?

MABI drew 55 participants including representatives from all the organizations discussed in this update and more from the larger bioregion and beyond such as MINAE-SINAC; the Santa Elena ASADA; the Universities of Georgia, Texas A&M, Brown, California, Stanford, Utah, and Vermont in the States, and the Universidad Nacional in Costa Rica; The School for Field Studies; FCER; Conservation International and the Nature Conservancy ([iniciativamonteverdearenal.blogspot.com/2014/02/instituciones-invitas-invited.html](http://iniciativamonteverdearenal.blogspot.com/2014/02/instituciones-invitas-invited.html)). The conference began with poster presentations by the different organizations so that everyone knew the focus, priorities, and activities of the other organizations. Emphasis was on forging "communication links between existing groups" (N. Nadkarni, pers. comm.). Participants worked to develop a common vision. Further discussion and planning took place in committees: Education, Conservation, Research, Maps, Communication, and Funding. The leaders of each committee constituted a Coordinating Committee. The Conference blog outlined the challenges, possible solutions, and committee proposals ([iniciativamonteverdearenal.blogspot.com/2014.02...](http://iniciativamonteverdearenal.blogspot.com/2014.02...)). The Research Committee planned to develop a website where scientists would be able to post research projects and data sets. Participants realized that a key next step was finding funding to hire a part-time coordinator, and they planned a follow-up conference.

The second MABI conference was held in 2015 at the Texas A&M's Soltis Center near the eastern border of the League's CER and north of San Ramon. Celia Harvey gave an excellent keynote speech on "Global Challenges and Opportunities for Biodiversity Conservation" that set the context for the conference. Fortunately, it and the whole conference were recorded (MABI 2015). Working committees reported on developments in the last year. There were papers on biological research, and many on tools for conservation, (including corridors and mapping),

followed by sessions on "Thinking and Working Systemically," and on working for carbon neutrality and climate resilience (MABI 2015). In 2016, the third MABI conference was held at the University of Georgia's San Luis campus. Its main focus was the on-line database of all research (including data sets), projects (including long-term monitoring), educational resources, etc. in the area (MABI 2016). Subsequently, several volunteers constructed the database website and began entering some information, especially on environmental education, but progress has been limited by the lack of funding to hire a data entry person (MABD 2018; C. Yang, pers. comm.). The 2016 Conference also had presentations on existing group conservation and individual research projects (including poster presentations). A fourth MABI conference (in 2017) followed a different format, bringing together MABI, CORCLIMA, the BBC, and MVI to focus on reforestation in three workshops. The first workshop, held in May 2017 at MVI, analyzed the scientific basis of effective reforestation and featured talks by Deb Hamilton, Nalini Nadkarni, and Eladio Cruz. The second, in June in the lower part of the Corridor (Coyolito) where the Women's Association had a tree nursery, stressed positive and negative experiences with reforestation. The third, held at UGA in San Luis in July, focused on ways to raise money and cooperate in reforestation projects in the Corridor (MABI 2017). Although no MABI conference was planned for 2018, several successes continue from the Conferences. The most important has been improving communications and contacts among the various stakeholders, educating them about what different organizations and individuals were doing, and laying the groundwork for new kinds of cooperation. A concrete example of this was the formation of the Biologists' Group after the 2016 Conference. Each monthly meeting at MVI, features a talk by a biologist on her/his research with discussion and sharing of news, including new publications (D. Hamilton, pers. comm.).

#### **G. Arenal-Monteverde Protected Zone Management Plan (ZPAM)**

Another major initiative, completed in 2016, involves a somewhat smaller geographic area that lies within the MABI region. The 28,314 ha



Arenal-Monteverde Protected Zone has been a legally recognized entity for decades, first as a Forest Reserve to protect water resources for hydroelectric power; this Zone does not include what is now Arenal National Park. In late 2014, MVI was awarded a grant by Costa Rica por Siempre (Costa Rica Forever, an international non-profit funded by a debt-for-nature swap) to write a Management Plan for the Protected Zone for SINAC. F. Burgos of MVI worked in consultation with all of the conservation organizations (who protect nearly 80% of ZPAM) and with numerous stakeholders in the Zone to develop the plan (MVI Newsletter 4/20/2015; F. Burgos, pers. comm.). The process had two very positive results: conservation organizations put a lot of energy into developing closer working relationships that avoided historical tensions, and there are now more than 20 detailed GIS maps of multiple features for the whole area (R. Chinchilla, pers. comm.). The Director of MCL says she uses these maps all the time (L. Stallcup, pers. comm.). "The major recommendations include the need for additional personnel for the monitoring of the protected zone, increased collaboration and coordination among the conservation partners, increased research and ecological monitoring, proactive measures to increase ecological resilience to anthropogenic challenges such as climate change, and the need for clear boundary determinations and their mapping" (F. Burgos, pers. comm.; MVI Annual Report 2016). SINAC has accepted and approved the Plan, which they posted on line (SINAC 2016); they have started implementing some of the suggestions (D. Hamilton, pers. comm.).

#### **H. Monteverde Commission for the Integrated Management of Solid Waste (COMIRES)**

In 2010, conservation organizations joined the local government to create a commission (COMIRES) to develop plans for dealing with the area's solid waste and comply with a nation-wide 2010 law (Ley No. 8839). COMIRES produced its first Management Plan in 2013. The local government now runs regular garbage pick-ups (for which it charges fees), has built a recycling collection center, has constructed mini-recycling receptacles around the district, has full-time staff for the recycling program, and involves

volunteers in monthly recycling pick-ups and community education (M. Díaz, pers. comm.).

However, population growth and large increases in the number of tourists have been generating much more solid waste. Local garbage trucks use a lot of fuel collecting and transporting garbage down the mountain to the big landfill near Miramar, where they pay a tipping fee based on tonnage. About 40% of Monteverde's waste is organic; as this decomposes in the landfill, it generates methane, a powerful greenhouse gas. These problems have prompted a variety of local solutions, including a new COMIRES Management Plan for 2018 to 2022 (J. Welch, pers. comm.). Some individuals and businesses have been composting organic waste for years to use in gardens, and pig farmers pick up food remains from several restaurants. The Hotel Belmar has had an employee trained in state-of-the-art composting who operates their extensive composting system that yields rich compost for their large biointensive organic gardens (R. Garro, pers. comm.). Several individuals have also been experimenting with advanced composting techniques that include local microorganisms and that can benefit local farmers and home gardeners (J. Welch, F. Camacho, pers. comm.). Welch's experiments are being done as a COMIRES pilot project in managing organic waste through a centralized composting system to produce environmentally friendly products that contribute to carbon neutrality while promoting organic agriculture. He has started selling sacks of the organic compost and gallons of the liquid containing local microorganisms that can accelerate decomposition of organic materials in composters, septic tanks, grease traps, etc. (MCF 2018; J. Welch, pers. comm.). In 2017, Belmar and Los Piños offered household composting workshops to their neighbors. The following year, Belmar and MVI cooperated to offer well-attended workshops for larger groups; this meshed with MVI's push for intensive organic home table gardens that would fit in small yards. The MCFP, supported by JICA (the Japan International Cooperation Agency), offered composting workshops using Japanese techniques (J. Welch, R. Garro, pers. comm.). Another set of experiments focuses on improving the conversion of used cooking oil to biodiesel

fuel (J. Welch, pers. comm.). Other local efforts stress preventing and reducing waste, especially from paper and cardboard, single-use plastics, and metals other than recyclable cans.

### **I. Monteverde Special Commission for the Integrated Management of Water Resources (CEGIREH)**

Rural areas such as Monteverde have Associations that administer community water and drainage systems (ASADAS). They are overseen by the national AyA (Costa Rican Institute of Water and Drainage). The Santa Elena, Monteverde, and San Luis ASADAS have been in charge of providing clean water to the zone by protecting springs, treating drinking water, and cleaning and monitoring streams and rivers. However, the growth of tourism increased demand for clean water as climate change decreased the supply; more untreated wastewater poses health risks locally and for areas downstream.

CEGIREH grew out of a workshop at MVI in 2014 to deal with local concerns about water resources and wastewater. All the main public and private players related to water in the area (including the Ministry of Health) are members of CEGIREH (MVI Assembly Reports 2014, 2016, 2017). MVI's Coordinator of the Community Health Program chairs the Commission; she is aided by MVI's Coordinators of Sustainable Futures and GIS; MVI has also provided water-testing equipment and scientific expertise. CEGIREH has received local grants to support two baseline studies on wastewater. One study (Guevara and Bonilla 2017) did scientific analyses of water quality using physical, chemical, and bio-indicators that provided evidence of stream and river pollution. The study also conducted a survey of 265 people in the zone to evaluate public knowledge of the problems and household cultural practices associated with greywater, much of which (especially in the Santa Elena downtown area) is untreated and currently goes into streets and streams. Most buildings in the area have septic systems for black water, but 43% of those surveyed did not know the difference between grey and black water, and a majority did not know about options to treat greywater or were not aware of biodegradable cleaning products that could reduce greywater pollution; a number of the septic tanks had

overflowed (Guevara and Bonilla 2017). The second baseline study of wastewater surveyed knowledge and practices by individuals in businesses, as well as public and private institutions (Welch 2017). This group was better educated and more informed than the first. All respondents favored water conservation, protection of waterways, and treatment of wastewater. All knew the difference between black and greywater and most knew of and used various ways to treat them, generally without problems such as overflows, leaks, or odors. They used some biodegradable products. Slightly more than half knew of CEGIREH (Welch 2017). In 2017, the Commission presented these baseline findings to the local government and then to the general public. The following year, the Commission proposed an Integrated Wastewater Management Plan for the district and invited public discussion. Preliminary planning for a centralized wastewater treatment facility and a search for funding was underway by 2018 (J. Welch, pers. comm.). In the meantime, CEGIREH and public and conservation organizations can extend their efforts to mitigate the problems. Education and publicized demonstration projects are key, especially if encouraged by incentives such as avoiding fines. The Santa Elena ASADA has published a magazine, *Agua Pura*, with articles on greywater, solid waste, results of AyA tests of water quality, chlorination of drinking water, and contributions of conservation organizations. They, the MVI, and Friends School have printed such brochures as *Every Drop Counts* (n.d.) and sponsor talks and fairs focused on water. All the EE programs have involved children in water conservation in their schools and homes. Greywater pollution can be reduced if more people and businesses are educated to use affordable biodegradable cleaning products and the special microorganisms that clean grease traps. There are several demonstration biogardens (MVI, MCL's Bajo Tigre, and Belmar) that use reedbeds to clean greywater. Local authorities need to inspect septic systems, regulate their cleaning, and promote the use of microorganisms that increase organic decomposition. There are a number of demonstration projects that treat human and animal waste in biodigestors, producing methane

for cooking (2 at UGACR and Belmar and 1 at each of a dozen farms in San Luis). Biodigestors need more land than is available in downtown Santa Elena, but there could be nearby ones that would be stepping stones to a biogas powered centralized treatment plant for all organic waste (J. Welch, pers. comm.). The amounts of grey and black water have been reduced by water conservation measures such as greater use of low flow faucets and low flush toilets. The Friends School even checked all of their water pipes, eliminated leaks, and saved money on water bills. Another way to address water shortages is to capture rainwater from roofs and use it for irrigation (as at Belmar) or to flush toilets (as at CFS, which cut its piped water consumption). MVI has a waterless composting toilet and has developed a demonstration rain garden that has been replicated; rainwater that would have flowed downhill, picking up contaminants and causing erosion, is now contained (Burlingame 2018; R. Garro, pers. comm.).

#### **J. Monteverde Commission for Resilience to Climate Change (CORCLIMA)**

CORCLIMA developed from growing local concern informed by global concerns over climate change. The UN Earth Summit (Rio de Janeiro 1992) and subsequent conferences brought international attention to climate change, culminating in the Paris Agreement of 2015 under the leadership of Costa Rican Christiana Figueres, Executive Secretary of the UN Framework Convention on Climate Change, 2010-2016. Costa Rica's goal is to become carbon neutral by 2021. MINAE's Directorate for Climate Change (DCC), following the National Climate Change Strategy (2009) "manages national climate change initiatives" (Brenes, et. al 2016). Its two main strategies are mitigation and adaptation.

Scientists have been documenting evidence of climate change in Monteverde since at least 1999 (Brenes, et al. 2016). In 2014, approximately 300 people took part in a climate march in Santa Elena. The following year, 41 people from 25 organizations participated in an intensive long workshop given by Costa Rica's EARTH University to learn how organizations can achieve carbon neutrality certification according to rigorous international ISO standards (Brenes, et al. 2016; D. Hamilton, F. Perkins,

pers. comm.). The workshop led to the formation of a new group in 2016, known by its Spanish acronym CORCLIMA, which in 2017 became a special commission of the local government that works with representatives of all interested parties. Their mission is to "unite efforts in Monteverde to lower emissions, capture carbon, and adapt to climate change" with a vision of capturing more carbon than Monteverde emits and becoming a "model for resilience to climate change" (CORCLIMA. org). They prefer the term resilience to carbon neutral or negative, saying "mitigating and adapting to climate change create resilience, the ability of a social or ecological community to function despite major disruptions" (Brenes, et al. 2016). In 2016, three local authors wrote an excellent bilingual booklet: *Pathways toward Climate Change Resilience in Monteverde, Costa Rica* (funded by MCF and the Global Fund for Community Foundations). Following the National Climate Change Strategy, CORCLIMA analyzed Monteverde's greenhouse gas emissions by sectors, outlining steps that could be taken for mitigation and adaptation. Costa Rica is fortunate that more than 98% of its electricity comes from renewable sources (hydro, wind, geothermal, biomass, and solar) that do not emit greenhouse gases, although these sources may not be able to supply future needs. Monteverde is fortunate that it has so much forested area that is already sequestering carbon. Transportation and agriculture (including cattle) are the primary sources of greenhouse gases in Monteverde as well as nationally (Brenes, et al. 2016).

In 2017-2018, CORCLIMA began measuring carbon emissions and sequestration using techniques from the 2015 EARTH workshop, the National University (UNA), the Meteorological Institute, and, subsequently, the methodology developed by DCC for cantons. In 2018, DCC named Monteverde as one of 6 municipalities in a pilot program for Country Carbon Neutrality 2.0 (K. VanDusen, pers. comm.; Dirección Cambio Climático Costa Rica, Facebook, July 27, 2018). CORCLIMA embarked on baseline studies to calculate emissions from all the main sources of greenhouse gases; they extrapolated from the samples to the whole area. Other teams began carrying out a carbon sequestration inventory; they are measuring tree diameters on

24 plots in randomly selected farms every year for 5 years and will then scale up the results. The findings will shape decisions on steps for mitigation and adaptation (CORCLIMA.org).

In the meantime, CORCLIMA has begun tackling the transportation sector. They have sponsored talks, fairs, and demonstrations to promote more walking and biking and a switch to electric vehicles (bikes, golf carts, automobiles) that could be recharged by an expanding network of solar panels. They are also working on a plan for clean collective transportation within the Monteverde area. CORCLIMA recognizes a hidden source of greenhouse gases in the indirect emissions linked to the travel of 250,000 tourists to Monteverde per year. UGACR and MVI offer carbon offsets where cash payments are used for reforestation; some hotels, such as Belmar, offer carbon offsets through FONAFIFO; the Chamber of Tourism and the MCF work together to direct "offset" donations from visitors to local climate change projects; these programs need to be expanded (J. Welch, pers. comm.). CORCLIMA has also started working on mitigation and adaptation efforts in agriculture and a number of the other areas discussed in Brenes, et al. (2016; see also Facebook page for CORCLIMA-Monteverde, Our Story, Feb. 7, 2018 and [monteverde.fund.org](http://monteverde.fund.org) Local Alliances). CORCLIMA cooperates with COMIRES, CEGIREH, the local municipal government, the tourist bureau, all the conservation and educational organizations mentioned in this Update, as well as many local businesses, and national organizations (see list of collaborators at [corclima.org](http://corclima.org) under About Us).

### **10.7 Environmental Education and Sustainability at the University/College Level Primarily for Students from North America**

Residents of the Monteverde zone who want to continue their education at the university level have attended several of Costa Rica's excellent universities in the Central Valley or at satellite campuses; the University of Costa Rica (UCR) and the National University (UNA) are known for their science and environmentally related programs ([ucr.ac.cr](http://ucr.ac.cr), [una.ac.cr](http://una.ac.cr)). Other residents have sought higher education through UNED (Universidad Estatal a Distancia or State University for Distance Learning), which has 45

sites in the country, including Santa Elena. Students can earn degrees by correspondence and/or online, working with professors at the various centers ([uned.ac.cr](http://uned.ac.cr)). Some residents have also gone to universities in North America. However, most higher education in the Monteverde Zone has been for students coming from abroad (mainly the US). Costa Rica has become the leading Latin American study abroad destination (Dyer 2014, Institute of International Education 2014). Monteverde has been a magnet for US college/university courses, starting with the OTS graduate Fundamentals course in 1971 (Burlingame 2002). The Monteverde Institute has offered programs for international students since 1987; since 1999, three other institutions have established centers in the area.

#### **A. The Monteverde Institute (MVI)**

MVI has built on its mission of "education for a sustainable future," providing a broad range of courses supported through many institutional partnerships. It puts sustainability and conservation into practice on its campus and through its courses and community interactions. MVI has encouraged students, researchers, interns, and volunteers to develop applied research projects that generate information and options to help local communities deal with pressing issues. In addition, MVI has brought substantial educational, cultural, and economic benefits to local communities (Burlingame 2018, MVI Annual Reports; [monteverde-institute.org](http://monteverde-institute.org)). By the end of 2017, MVI had provided more than 585 courses (long and short) for nearly 10,600 students; there are about 25 courses each year (F. Lindau (Messerli), E. Coghi, D. Santamaria, pers. comm.). Tropical Biology and Conservation, the University of California Education Abroad Program (UCEAP) began in 1987 and increased to two semesters per year in 1992. This program has consistently had the largest number of students. In the continuing long course, "Sustainable Futures" (SF) that started in 1995, upper level undergraduate and graduate students in architecture, landscape architecture and planning, engage in "service learning" to develop their knowledge and skills by working (gratis) on planning and designing projects that help local communities and institutions. Projects have ranged from designs for specific facilities (including those of MVI) to large scale "scenario

planning." In 2001, a partnership with the University of South Florida produced an annual course on "Globalization and Community Health." A semester-long interdisciplinary place-based program, "Globalization, Development, and Environment," began in 2009 as a joint venture between Mount Holyoke and Goucher Colleges. 2017 saw the beginning of a new long summer program with Duke Engage focused on "habitat and water resource restoration in the Bellbird Biological Corridor" ([dukeengage.duke.edu/wp-content/uploads/2017/02/costa-rica-2017](http://dukeengage.duke.edu/wp-content/uploads/2017/02/costa-rica-2017)). Most courses are shorter; MVI collaborates with partner institutions to provide a variety of educational and support services. Internships offered by MVI have expanded considerably since 2013 (details on courses at Burlingame 2018).

By 2009, MVI's campus occupied 24 ha; two years later, MVI and CRCF began joint ownership and management of the newly created 14 ha Dwight and Rachel Crandell Memorial Reserve adjacent to MVI's campus. This Reserve completes a corridor in the 28,027 ha of privately protected forest reserves known as the Monteverde Reserve Complex (D. Hamilton, pers. comm.).

A new wing was added to the main building in 2002 to house the John and Doris Campbell Library and a laboratory, which was expanded in 2014. Behind it is a small classroom building, constructed in 2002 by the Fox Maple School of Traditional Building (Maine) using non-native trees. Construction of a new outside timber-framed, multi-functional, glass-enclosed classroom in 2012 was a collaborative project among local artisans, volunteers, and MVI courses (Burlingame 2018; [monteverde-institute.org/facilities-at-mvi](http://monteverde-institute.org/facilities-at-mvi)). Sustainable construction has been joined by sustainable practice at MVI, as detailed on MVI's web site. MVI has also worked with homestay host families to help them improve energy efficiency in their homes, and to promote recycling and composting.

Since 2013, students and volunteers have developed demonstration organic "Carbon Gardens" around the new classroom, including a vegetable and herb garden, a keyhole garden, raingardens (to use rain runoff from the Fox Maple roof), a biogarden to treat greywater, a greenhouse for raising native plants, and a native

tree nursery producing saplings for reforestation. Native plants and tree saplings are planted on MVI's campus and donated to local people for their use. In 2016, MVI signed an agreement with the CRCF to produce large numbers of native tree seedlings in two nurseries for large-scale reforestation in the BBC (D. Hamilton, pers. comm.). Volunteers tagged trees behind the main MVI building to establish an arboretum. The gardens have been used for experiments with sustainable agricultural techniques and provided educational opportunities and nutritional information for MVI students, staff, and local communities (D. Hamilton, pers. comm.; [monteverde-institute-blog.org](http://monteverde-institute-blog.org)).

From the beginning, MVI was interested in fostering, facilitating, and applying research in the region. Research done by international students and faculty working with MVI staff and local and visiting resource people continues to be made available to other researchers and the community through public presentations of research findings and the collection of research papers in the library; many student papers are now digitized. MVI staff members have also conducted and led applied and long-term research projects such as: experiments to discover best reforestation practices for tropical native tree species, a forest integrity study comparing an area reforested 14 years earlier (La Calandria) with a primary forest, and carbon dioxide sequestration in tropical trees. Other research focused on: phenology and dietary preferences of the three-wattled bellbird, food resource tracking and its conservation implications for bellbirds, evidence of song learning in bellbirds, bird community changes as a possible response to climate change, lichens as bioindicators of pollution and climate change, and pollution in watersheds below Santa Elena (D. Hamilton, pers. comm.; Hamilton, Singleton, and Joslin 2018; Burlingame 2018). In addition, MVI has hosted researchers who worked on: bird and mammal mapping, bellbird conservation, plant physiology and climate change, and mammal conservation in Costa Rica. The Director's Report to the 2016 Assembly provides a partial list of research affiliates over the previous 30 years.

MVI has used proceeds from its international courses, donations, and grants to support programs that enhance education, well being, and

sustainable development and culturally enriching activities in Monteverde and surrounding communities (Burlingame 2018). In 2008, MVI began its Integrated Water Resources Program, which built on concerns over use of water resources and public health. The program also carries out education and community outreach, particularly through its Adopt-a-Stream Program that supervises monthly stream data collection and annual reports on water quality by students from the three high schools. The study, "The Impact of Economic Change on Food Habits and Nutritional Health in Monteverde, Costa Rica: Mixing Agriculture and Tourism," started in 2008 with funding from the National Science Foundation and collaboration from the University of South Florida and evolved into MVI's Community Health Program by 2011. Data indicated that as families increased their involvement in tourism, food insecurity and health problems increased. In 2012, MVI began encouraging better nutrition through workshops and demonstration gardens and small portable table gardens (starting 2015) to alleviate food insecurity issues. The second initiative encouraged more physical exercise with a "Monteverde in Motion" program; it became strong enough to stand on its own by 2016. The third outreach area was promoting a healthy environment, especially clean water (J. Peña, pers. comm.; see 10.6.I).

Students in service learning courses, interns, and volunteers working with local organizations have contributed to sustainable community development in a wide variety of ways. They have designed wastewater treatment options, proposed ways to improve traffic flow in congested Santa Elena; and developed architectural and landscaping plans for many institutions. They also helped build: greenways and sidewalks from the Friends School along the main road to Santa Elena and two aerial road crossings for animals; two community parks, part of the Pacific trail in the BBC, and raingardens and biogardens. Volunteers expanded MVI's two tree nurseries and raised large numbers of tree seedlings for reforestation in the BBC. Students analyzed: the rapid growth of Airbnb and its impacts in the zone; and the impacts of tropical storm Nate and recovery efforts (MVI Annual

Reports; Newsletters; Hamilton, Chinchilla and Zuñiga 2018; Burlingame 2018).

In 2012, MVI reached out to a new group, local 12-15 year olds, with a camp experience. Counselors aged 16-20 and adult volunteers from seven area communities helped the younger kids have fun, engage in community service, and "develop healthy and educational links between Monteverde's youth and its community members" ([monteverde-institute.org/summer-camp](http://monteverde-institute.org/summer-camp)). The camp is now an annual event.

MVI has provided direct financial benefits for staff, teachers, taxi drivers, cooks, guides, and for families offering homestays for MVI students, as well as owners and employees of tourism establishments and other businesses. In 2017, MVI payments of \$416,630 remained in the community (MVI Assembly Report 2017). Some in the community have received individualized financial benefits such as scholarships to attend MVI courses or aid (for MVI employees) to continue their education.

MVI developed serious financial problems by 2005 as its financial debt burden grew (from the construction of its new building and library addition and from land acquisition) while income from courses decreased. Beginning in 2006, MVI's Director, working closely with the Board, instituted drastic reductions in expenses through major personnel cuts, sale or divestment of some properties, and expanded efforts to increase income and find new partnerships for offering courses on a regular basis. The leaner, more focused MVI paid off its debts by 2008 and has successfully expanded its financial base (more courses and students) and extended its community outreach. The Director reactivated the U.S. non-profit Alliance for the Monteverde Institute (AMVI) in 2009. MVI has played crucial roles in community conservation and sustainability efforts, especially the BBC, MABI, ZPAM, COMIRES, CEGIREH, and CORCLIMA. The Institute's GIS person has made maps for all of these organizations and more. MVI also played a major part in founding the MCF. MVI's weekly community electronic Bulletin Board notifies all interested parties of upcoming events in the area.

### **B. Council on International Educational exchange (CIEE)**

CIEE is a U.S. based non-profit organization that has provided international exchanges in many countries since 1947 (ciee.org). In Costa Rica, CIEE is based in Monteverde, where it started offering a summer quarter Tropical Ecology and Conservation Program through MVI in 1989 and added two semester programs in 1996 under the direction of Alan Masters, who became the Director of CIEE Programs in Monteverde in 1993. CIEE separated from MVI in 1999 and became an independent organization in Monteverde. Students in the Ecology Program have courses and live at the Biological Station. In 2007, CIEE added the Sustainability and the Environment Program, with Karen Masters as Director. Students in this program live with homestay families. CIEE then moved to its own Study Center in Cerro Plano where there are classrooms, meeting areas, a library, and computer facilities with eco-friendly construction and native plant landscaping. Both Programs take extensive field trips on the Pacific and Atlantic slopes (A. and K. Masters, pers. comm.; ciee.org/study-abroad/costa-rica/monteverde/sustainability-environment).

The Tropical Ecology and Conservation Program is designed for biology majors, with courses in Tropical Diversity, Tropical Community Ecology, Independent Study, Spanish, and a course that explores the impact of humans on tropical ecosystems, including "urbanization, food production, energy generation, and tourism [and] ... innovative ways to mitigate or minimize human footprints on tropical ecosystems" (A. Masters, pers. comm.; ciee.org). The full texts of all research papers since 2004 are available in MVI's library digital collection; each one has an abstract in English and Spanish and the collection is key word searchable (M. Leitón, pers. comm.; monteverde-institute.org/mv-digital-collections-Tropical Ecology).

The Sustainability and the Environment Program for majors in Environmental Studies/Science offers two semester courses, a January course and 3 summer courses. Courses include tropical conservation biology, policy, sustainability, Costa Rican natural history Spanish, and independent research. One of the

summer courses (since 2016) is Environmental Engineering for the Tropics (K. Masters, pers. comm.; ciee.org). Students in semester courses must complete internship projects. These have ranged from constructing a biodigestor and composting toilet for a coffee farm to designing native plant gardens and greenhouses, to creating interactive exhibits for MCL's environmental education program. Interns built artificial wetlands to treat greywater, created a website and produced GIS maps of reforestation plots for CRCF, and worked with Hydroponics of Monteverde on "alternative, renewable fertilizers." Other projects included producing organic compost for environmentally friendly coffee and turning organic waste into biofuel. Two recent interns worked with the local climate change group CORCLIMA. One developed methods to measure carbon sinks in plots of land; another measured net greenhouse gas emissions on 9 local livestock farms (K. Masters, pers. comm.; study-abroad-blog-monteverde.ciee.org).

### **C. University of Georgia, Costa Rica (UGACR)**

In 2002, the University of Georgia Foundation purchased the 63 ha Ecolodge San Luis and Biological Station in San Luis adjacent to the MCFP to develop a satellite campus for UGA. The property is 60% forest, 30% integrated farm, and 10% built space (F. Camacho, pers. comm.). UGACR's Mission "is to facilitate transformative educational and research opportunities for students and faculty from UGA and other academic institutions from across the planet" (F. Camacho, pers. comm.).

UGACR has built campus facilities with an emphasis on sustainability. Climate is controlled in: a wet lab furnished with field equipment, an insect collection, GIS lab, and herbarium, which includes William Haber's donation of his extensive herbarium. Indoor and open-air classrooms are equipped with the state-of-the-art electronic equipment. There is a weather station that posts real time data on the website; the campus is connected to the Internet via a high-speed fiber optic and WiFi network. Four bungalows house students; faculty, researchers, and interns have their own residences; these facilities have solar water heaters and LED lights. Campus total capacity is 110 people per night (F. Camacho, pers. comm.). The cafeteria, a

computer lab, library, and offices are located in the student union. A recreation center, fields and courts for various sports, and 3 k of trails provide activity options. UGA landscape architecture students designed a 1.5 ha botanical garden, which includes medicinal plants and an arboretum. UGA rebuilt the 12-room Ecolodge San Luis where tourists and the general public have the opportunity to stay and participate in the campus's educational programs on sustainability, reforestation, and natural/cultural history of the area. More than 700 tourists/year stayed an average of 4 days at the Ecolodge in 2013-2017 ([ugacostarica.org](http://ugacostarica.org)).

Tracking goals and improvements in campus sustainability has been a priority from the beginning. The campus has an integrated farm that produces 15% of food consumption. Livestock wastewater is processed by a biodigester producing biogas and biofertilizers for the farming system and reducing the farm's greenhouse gas emissions. After seeing the effectiveness of the farm's biodigester, in 2013, UGACR built a large biodigester on campus to process all human waste; it produces methane to power the kitchen stove. The processed water leaves the system 99.9% clean and is reincorporated into the environment (F. Camacho, pers. comm.). A native tree nursery (started by CRCF and taken over by UGACR) "produces 3000-5000 seedlings of 20 species of native trees each year that are planted in the BBC for ecological restoration, agroforestry, and carbon sequestration" (F. Camacho, pers. comm.). Funding to support this reforestation work comes from UGACR's carbon offset program that began in 2008. UGA students must pay \$25 as part of their required fees to compensate for the carbon footprint caused by their travel to the campus. Students from other institutions and tourists may make carbon offset contributions. By 2017, more than 40,000 trees had been planted on farms in the BBC. ([ugacostarica.org](http://ugacostarica.org) for Sustainability; [ugacostarica.org](http://ugacostarica.org) blog.com, Oct. 11, 2017).

There are about 15 UGA programs (semester and short-term) per year, representing more than 25 disciplines and 8 Colleges with about 250-275 students and 40 faculty and teaching assistants (H. Mata, pers. comm.). Programs include Tropical Biology, Landscape Architecture,

Tropical Reforestation Service-Learning, Veterinary Medicine, Sustainability of Tropical Agro-Ecosystems, Environmental Anthropology, Latin American and Caribbean Studies, and Theater and Film ([ugacostarica.org](http://ugacostarica.org)). Approximately 40-45 short programs (average 5 days) for institutions other than UGA, including OTS, bring ca. 1200 students and faculty a year.

UGACR actively promotes research on campus and in the area, offering laboratory and residential facilities, logistical support, institutional partnerships, research sites, research assistants, species lists, weather data, as well as help with government permits. Several staff members have been carrying out their own research. Station Manager and Associate Director Fabricio Camacho's research has focused on the "bio-optimization of compost through the integration of cultures of native soil microorganisms and digestates from anerobic digestors" with the aim of helping farmers "rebuild the natural fertility of the soil" without using synthetic pesticides ([ugacostarica.org](http://ugacostarica.org)). Other staff research focuses on the classification and natural history of the butterflies of San Luis and on bird collisions with reflective windows and how to prevent them. Independent researchers and graduate students have also carried out research projects, such as Shahady's study of water quality in the BBC (see above) and camera trapping to document terrestrial and arboreal mammals (see [costarica.uga.edu/faculty-researchers/research-projects](http://costarica.uga.edu/faculty-researchers/research-projects)).

Community involvement and outreach are part of UGACR's mission. They purchase 25% of their food and many services from local providers. UGACR has developed "innovations for the sustainable intensification of small-scale agriculture and forestry (i.e. biodigestors, effective microorganisms, compost optimization, agroforestry) taking into consideration the local farmers' needs. These innovations, after being tested on campus, are gradually transferred into the farming communities under a careful participatory approach" (F. Camacho, pers. comm.).

UGACR has played a crucial role in MABI, hosting the third conference in 2016 and part of the fourth in 2017 (see 10.6.F above). UGACR is also an active partner in the BBC. In addition to their reforestation efforts, they have conducted



water quality research at 18 sites along 3 rivers in the corridor and have contributed to GIS maps of the corridor (see 10.6.E above). UGACR became a certified member of the Audubon Cooperative Sanctuary Program International in 2018 (auduboninternational.org).

#### **D. Texas A&M Soltis Center (TAMU-Soltis)**

Texas A&M opened its 117 ha Soltis Center for Research and Education in 2009. It is located in San Isidro de Peñas Blancas, San Ramon, adjacent to the eastern border of CER (soltiscentercostarica.tamu.edu). TAMU-Soltis seeks to: "train succeeding generations of Texas A&M students with the aid of experiential, field-based learning; catalyze and facilitate critical and innovative research in the biological, physical, and social sciences; [and] serve as a major international location for research and education in sustainability issues and wise stewardship of natural resources" (soltiscentercostarica.tamu.edu/content/mission-vision-and-objectives).

The land and facilities of the new center were donated to the TAMU System by Bill and Wanda Soltis. Bill Soltis, a TAMU graduate, had traveled to Costa Rica on business and started buying forested land next to CER to preserve it. He donated 16 ha that had been deforested for a farm and reforested it for the campus, provided a 100 year free lease for ca. 100 ha of primary and secondary forest that he and partners own on the border of CER (E. Gonzalez, pers. comm.), and underwrote construction costs for the Center, using designs by TAMU architecture students. An academic building has a wet and dry lab, 3 classrooms, library, computer facilities and WiFi, offices, and cafeteria, with 8 dormitories that sleep up to 56. All of the facilities are handicap accessible (soltiscentercostarica.tamu.edu).

The Center hosts courses run by TAMU faculty focused on Environmental Design, Water Management, Field Studies in Tropical Biology, and Geography Mapping. In 2018, the campus welcomed an NSF funded Research Experience for Undergraduates (costaricareu.tamu.edu). They also facilitate service-learning programs; in 2010, TAMU's chapter of Engineers Without Borders built a computer lab at the School of San Juan de Peñas Blancas. Students from TAMU's College of Education established an English as a Second Language Program for local children and

donated English books to the school. Other students created a short hands-on recycling course and built a water distribution system for local communities (soltiscentercostarica.tamu.edu). Non-TAMU schools and organizations, such as OTS, have brought courses, workshops, and tour groups to the Center (soltiscentercostarica.tamu.edu). Usage of the station doubled in the last two years to more than 7000 person days for 2018 (E. Gonzalez, pers. comm.).

Since 2007, geographers and other researchers have been mapping and establishing benchmarks in the 100 ha of forest, gathering baseline data on biota, making species lists (and posting them on the web site), and collecting data at a meteorological station that posts real time on-line information (soltiscentercostarica.tamu.edu). Monteverde scientists have contributed to baseline research; D. Hamilton and R. LaVal have collected vertebrates, and B. Haber has collected insects for his Electronic Field Guide Project (D. Hamilton, pers. comm.). Most of the current researchers come from TAMU. The Director encourages more researchers to use the site, as the site provides a unique and rich setting for research and education activities (E. Gonzalez, pers. comm.).

By 2017, they had taken several regional initiatives to advance research into global climate change and its impact on biodiversity. They have established contacts with the main Costa Rican universities as well as partnerships with local landowners. They built three weather stations "along the altitudinal gradient of the Peñas Blancas river watershed" and plan to add "eco-hydrology and vegetation data for each site" (E. Gonzalez, pers. comm.; soltiscentercostarica.tamu.edu). They also have developed a regional GIS database and created 230 maps (soltiscentercostarica.tamu.edu). A founding member of MABI, TAMU-Soltis hosted the second annual conference in 2015 (see 10.6.F above).

## **10.8 Environmental Education in the Primary and Secondary Schools**

### **A. EE in Schools of the Monteverde Area-Overview**

EE in local primary and secondary schools includes more attention to water and waste issues, climate change, endangered species, and

sustainable living (Blum 2012). Primary schools (grades 1-6) supported by the government include two in Santa Elena and Cerro Plano and ca. 20 other in surrounding towns. The public Colegio Técnico Profesional de Santa Elena (similar to a US high school) offers specialized programs or majors in agriculture, ecological tourism, and food services in addition to traditional academic subjects (See Section 10.5). There are also 3 private bilingual schools in the area: Monteverde Friends School (MFS), The Cloud Forest School (CFS), and the Adventist School (the latter does not have a high school) that are now accredited by the Ministerio de Educación Pública (MEP: Ministry of Public Education). All area schools have basic curricula, including Environmental Education, shaped by MEP. Most teachers in the primary public schools still lack sufficient training and resources for EE and depend upon the EE Programs at the two cloud forest reserves (Blum 2012). CEAM (see below) helps coordinate EE activities.

A new initiative in sustainable development involving Colegio majors came from a Monteverde Community Fund grant to the Colegio in 2014 to help build a biodigester to process animal waste from the agricultural program; it keeps the waste out of regional streams and produces methane gas to use for cooking in their Food Services Program ([monteverdefund.org/mcf-newsletter-January-2014](http://monteverdefund.org/mcf-newsletter-January-2014)). Students from the 3 high schools continue to be involved in the Adopt-a-Stream program offered by MVI for regular monitoring of the health of local streams using equipment from MVI.

#### **B. Monteverde Friends School (MFS)**

MFS has about 120 students ([mfschool.org](http://mfschool.org)). The school is committed to Quaker values, including "Stewardship: The school promotes an appreciation of and connection to the natural world. By increasing our awareness of our interdependence with all life on earth, we strive to use water, land, and other resources mindfully and wisely. Our resolve is enhanced by the natural beauty and biodiversity that surrounds us" ([mfschool.org/aboutMFS](http://mfschool.org/aboutMFS)). Students go on field trips to local reserves and educational nature exhibits. They carry out an independent project in their last year; e.g., following a stream from its origin to the sea, investigating the local recycling

program. High school students have organized recycling at the school. In 2017, the high school science teacher, an accredited teacher in Advanced Placement Environmental Science, gave the first college level course in this subject at MFS, aided by local biologists. His students all received high scores in the US AP test (MFS Newsletter June 2017). That same year, the school's 65th anniversary celebration included a two day symposium on changes in Monteverde over those years; one panel focused on environmental changes and another addressed changes in tourism and the economy.

The school installed 12 solar panels in 2016. They adopted water conservation measures in 2016 and 2017, including dry- and low-flush toilets. The school wants to create a carbon neutral campus. The challenge is that over 90% of their carbon emissions come from transportation, mainly parents dropping off and picking up their children (K. VanDusen, pers. comm.). They also built a nearby 3-unit environmentally friendly house for teachers in 2017. MCF helped support its water conservation systems: rainwater catchment provides water for low flow toilets and washing machines and processed greywater irrigates native fruit trees and a permaculture garden. The roof is ready for solar panels (MFS Newsletter, June 2017 at [mfschool.org](http://mfschool.org)).

#### **C. Cloud Forest School (CFS)**

The CFS, established in 1991, has about 200 students and is the only school in the area dedicated to "learning the language of a sustainable future" through environmental education and on-campus land stewardship ([cloudforestschoo.org](http://cloudforestschoo.org); Burlingame 2013). CFS acquired its 46 ha campus through a loan from the U.S.-based Nature Conservancy, to establish legal precedents for conservation easements in Costa Rica. The easement put the farm (72% forested) under strict protection. "Green Building" standards for new buildings were developed in 2003 and used that year in construction of the Gazebo or Kiosco (with Monteverde's first solar panel) and all subsequent construction with funding from the US Cloud Forest School Foundation (Burlingame 2013). In 2015, a grant from the MCF funded a pilot rainwater catchment system for flushing toilets

with the goal of reducing the school's use of potable water (C. Yang, pers. comm.).

Once CFS owned the land, they hired a steward to monitor land-use plans and work with the EE Coordinator, staff, and volunteers to integrate stewardship activities with the curriculum. By 2017, more than 13,000 native trees representing a number of species had been planted (M. Brenes, pers. comm.). Volunteers have constructed and maintained trails and mapped reforestation areas (CFSF Rainbow Spring 2014). Two organic vegetable gardens, 2 greenhouses, and native plant gardens featuring a medicinal plant garden and thematic gardens to attract various animals provide additional EE resources. The large project using earthworms to compost organic waste came to an abrupt halt when pizotes (coatis) broke into the enclosure and ate all the worms!

Environmental Education (EE) has always had a central role in CFS's curriculum, but it took a big leap forward in 1998 with the hiring of a full-time EE Coordinator. Coordinators have taken various approaches to EE including teaching separate courses on EE themes, providing resources to teachers, arranging field trips, and helping teachers integrate EE issues and themes into their subject matter courses for different grade levels (L. Grenholm, C. Yang, pers. comm.). The EE person also worked with the land steward to create activities that integrated theory and practice for students. All students have some responsibility for the stewardship of their campus; for example, they have been involved with a campus-wide recycling program since 2013. As she departed in 2016, the EE Coordinator prepared a very useful Manual for future coordinators based on her several years of service in the position; her successors have built their programs on her document (Yang 2016). CFS's camera trap on the trails in the forest above the campus has recorded cats (including a puma and ocelot), coyotes, and other more common animals (CFSF Rainbow, Spring 2018).

CFS has been in the ICT Blue Flag Program (C. Yang, pers. comm.). In 2013, CFS formed a new alliance with UNION VARSAN S.A., owner of a local sustainable farm, to offer students opportunities for internships, hands-on farm activities, and educational tours. The business is

committed "to offer young people a career alternative to tourism" (CFSF Rainbow Spring 2013, G. Vargas, pers. comm.).

#### **D. Monteverde Commission on Environmental Education (CEAM)**

CEAM is a cooperative group of environmental educators formed in 2005 by the MCFP, SECFR, MCL, ACAT, the local government, and the Santa Elena ASADA (ceamonteverde.weebly.com). CEAM coordinates environmental activities for students, raises local environmental consciousness, and contributes to sustainability. From 2005-2009, they sponsored an annual prize contest for ecological stories by students from 14 schools. The 15 best stories from all these years were published in 2014 with funding from the local government and BESA (M. Díaz, pers. comm., CEAM 2014). In 2016, CEAM sponsored a new contest for ecological stories for grades 4-6 in 14 schools that focused on water resources. The prize was a visit to a national park for the student and the parents. CEAM is looking for funding to publish the winning essays. CEAM has also started sponsoring new workshops, such as one on the conservation of bats. They continue offering educational programs on recycling, helping COMIRES, and organizing annual Environmental Fairs and celebrations of Earth Day (M. Díaz, pers. comm.).

CEAM, under the leadership of M. Díaz from MCFP and Y.M. Arias of SECFR, organized a 3-year training program for those concerned with environmental issues and education. Funded by ACAT and the US Fish and Wildlife Service, workshops involved 103 people from conservation organizations, local government, and agencies in the region (Menacho 2010). CEAM is one of 34 active organizations in ACAT's CREA, the Regional Environmental Education Commission, which was established in 1998 (CREA-ACAT 2017).

### **10.9 Conclusion: Lessons from Monteverde and Topics for Future Research**

#### **A. Recommendations for Future Work**

Environmental organizations and conservation/sustainability practices are rich areas for historical analysis and documentation. Many of the organizations discussed in this Update are more than 20 years old; their early records are deteriorating in quality. This history

should be preserved in digital form, preferably in a central location. Because organizations are evolving so rapidly, it would be ideal to have a single electronic database (linked to the future MABD) with historical and current information and live webpage links for all these organizations. Such a database could also include all available GIS maps and real-time camera trap photos/videos to enable tracking animals' movements in the zone.

Recommendations for special projects are: a) continue to follow the evolution of each of the conservation organizations discussed in this Update; b) analyze the evolution of organizations, issues, players, and projects related to water (CEGIREH), to waste (COMIRES), and to climate change (CORCLIMA) and their interactions in the Monteverde area; c) examine relationships between Monteverde conservation and sustainability organizations and regional, national, and international organizations, movements, policies, and agreements d) evaluate the success of experiments on sustainable and integrated/organic agriculture and reforestation and their applications in the zone; e) explore the developments of personal networks linking conservation organizations and their impact on building a base for consensus decision-making; f) assess the impacts of the EE programs started at MCL in 1986, at MCFP in 1992, and at CFS in the early 1990s on those early students who are now adults; and g) write a history of the Finca La Bella community.

There are many topics to explore in the growth of Monteverde area tourism, beginning with an accurate estimate of the number of tourists in Monteverde to assess environmental impacts on biota, water, and waste. This is also critical to understanding the impacts that paving the road up the mountain will have. A study on the growth of the area's adventure tourism industry, and the effects of the commission system, will show the sector's economic contribution to the Zone. How sustainable and or green are tourism businesses, and how do they define, value, measure, and implement sustainability? The answers to these questions will come from carefully designed social science surveys and questionnaires.

## **B. Failures or Problems of Conservation Organizations and of Sustainability**

"There are multiple visions and practices of environmentalism operating in a scene of complicated regional social, economic, political, and ecological change" (Vivanco 2006). Conservation organizations have not made sufficient efforts to understand the differing visions and practices says anthropologist Vivanco. "The fact that many residents see the now-protected forests as off-limits to their recreation and use reinforces the authority of the environmental organizations that police those lands, but fuels quiet talk by some people of future land invasions" (Vivanco 2006; see also E. Vargas Essay in section E below). Historian Davis claims "many residents share the perspective that support for conservation in Monteverde is relatively shallow" and "only as viable as the continued flow of money and jobs through tourism" (Davis 2007). Another anthropologist discusses conflicts between the values of conservationists and more urban Costa Ricans in Sta Elena, Cerro Plano, and San Luis with their development associations and their understanding of sustainability in more social and economic terms (Blum 2012; see also Davis 2007). Some Costa Ricans have resented a lack of access to scientific research information generated in Monteverde but available only in English and in locally inaccessible specialized journals (Blum 2012, Kutner 2018).

Some think that the rapid development of tourism, especially adventure tourism, is destroying what was special about Monteverde. In 2016, *Lonely Planet* commented: "On a good day, Monteverde is a place where you can be inspired about the possibility of a world in which organic farming and alternative energy sources are the norm. On a bad day, Monteverde can feel like Disneyland in Birkenstocks." Zip lines, which started in Monteverde, are now widespread and more accessible and cheaper in other areas, so adventure tourism may decline in Monteverde (Davis 2007). Crowds of tourists in MCFP and other tourist destinations, billboards, and heavier traffic are associated problems. In addition, tourists and the population increase they caused have strained water supplies, increased amounts of waste, burdened infrastructure, and have had some negative effects on the biota.

Financial stability remains a persistent problem for many of the conservation organizations in Monteverde. Problems were magnified with the global economic downturn by 2009; for Monteverde, this involved decreases in tourism and international donations. Organizations are working to develop endowments and more stable sources of funding. Money and personnel are also needed to develop and maintain the ambitious projects proposed by COMIRES, CEGIREH, CORCLIMA, and the MABI database.

### **C. Successes of Conservation Organizations**

1. A traditional measure of conservation success is the amount of forest that has been protected. By 2017, BESA, MCFP, CER, SECFR, Curi-Cancha, and CRCF included 27,650 ha; these reserves are part of the Arenal-Monteverde Protected Zone of 28,314 ha. The Monteverde Reserves plus Arenal Volcano National Park and the Alberto Manuel Brenes Reserve provide 50,000 ha of continuous protected areas (L. Stallcup, pers. comm.). Most of the Monteverde reserves are included in ACAT's 387,000 ha which offer some measure of protection.

2. The practice of linking forest patches to protected areas via corridors has expanded beyond buying land to large-scale reforestation efforts with native tree species by many organizations. Increased forest connectivity on private land has been most successful in the upper third of the Bellbird Biological Corridor, extending from the Monteverde Reserves down to Guacimal. This reforestation has provided benefits to the private landowners as well as to wildlife. As Nadkarni has noted, however, the forests growing back after severe deforestation are not the same as the original ones, and could be thought of as the "third state," forests that bring new ecological relationships (Nadkarni 2018).

3. Endangered species have been returning. All 6 Costa Rican members of the wild cat family have been seen on camera traps, although the few jaguar sightings may indicate that one or more is passing through and are not residents (L. Stallcup, pers. comm.). Tapir tracks have been observed for many years; now these animals are being seen on camera trap videos. Large birds

such as guans, umbrella birds, and great curassows, which have disappeared in unprotected areas because of hunting, are being seen in the reserves. Two frog species thought to be extinct have reappeared in the CER. We also have been learning much more about what species are found in multiple area habitats from scientific studies and observations by guides and naturalists. The annual Monteverde Christmas Bird Count celebrated its 25th year in 2018.

However, recent camera trap research in CER and UGACR's campus that focused on large terrestrial mammal and terrestrial bird populations photographed only 25 "of the 33 species historically found in the region; most species were rarely detected ...[and] only five were found more than once per 30 days of camera time" (Zamzow, et al. 2018). While the three-wattled bellbird and resplendent quetzal have been breeding in the reserves (mainly in nest boxes watched by cameras), their status is still threatened on their migratory routes. Therefore, conservationists are protecting and replanting the birds' wild avocado food sources along these routes (Hamilton, Singleton and Joslin 2018).

4. Environmental Education is part of the curriculum for primary and secondary schools. Numerous groups have provided EE for local schools and the community; these groups cooperate through CEAM to offer activities, fairs, and environmental clean-ups involving the broader community. There have been more outreach efforts to the people whose resentments were mentioned in item B above, stressing the benefits of conserved areas and providing practical education in such areas as improving farm productivity and developing rural tourism. Other forms of EE have expanded in the institutions for foreign university students, in guided tours of reserves, in some green hotels and restaurants, and in educational businesses with animals and orchids.

5. Organizations have continued to emerge to meet new needs: a local government, the Community Fund, the CRCF, ProNativas, the BBC, MABI, COMIRES, CEGIREH, CORCLIMA, and CEAM. Volunteers serving on committees and on each other's Boards link these organizations to each other and to continuing organizations. Monteverde's conservation organizations occupy different niches and do not

compete with each other, but they do cooperate with each other and with other organizations at local, national, and international levels.

The successes of conservation organizations in these areas have been possible because of the following factors (Burlingame 2000):

1. Resident and visiting scientists and conservationists have provided basic and applied knowledge that led to the formation and growth of conservation organizations and their programs.

2. Economic prosperity and a diversified economy supported the development of conservation organizations and made an educated middle class a reality. Since 2000, tourism has surpassed agriculture as the main economic driver and source of conservation support.

3. Successive immigrants brought new perspectives, skills and knowledge, starting with the Costa Rican settlers, followed by the Quakers, then the biologists, the tourists and business people, civic leaders, educators, and artists to create what the 2013 session at the ATBC called "The Perfect Storm: Educational, Conservation, and Community Synergisms for Tropical Ecology Research in Monteverde, Costa Rica."

4. Monteverde's conservation organizations and the people who support them have been able to change as conservation thinking evolved from a focus on preserving particular endangered species in a reserve to concern about protecting habitat for organisms that migrate outside of reserves (such as quetzals, bellbirds, jaguars). Thinking then broadened to preserving biodiversity in much larger areas through such measures as creating connectivity (corridors) between protected areas and working with people in those corridors and around protected areas to meet their needs and offer sustainable options for their livelihood in agriculture, tourism, or other occupations. Today's challenge of climate change broadens conservation thinking to the global level. Members of the organizations have kept up-to-date on national and international conservation thinking, policies, organizations, and technological tools such as GIS (C. Harvey, Keynote Address at MABI II, 2015; Davis 2007). They learned how to tap into outside sources of funding and steer benefits of tourism to conservation and sustainable development ends. The organizations have shown resiliency and resourcefulness; their success has been possible

because of dedicated, hard-working, motivated, educated, and creative people.

5. Information and access have been improving. Making the Nadkarni and Wheelwright, eds., *Monteverde: Ecology and Conservation of a Tropical Cloud Forest* and the Chapter Updates available on the internet in English and Spanish with free access was a major contribution ([digitalcommons.bowdoin.edu/scholars-bookshelf/1/](http://digitalcommons.bowdoin.edu/scholars-bookshelf/1/); [3/](http://digitalcommons.bowdoin.edu/scholars-bookshelf/3/); [5/](http://digitalcommons.bowdoin.edu/scholars-bookshelf/5/)). It is important to continue regular digital updates to the book. The proposed on-line MABI database will also be important in communicating pure and applied scientific and social science research information (MABD 2018). MVI's library has been building a searchable digital collection and has created an electronic list of MCFP's library holdings MVI has an offprint collection of local research, but they are missing many articles. Researchers need to be encouraged to submit copies of their articles to MVI and to opt for Open Access journals for their publications; US universities such as MIT and U. of California now require their faculty to publish in these journals (Kutner 2018). Electronic media have contributed to rapid communication in the zone and at national and international levels. MVI's weekly electronic bulletin board reaches a wide audience with information about upcoming talks, meetings, and events, including the monthly meeting of biologists.

#### **D. The Monteverde Zone and its Conservation Organizations as Models**

Simply copying Monteverde and its conservation organizations and applying these activities elsewhere is problematic because of the unique elements in Monteverde and in Costa Rica. However, some of the conservation and educational organizations or some of their programs and practices can be adapted as models. Monteverde's successes with ecotourism as a way to support conservation organizations and the development of ecotourism businesses can serve as a model for certain locations.

The Monteverde-Arenal Bioregion Initiative, launched in 2014, proposes to extend the synergisms of the Monteverde area that have contributed to its successes in research, conservation, and education to the larger bioregion around it. CORCLIMA openly wants

to be a model for Costa Rica in addressing the challenges of climate change.

#### **E. "Human Voices Around the Forest"**

E. Vargas' update to his (essay), "Human Voices Around the Forest" offers a concluding vision of promises and challenges to conservation successes:

"As neighbors living around the protected areas, we enjoy the beauty of landscape, the pureness of water and air, the peace of the bird's songs; but it also implies a responsibility: to care for this natural richness, as the source of life and admiration for all creatures, among them, human beings. For this purpose, it is essential that our short and medium term actions be framed by an integral, long-term vision.

"The conservation organizations and the government highlight the extension of protected forest as proof of conservation success in Monteverde and Costa Rica. However, we do not know if in a few decades, these organizations will have the capacity and the necessary resources to ensure the protection of such a large area. Will they be able to do it without the participation and support of the people living around these forest reserves? What will be the future pressures on these areas? Other actor's voices are being heard, from the inhabitants of nearby communities (e.g. Guacimal, Chachagua) defending their water sources for human consumption from the agro-industry and tourism developments pushing for water concessions. For example, after several

years of protest, the Guacimal and Santa Rosa communities went to the Constitutional Court (Sala IV) to appeal for legal protection against the water concession approved by MINAE for the irrigation project SUDAGUA. This water concession would have left the Veracruz River with only 16% of its flow (almost dry). In December 2016, the Court ruled in favor of the community appeal on the grounds that SUDAGUA did not comply with environmental impact studies (Lara 2016). La Alianza de Comunidades por la Defensa del Agua is currently working on a project to obtain a legal protection status for the Veracruz and Guacimal rivers by creating a Water Reserve for drinking water (Caballero 2017). If this proposal gets official support, it may become a precedent for many other communities and rivers facing the same risk. However, public and private hydroenergy companies are creating more pressures as they construct dams on various rivers whose main water sources are in the Monteverde Reserve Complex.

"These cases offer an idea of the big challenges for the conservation organizations, governments, educational institutions, community leaders, farmers and enterprises of the region. Enduring sustainability will depend on the will among all organizations and actors involved to maintain and improve the collaborative work relationships that have distinguished our communities."

## Key to Acronyms

**ACAT:** Area de conservación Arenal-Tempisque [Arenal-Tempisque Conservation Area; previously ACA]

**ASADAS:** Asociaciones administradoras de los Sistemas de Acueductos y Alcantarillados Comunes en Costa Rica [Administrative associations of rural community water and drainage systems]

**ATBC:** Association for Tropical Biology and Conservation

**AyA:** Acueductos y Alcantarillados [Costa Rican Water and Drainage Institute]

**BBC:** Bellbird Biological Corridor

**BESA:** Bosqueterno, S.A. [Eternal Forest, Inc.]

**CASEM:** Cooperativa de Artesanías de Santa Elena-Monteverde [Santa Elena and Monteverde Artisan Cooperative]

**CEAM:** Comisión de educación ambiental de Monteverde [Monteverde Commission on Environmental Education]

**CEGIREH:** La Comisión especial para la gestión integral del recursos hídrico [Monteverde Special Commission for the Integrated Management of Water Resources]

**CER:** Children's Eternal Rainforest [previously used Spanish acronym BEN]

**CFS:** Cloud Forest School [previously used Spanish acronym CEC]

**CFSF:** Cloud Forest School Foundation

**CIEE:** Council on International Educational Exchange

**COMIRES:** Comisión de manejo integral de residuos sólidos de Monteverde [Monteverde Commission for Solid Waste Management]

**CORCLIMA:** Comisión resiliencia al cambio climático de Monteverde [Monteverde Commission for Resilience to Climate Change]

**CRCF:** Costa Rican Conservation Foundation

**CST:** Certification for Sustainable Tourism [from ICT]

**DCC:** Dirección de cambio climático [Directorate of climate change; in MINAE]

**EE:** Environmental Education

**FONAFIFO:** Fondo Nacional de Financiamiento Forestal [National Fund for Forest Financing; in MINAE]

**FR:** Friends of the Rainforest [previously FCER: Friends of the Children's Eternal Rainforest and MCLUS]

**ICT:** Instituto Costarricense de Turismo [Costa Rican Institute of Tourism]

**MABI:** Monteverde-Arenal Bioregion Initiative

**MCF:** Monteverde Community Fund

**MCFP:** Monteverde Cloud Forest Preserve

**MCL:** Monteverde Conservation League

**MCLUS:** Monteverde Conservation League U.S.

**MEP:** Ministerio de Educación Pública [Ministry of Public Education]

**MFS:** Monteverde Friends School

**MINAE:** Ministerio del ambiente y energía [Ministry of the Environment and Energy]

**MVI:** Monteverde Institute

**OTS:** Organization for Tropical Studies

**PES:** Payment for Environmental Services

**SECFR:** Santa Elena Cloud Forest Reserve

**SINAC:** Sistema nacional de áreas de conservación [National System of Conservation Areas]

**TAMU-Soltis:** Texas A&M University Soltis Center for Research and Education

**TSC:** Tropical Science Center

**UGACR:** University of Georgia, San Luis Costa Rica

**ZPAM:** Zona Protectora Arenal Monteverde [Arenal Monteverde Protected Zone]



## Sources

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**NOTE:** Most of the sources for this Update are “grey literature,” unpublished computer generated reports, newsletters, and documents available from the organizations that produced them. Also, most all of the organizations discussed in this Update have websites with extensive information and Facebook pages.

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