

REVIEW ARTICLE

Developing an Effective Community Conservation Program for Cotton-Top Tamarins (*Saguinus oedipus*) in ColombiaA. SAVAGE^{1*}, R. GUILLEN², I. LAMILLA², AND L. SOTO²¹Disney's Animal Kingdom, Education and Science Department, Lake Buena Vista, Florida²Fundación Proyecto Titi, Barranquilla, Colombia

Developing effective conservation programs that positively impact the survival of a species while considering the needs of local communities is challenging. Here we present an overview of the conservation program developed by Proyecto Titi to integrate local communities in the conservation of Colombia's critically endangered primate, the cotton-top tamarin (*Saguinus oedipus*). Our comprehensive assessment of the threats effecting the long-term survival of the cotton-top tamarin allowed us to establish the primary components of our program. Proyecto Titi has three areas of emphasis: (1) scientific studies detailing the biology and long-term survival of the cotton-top tamarin, (2) conservation education programs to increase public awareness and conservation knowledge, and (3) community empowerment programs that demonstrate a valuable economic incentive to protecting wildlife and forested areas in Colombia. This integrated approach to conservation that involves local communities in activities that benefit individuals, as well as wildlife, has proven to be remarkably effective in protecting cotton-top tamarins and their forested habitat. Our biodes program, which uses small cook stoves made from clay, has demonstrated a marked reduction in the number of trees that have been harvested for firewood. Developing environmental entrepreneurs, who create products made from recycled plastic for sale in national and international markets, has had a significant impact in reducing the amount of plastic that has been littering the environment and threatening the health of wildlife, while creating a stable economic income for rural communities. Proyecto Titi has provided economic alternatives to local communities that have dramatically reduced the illegal capture of cotton-top tamarins and forest destruction in the region that has positively impacted the long-term survival of this critically endangered primate. *Am. J. Primatol.* 71:1–12, 2009. © 2009 Wiley-Liss, Inc.

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INTRODUCTION

Developing effective primate conservation programs, which address the conservation needs of the animals and the needs of local communities that directly impact the habitats that the primates need to survive, is a challenging task. As primate habitats and populations become smaller and more fragmented and human populations increase, the need to develop strategies that demonstrate tangible benefits to conserving endangered primates is essential. Primatologists are skilled at developing conservation plans that address the biological needs of primates. Through partnerships, many have developed successful programs that have increased knowledge through the development of successful community education programs and have worked to address the needs of local communities that live near or in primate habitats [Bettinger & Reynolds, 2008; Bettinger et al., 2006; Cartwright & Bettinger, 2006; Chambers & Ham, 1995; Dietz & Nagagata, 1995; Engels & Jacobson, 2007; McNeely, 1995; Weber, 1995].

However, creating knowledgeable individuals is just one part of the conservation solution; it is essential that there is positive behavioral change that is consistent with developing protection programs for animals and their environment [Jacobson, 1995; Jacobson & McDuff, 1997]. Although primate conservation programs can indeed focus on creating knowledgeable individuals, issues relating to poverty can override the most well-educated communities,

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thus putting the long-term conservation of primates and their habitats at continued risk. The trend in successful conservation programs has been one of integrated rural development that demonstrate direct benefit to the local people (money, jobs, access to health related resources, and food) by conserving species and their habitats [Happold, 1995]. Integrated conservation programs have been seen as a valuable means of achieving effective conservation goals [Adams & Hulme, 2001], when developed with the appropriate objectives in mind.

Here we present an overview of Proyecto Titi's conservation program that has grown from a study of the biology of the cotton-top tamarin (*Saguinus oedipus*) in the wild to a comprehensive conservation program that incorporates effective conservation education initiatives and the needs of local communities to protect Colombia's critically endangered cotton-top tamarin. Using the cotton-top tamarin as a flagship species for conservation [Dietz et al., 1994; Mallinson, 1991; Mittermeier, 1986], we developed a model program that has had success in Colombia and may provide useful insights for primatologists interested in developing effective conservation plans in primate habitat countries.

Developing a Biological Opinion to Identify Threats to the Survival of the Species

Understanding the root causes of primate population decline is essential in the development of a comprehensive conservation program. This requires a comprehensive assessment of the factors that will influence the long-term survival of the species. We have focused our efforts on (1) long-term monitoring of the reproductive and behavioral biology of the cotton-top tamarin; (2) documenting the loss of forested habitat, developing techniques to accurately estimate the remaining wild population, and monitoring them over time; and (3) identifying factors that contribute to the decline of this critically endangered species. Having long-term data provides the opportunity for us to evaluate the effectiveness of a variety of initiatives developed to protect cotton-top tamarins in Colombia.

Long-term monitoring of species

Developing a long-term monitoring program that allows for the investigation of factors that influence the survival of species in the wild is an essential component of any successful conservation program. We began by developing field sites within the historic distribution of cotton-top tamarins, so that we could conduct long-term field studies to investigate the reproductive and behavioral biology of this species. [Savage, 1990; Savage et al., 2003, 2009a,b]. Having data from two field sites allowed us to compare a variety of factors (fecundity, survival rates, home range size, feeding ecology, group

dynamics, etc.) to determine if there were any biological causes that were influencing the long-term survival of the species [see Savage, 1990; Savage et al., 1996a,b, 1997b, 2009b]. Our studies have shown that wild cotton-top tamarins do not appear to have high rates of adult or infant mortality, issues of disease exposure, or any obvious biological cause for their decline at our study sites. However, we have observed challenges with animals effectively dispersing, given the limited forested habitat in the area. It is common to see animals evicted or dispersing from their groups living in an area with limited forested resources, such as treed fence lines, until they are able to evict a resident from another group or take over a section of habitat from an established group [A. Savage, personal observation]. Given the small forest patches that are found in the northern portion of their historic distribution, the opportunities for long-distance dispersal are challenging. Thus, we have observed an increase in aggression as animals attempt to evict residents from established groups. These aggressive episodes appear to have led to higher incidence of injuries and possible mortality [A. Savage, personal observation].

Documenting forest loss and species decline

Colombia is among the top ten countries to suffer significant loss of forested habitat [Mast et al., 1993] with a 0.5% annual rate of destruction [Braatz, 2001] and the status of their forest habitat has been designated critically endangered throughout a significant portion of Colombia [Brooks et al., 2002; Olson & Dinerstein, 1998]. Cotton-top tamarins have a much localized distribution within northwest Colombia (departments of Antioquia, Atlántico, Bolívar, Chocó, Córdoba, Sucre) [Hernandez-Camacho & Cooper, 1976; Hershkovitz, 1977; Mast et al., 1993], making them highly vulnerable to the effects of habitat destruction. A study by Miller et al. [2004] documented a 31% decrease in forested habitat within the tamarins' historic distribution between 1990 and 2000, because of the conversion of tropical forest habitat to agricultural uses and urban development, extraction of forest resources for firewood and lumber, and logging on both private and protected areas. The rate of habitat destruction continues at an unprecedented rate in Colombia and the creation of small isolated forest remnants is prevalent throughout much of the distribution of the cotton-top tamarin.

Our goal has been to develop a comprehensive monitoring program that can examine the effects of habitat loss [Miller et al., 2004] and its effects on estimating the remaining wild population of cotton-top tamarins [Savage et al., in review]. There has never been a comprehensive census of the population of cotton-top tamarins; however, Hernandez-Camacho and Cooper [1976] reported that between

20,000 and 30,000 cotton-top tamarins were exported from Colombia in the late 1960s to early 1970s. Given the rapid rate of forest decline, it was imperative to develop a population monitoring program for the cotton-top tamarin. Given their small size, arboreal nature, and fear of humans, using standard line transect sampling methods dramatically underestimates the size of the population. We, therefore, developed a collaboration with scientists from the Centre for Research into Ecological and Environmental Modeling at the University of St. Andrews, and created a “lure strip transect,” which combines the use of playbacks of territorial vocalizations with traditional transect surveys to yield a robust method of estimating population size. The results from our census found a dramatic decline in the existing cotton-top tamarin population in Colombia [Savage et al., in review]. Given the marked decline in suitable forest habitat combined with a small population, the cotton-top tamarin has been reclassified as Critically Endangered by the International Union for Conservation of Nature (IUCN) [IUCN, 2008].

Factors influencing the long-term survival of cotton-top tamarins

Our studies show that the primary threats to the survival of the cotton-top tamarin has been the dramatic loss of habitat from the conversion of tropical forest habitat to agricultural uses, extraction of forest resources for firewood and lumber, and capture for sale in the illegal pet trade. This destruction and consumption of forest resources is driven by the fact that 65% of the population in Colombia lives below the poverty line [World Bank, 2002]. Rural poverty is especially acute, with more than 80% of inhabitants living in poverty. With a lack of sustainable income, limited access to employment opportunities, and lack of knowledge of the long-term impact of continued unsustainable extraction of forest products, the future of cotton-top tamarins and the biodiversity in Colombia is severely threatened.

Creating a new culture of conservation in rural communities

Thus, the need to educate and economically empower rural communities that directly impact areas critical to cotton-top tamarin conservation programs are essential if we are to insure their survival. Developing relationships with rural communities requires a long-term commitment and dedication to building effective partnerships. Many rural communities feel disenfranchised and not engaged in matters that affect their daily lives, and their understanding of global conservation issues is limited. There is often mistrust of government organizations, politicians, and NGO's who promise to make changes for the betterment of their communities. Thus, developing

long-term programs and relationships show a commitment to the well-being of both communities and the primates that are in need of protection [Wrangham & Ross, 2008]. There have been several long-term programs that have worked with local communities, increased education awareness, and provided economic opportunities through ecotourism and other business ventures as a means to generate support for primate conservation initiatives and have demonstrated their effectiveness in protecting primates and their habitats [Curran & Tshombe, 2001; Engels & Jacobson, 2007; Goodall, 2001; Horwich & Lyon, 2007; Weber, 1995; Weber & Vedder, 2001; Wrangham & Ross, 2008].

Community Education Programs

When Proyecto Tití began working with local communities, developing education initiatives was a critical component for the success of our cotton-top tamarin conservation program. Our early studies found that there were many myths and misconceptions about the forest and the wildlife of the area. More than 90% of the population we surveyed had no idea that cotton-top tamarins were endemic to Colombia and not found in other countries [Savage et al., 1997a]. Our educational strategy involved developing formal and informal programs that (1) increased awareness to the plight of the cotton-top tamarin and the biodiversity of the region; (2) addressed farming practices to minimize impact to the remaining forest habitat; (3) developed teacher training programs to increase scientific literacy in the schools; (4) addressed pet trade issues for rural, urban, and enforcement authorities; and (5) partnered with educational entities to integrate this information into existing school curriculum and established programming.

We developed classroom and field activities for elementary and secondary school children that were designed to create an awareness of the plight of the cotton-top tamarin, and engaged students in a variety of activities in the classroom, field, and in international exchanges that would promote the conservation of Colombia's natural resources. Our education program continued to expand to include teacher training programs, the establishment of a rural school dedicated to conservation and sustainable farming practices, and field training for Colombian university students [for a detailed review, see Savage, 1993; Savage et al., 1997a, 2000]. We developed a strong partnership with the Barranquilla Zoo and we now reach urban audiences through a series of classroom workbooks (CARTITILLA) aimed at fifth to seventh grade school children [Guillen, 2003]. Urban communities were limited in their understanding of wildlife conservation issues and were the primary market for the illegal pet trade of cotton-top tamarins. The workbook focused on the cotton-top

tamarin and its tropical ecosystem, including knowledge-based activities, interactive games, role playing scenarios, and inquiry based questions that would lead students to a conservation-based discovery. It was used in 15 schools with more than 3,000 students. Results from our evaluations showed an 81% increase in the level of accuracy for correctly identifying a cotton-top tamarin, a 77% increase in understanding that cotton-top tamarins are found only in Colombia, and 65% increase in the understanding of the pet trade as a threat to the survival of the species. Regional pride was instilled in these students, so that they were more interested in exploring opportunities that would help to protect cotton-top tamarins for the future [Guillen, 2003].

Our extensive education program has created knowledgeable individuals who are concerned for the environment and our community programs were filled to capacity. However, our focus group data suggested that although we had individuals that were concerned about wildlife conservation issues, there were still pressing economic issues that were creating a disconnect between our efforts to educate communities to conserve natural resources and their ability to engage in activities that promoted wildlife conservation.

Developing Economic Alternatives for Communities

Addressing pressures exerted by local communities on forested habitats plays an important role in finding solutions to protect habitat. One challenge facing cotton-top tamarins was the amount of wood that was harvested from the forest and consumed for firewood. It is estimated that globally, nearly 2.5 billion people consume firewood, charcoal, crop residues, and dung as their primary source of energy [Reddy et al., 1997]. Malaney's [1999] "energy ladder" outlined a strategy suggesting that income groups rely on more efficient fuels such that the lowest economic rung consumes wood, dung, and other biomass, which burn with approximately 15% of the efficiency of electricity. The lowest economic rungs also used fuels with the highest emissions of carbon dioxide, methane, and particulates, a significant contribution to indoor air pollution and deterioration of women's health. Efforts to minimize the use of firewood are underway in many countries [Kammen, 1995]. International aid organizations have focused on the "improved" cook stoves to improve efficiency and reduce health risks, with stove designs being continuously refined [Kammen, 1995; MacCarty et al., 2008; Still & Winiarski, 2001].

Our initial attempts to introduce solar box cookers to this region as an alternative to cooking with firewood were not successful. There was a negative response by the families asked to use a solar box cooker because (1) coffee could not be made in a

timely manner; (2) food cooked in the oven did not have an appealing taste; (3) time needed to cook food was not feasible given the demands of rural living; and (4) food could not be reheated quickly [see Savage et al., 1997a, for a complete review]. However, in discussions with local villagers in Colombia, we discovered the traditional Colombian "binde" a small cook stove that was made from a termite mound [Savage et al., 1997a]. Interviews with local villagers indicated that bindes required less firewood than cooking over an open fire. Although accepted by local communities in Colombia, there were limitations with bindes made from termite mounds because they often cracked and disintegrated with repeated use.

Given that bindes were already a part of the culture, our goal was to make bindes better. We designed a durable binde made of clay (Fig. 1).

We found that bindes were readily accepted by the communities and proved to significantly reduce the amount of firewood consumed. A family of five used approximately 15 logs a day to cook their food over an open fire. Using a binde, the number of logs consumed each day was reduced by 2/3rds [Savage et al., 1997a]. Food cooked in a binde did not take significantly longer to cook than over open fire and it retained its flavor. Because bindes produced less smoke, women reported less eye and lung irritation than when cooking over an open fire [Savage et al., 1997a].

Given the initial success of our bindes program, we wanted to evaluate the long-term use of bindes. In October 2006, 200 clay bindes were distributed to 170 households that traditionally cooked over an open fire in five communities in the departments of Atlántico (Hobo, Lururaco) and Bolívar (Santa Catalina, Pendales, Los Colorados) near our field site at Hacienda El Ceibal (Fig. 2). All participants received training on how to cook using a binde and information on how bindes benefit cotton-top tamarin conservation efforts (Details on how to construct a binde can be found at www.proyectotiti.com).



Fig. 1. Binde made from clay.

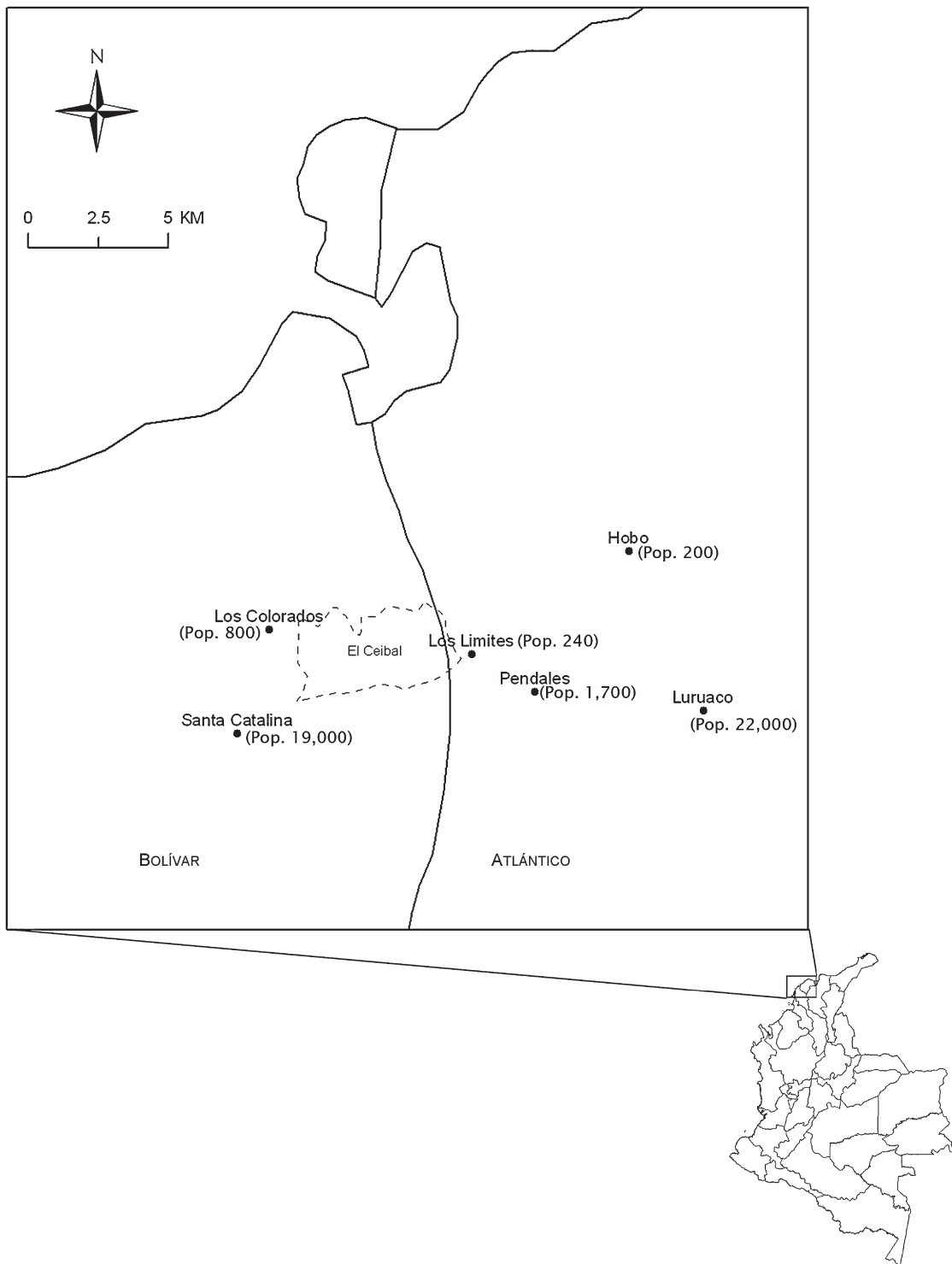


Fig. 2. The location and population of communities receiving bindes near our field site.

In most cases, each family received one binde per household, but in instances where there were multiple families in one target area (ranches) several bindes were provided to allow all families access to bindes. In December 2008, a survey was administered

to 107 families that had received a binde. Participation in the survey was voluntary and was restricted to individuals that were available to answer questions on the day the individual administering the survey visited their village. Survey questions were

designed to examine the potential use and benefits of bindes to local communities and cotton-top tamarin conservation knowledge.

All 107 individuals that participated in the survey were still using the binde they received in 2006. Although 57% of these original bindes had cracks or were slightly damaged during the 2-year study, they were still in use. Binde were typically used two (48%) or three (35%) times per day to cook food. Firewood (65%) and charcoal (27%) were predominantly used as fuel in bindes, whereas corn husks, yucca stalks, etc. were burned when available (7%). One hundred percent of the respondents believed that they used less fuel when cooking in a binde than over an open fire and they estimated a 50% reduction in firewood needed annually for cooking. Table I illustrates the primary reasons that families used bindes. Primary benefits included saving money because less firewood or charcoal was needed for purchase, benefits to the environment because fewer trees were cut to produce firewood and charcoal, and time saved in not having to collect or purchase fuel for cooking. Binde were also found to cook food faster, keep the kitchen cooler, and reduce the amount of burning of food and cooking utensils.

Ad lib comments suggested that participants were very interested in receiving more bindes of different shapes and sizes to accommodate the various sizes of cooking pots and pans. They also wanted other members of their communities, families, and neighboring communities to participate in the binde program, given the long-term benefits to people and conservation efforts in the region.

Respondents were also able to correctly identify a cotton-top tamarin (100%), its distribution within the country (82%), and provide at least two correct responses to factors that influence the survival of the cotton-top tamarin (100%). Their responses indicated a clear understanding of how the use of bindes can play an important role in helping to reduce the number of trees that are harvested for firewood.

Binde are now an essential part of our community empowerment program. We have trained several representatives from each community to make bindes, so that this technology can be spread within the region. These individuals create bindes for sale to those in their communities or in neighboring

communities and champion the use of bindes in the region.

Our studies have suggested that communities readily used bindes and found them to be of value, and also were cutting fewer trees in the forest [Savage et al., 1997a]. Programs that encourage the use of alternative energy sources, such as bindes, can reduce the amount of fuel that is consumed and can have positive effects for people and conservation efforts worldwide [Goldstone & Stern, 2008]. Reducing the exposure of women to smoke provides additional health benefits [see Saldiva & Miraglia, 2004, for a complete review]. Given the reported savings in both money and time, bindes can be an important tool in helping to reduce the impact of local communities on forest resources in Colombia. We believe that by providing local communities with choices that are both environmentally friendly and relevant to their daily existence, we greatly enhance our ability to positively impact the conservation of the forests that the tamarins need to survive.

Turning Trash into an Economic Treasure

Addressing the needs of local communities is essential in developing an integrated conservation plan for a species. Regardless of effectiveness of the conservation education programs, our experience has shown that if basic human needs are not met, local communities will not engage in activities that positively benefit wildlife. As human population increases in Colombia, efforts to manage waste continue to be a challenge in local villages. The situation in Colombia is worsening, particularly in rural communities, where traditional means of disposing of waste (burning, dumping in rivers or roadside dumps) cannot keep up with the increasing amount of waste being generated. The situation becomes not only a human health hazard, but also has negative implications for wildlife. Of recent concern in our attempts to protect cotton-top tamarins was the amount of plastic waste that appeared in forested areas [A. Savage, personal observation]. Much of this waste was generated from communities who live at the edge of the forests. It is a common occurrence that wildlife will often investigate and/or consume plastic resulting in an

TABLE I. Community Response to Using Binde and Their Potential Benefits

Why do you use a binde?	Response	What are the benefits to using a binde?	Response
Saves money	60%	Saves money	32%
Better for the environment	17%	I have to collect less firewood	15%
Saves time	13%	Cooks food faster	12%
Easy to use	6%	Makes cooking easier (less burning)	11%
Better for my health	4%	Uses less firewood	8%
		Less burning of pots and pans	8%
		The kitchen stays cooler	4%

increase in disease transmission between humans and wildlife [Daszak et al., 2000; Derraik, 2002]. To avoid this potentially dangerous situation occurring with the remnant populations of wild cotton-top tamarins, we developed a program to turn trash into a valuable resource for local communities.

Throughout most developing nations, there are skilled artisans that create products for sale to national and international markets to provide a sustainable income [Marston & Barrett, 2006]. Our goal was to create an artisan group that would create a product from plastic bags that were littering the environment and jeopardizing the future survival of cotton-top tamarins. By providing a stable source of income to the artisan group combined with effective conservation education messaging, they would then commit to protecting the forests and not capture cotton-top tamarins for the illegal pet trade.

Selecting Communities

The village of Los Limites had participated in many of Proyecto Titi's educational programs, and there was an interest in developing a partnership to increase their ability to actively conserve wildlife in the region [Savage et al., 2008b]. Yet, the challenge facing the community of Los Limites, (population of 240) was the lack of stable employment. Only one individual had a full-time paying job, and the rest of the inhabitants were seasonally employed or provided occasional day labor to neighboring ranches. Many of these individuals hunted wildlife from the forest or fished to provide their family with a source of protein. They also cut trees and captured wildlife to sell in the illegal pet trade as a means of providing some income for their families.

Although the individuals of Los Limites were certainly interested in conserving the cotton-top tamarin, their first priority was to provide for the basic needs of their families. Thus, in order for Proyecto Titi to effectively engage the village of Los Limites in protecting cotton-top tamarins and their habitat, we needed to establish a stable source of income for the families. By providing a source of income, we could leverage their interest in conservation and develop agreements so that they would actively protect the resources the tamarins needed for survival.

ECO-MOCHILAS: the Product

Given the abundance of plastic bags, we investigated the possibility of reusing these bags to create a product that would be of interest to consumers in Colombia and internationally. Colombia is known for "mochilas," bags woven from cotton, hemp, or synthetic materials to create a tote bag. So began the idea of "eco-mochilas," mochilas crocheted with recycled plastic bags [Holtcamp, 2007; Savage et al., 2008b].

The Formation of ASOARTESANAS

Developing women as environmental entrepreneurs, engaging them in environmental causes [Dankelman & Davidson, 1988], and addressing issues of gender equity and poverty in conserving biodiversity [Angel-Urdinola & Wodon, 2006; Rodriguez Villalobos et al., 2004] has been the focus of many successful programs. Similar to a report by Rodriguez Villalobos et al. [2004], we found that nearly 50% of the women living in villages near our field site were the primary economic providers for their families. Thus, we decided to focus our efforts on creating programs for women in the region. We recruited 15 women who were heads of households and well respected in their community. Most of these women did not have any formal education beyond rural secondary school and were not skilled artisans at the beginning of this program. They were trained to crochet and worked to develop products that were of the quality that would sell in national and international markets.

However, it was important that these women learned business skills if they were to become successful environmental entrepreneurs. We developed business-training classes for the artisans and helped them to form a registered business in Colombia, so that they could be a formally recognized organization with the appropriate structure to allow them to establish rules of business conduct and manage the expectations of individual members. In addition, our goal was to teach the women to develop financial goals that would allow them to save money for future investments. This was one of the most challenging tasks for a community that lives in a traditional day-to-day existence. ASOARTESANAS was created in 2004 with 15 founding members and a 5-person board of directors. Their mission states that they are creating products from recycled material to provide a stable economic future for their families and community, while aiding in the conservation of the cotton-top tamarin. The bylaws of ASOARTESANAS requires that the artisans are paid a fair wage for the products they produce and 1% of their monthly income is put into a savings account to purchase supplies needed to effectively run their business.

Eco-mochilas are sold to national and international vendors and via the internet. Using public awareness campaigns, press events, and marketing campaigns we have developed a network of zoos, schools, conservation organizations, businesses that sell "green" merchandize, and craft/art fairs that provide us with a stable market for our products.

Collection of Raw Material

Although plastic bags remain abundant in the area, it was critical that we develop a system to collect bags before they were disposed off as trash. This required a coordinated effort to collect plastic

bags, sort them by quality and color, and distribute them among the artisans. The artisans and their family members developed campaigns within their community and neighboring villages to collect plastic bags and shared information about the cotton-top tamarins. Additionally, there were school groups, the Barranquilla Zoo, and religious organizations that assisted in the collection of plastic bags. To encourage and reinforce their participation, prizes (e.g. school supplies) were given to the group that collected the most plastic bags, and they had the opportunity to visit our field site to see the wild cotton-top tamarins or the Barranquilla Zoo to see captive cotton-top tamarins. They were shown how their actions were helping to protect this endangered species. We have also instituted a “plastic bag pay policy” to all school and university groups that were interested in visiting our field site to see the cotton-tops. Each individual provided 100 recycled plastic bags as their entry fee. They received the opportunity to see a habituated group of cotton-top tamarins and learned about Proyecto Tití’s conservation program, and also visited Los Limites to see how the plastic bags are turned into eco-mochilas.

We have also developed programs with private businesses and organizations in the region. These organizations placed recycling bins in their workplace and employees donated their plastic bags to the artisans. Several of these businesses have organized campaigns where the individual that donated the most plastic bags was given a day off of work. These types of incentive-based initiatives have generated more than 500,000 plastic bags for the artisans in one campaign.

Developing an Artisan Network

Creating a skilled artisan network within northern Colombia has been our most challenging task to date. Each member of ASOARTESANAS is responsible for managing local artisans that have been trained through our workshops. We have sponsored numerous training workshops in neighboring villages to recruit additional individuals for the program. To date, we have trained approximately 600 women to become skilled artisans from 15 neighboring communities. Approximately 50% of the women that have participated in the training workshop remain engaged in the program. Given the cost of developing skilled artisans, we have developed a mentorship program to examine the effectiveness of having a skilled artisan mentor newly trained artisans [Carr, 1999]. Efforts to maximize our investment in training, while creating skilled artisans that contribute to the program and to their community, are essential for the success of our ability to conserve cotton-top tamarins and their habitat in Colombia.

Eco-mochila training workshops were held in three communities [Malambo, Barano, and Galapa] in August and December 2008. There was an open invitation to any woman in the community to attend the workshop with a maximum of 30 individuals per workshop. One hundred and thirty four women, ranging in age from 18 to 62, participated in the workshops and 48% of the women provided the primary income for their family. Sixty-six percent of the women who participated in the workshops had no income, 1% earned minimum wage (\$250/mo) in a full-time job, and the remaining 33% earned less than \$200/mo.

Each 5-day eco-mochila training workshop consisted of (1) skills training in creating eco-mochilas, (2) basic business concepts, (3) an introduction to the conservation of the cotton-top tamarin, and (4) local resources related to rural human health campaigns (family planning, proper nutrition, medical care). At the end of the 5-day workshop, participants were expected to produce at least two 5 × 5 cm eco-mochilas, and pass a skills test that demonstrated their understanding of plastic bag selection and preparation, crochet techniques, eco-mochila designs, and quality control. Pre and post tests were conducted during the workshop to assess knowledge on cotton-top tamarin conservation issues.

In an effort to increase long-term retention, a mentorship program was created by ASOARTESANAS. An experienced artisan visited the community of a subset of the recently trained artisans weekly ($N = 37$) to provide personalized mentorship and coaching, or provided weekly phone calls ($N = 15$) to monitor progress on production goals for 3 months. The personalized mentorship program required that the artisan spend at least one day/week in the community providing feedback on eco-mochila construction, quality control, and motivating the artisans to stay involved in the program. Weekly phone calls consisted of determining whether the artisan was able to meet the production goals and answering questions. A 4-month follow-up survey was conducted to assess participation and production levels in the two conditions.

Pre and post test results did not find a significant difference in conservation knowledge (Table II). Although we did not find a significant difference in knowledge in our surveys, we attribute this to our extensive community outreach program that has worked to impart meaningful information to local people about cotton-top tamarins.

Following the workshop, there was a significant difference in the number of women remaining in the personal mentorship group (78%) vs. the phone call only group (27%) (Fishers Exact test, two tailed, $P = 0.001$). When asked why they left the program, 53% responded they did not have confidence in their technical skills, 32% found work elsewhere, 11% had health issues that prevented their participation, and

TABLE II. Cotton-Top Tamarin Knowledge Assessment Prior to and Post Training

Percent correct	Galapa		Baranoa		Malambo	
	Pre	Post	Pre	Post	Pre	Post
Identification of a cotton-top tamarin	85%	92%	100%	100%	59%	100%
Identification of the distribution of the cotton-top tamarin in Colombia	100%	96%	100%	100%	73%	88%
Two reasons why the long-term survival of cotton-top tamarins is threatened	85%	100%	86%	100%	82%	75%

0.05% were dissatisfied with the salary. Production levels were higher and fewer quality control issues were observed in those artisans that were personally mentored (994 eco-mochilas produced) than those that were not (86 eco-mochilas produced).

The impact of this training and personalized mentorship also resulted in nine new artisans joining after the workshop. These women received training from their peers and feedback from the experienced artisans who visited their village and were successfully producing eco-mochilas at the end of the 4-month follow-up.

Given the cost of hosting training workshops and the need to maximize the number of skilled artisans that remain in our program to meet the demands of our growing business, providing personalized mentoring experiences for newly trained artisans, appears to be very beneficial in retaining artisans and increasing production. Given the various learning styles and literacy level of our workshop participants, having personalized, follow-up coaching was important in building the artisans' self-confidence while perfecting their technical skills. The additional recruitment of new artisans in the mentored group exemplifies how knowledge is transferred in many rural communities and can provide additional opportunities to increase our impact in engaging new artisans in our program.

The artisans of ASOARTESANAS have grown as community and environmental leaders, and have demonstrated tangible benefits to others in their community for participating in this program. Not only do the artisans have gainful employment, but this program has also generated employment opportunities for others in the community. The artisans employ assistants to help them sort the plastic bags by color, prepare and cut the plastic bags, and attach the informational hang tag. In addition, Los Limites now has tourists who visit to meet the artisans and to see how the eco-mochilas are made. Sales of food and beverages have increased 100%, providing a new source of income to others in the community.

ASOARTESANAS began as a group of 15 women who were interested in learning to crochet eco-mochilas, so that they could engage in a productive activity that would yield an economic benefit. Today, these skilled artisans have become teachers sharing their knowledge with other women in neighboring communities and internationally. In a collaborative

effort with WIDECAS, an organization that works with more than 50 countries on sea turtle conservation projects, we shared our successful program to reuse plastic bags. Exposure to and ingestion of plastic bags is not only a problem for wildlife in Colombia, but it is a major challenge for sea turtles. Given the number of sea turtle stranding with various plastic items in their stomachs [Lutz, 1991], we trained a group of artisans from WIDECAS to make eco-mochilas that could be sold to tourists visiting sea turtle nesting beaches [Savage et al., 2008a]. ASOARTESANAS successfully trained six individuals from Costa Rica, Panama, and Nicaragua to make eco-mochilas. These individuals returned to their countries and trained other artisans to make eco-mochilas. Today, the artisans have a thriving business selling a variety of products crocheted from plastic bags [D. Chacon, personal communication].

Conservation Impact

Proyecto Tití has had a remarkable impact in bringing the crisis facing cotton-top tamarins and their forested habitat to the forefront of the conservation movement in Colombia. Results from our scientific studies have resulted in the reclassification of cotton-top tamarins to Critically Endangered [IUCN, 2008], and our habitat and population analysis has provided important information to help The Nature Conservancy, CARDIQUE, and CRA (local environmental authorities in Colombia) to establish the first protected reserve for cotton-top tamarins in the northern region of Colombia.

Our earlier study [Savage et al., 1997a] showed that rural communities had limited knowledge and understanding of the factors that influenced the survival of this critically endangered species. Based on these findings, we have developed a successful community education and empowerment program that has resulted in the development of knowledgeable community members that actively engage in programs that benefit their families, their communities, and ultimately the conservation of the cotton-top tamarin and its habitat.

Proyecto Tití has demonstrated a clear economic benefit to individuals that participate in our community empowerment programs and has produced tangible results that are positively impacting the survival of the cotton-top tamarin in Colombia. To

date, ASOARTESANAS has recycled nearly two million plastic bags, and they continue to reach out to communities and cities to assist in the collection efforts. Plastic bag litter has decreased in rural communities and we rarely observe it in the forest. This has positive implications in reducing human and wildlife health concerns in the region. The artisans and their communities have had a positive impact by honoring their commitment to conservation, not only through the ability to share the story of the cotton-top tamarin, but also because we no longer have animals captured for the pet trade from our study area. We rarely receive reports of individuals keeping cotton-top tamarins as pets, and the number of trees harvested for firewood in our study areas has decreased substantially.

We received two reports that show how powerful a motivated group of individuals can be. In 2005, our field team noted a snare set up in our study area to capture ground dwelling animals. When the field team notified ASOARTESANAS, a full-fledged campaign ensued to find the offending parties. They were found and counseled by the community and that family was invited to join the eco-mochila program. That was the last snare we observed in the forest.

The second report was from an incident where individuals on a bus that had stalled decided to take a walk into the forest with the sole intent of trying to capture animals to sell into the illegal pet trade. There happened to be individuals who were involved in the eco-mochila program who were able to intercept these individuals before any animals were taken from the forest.

These two reports illustrate the ability that our long-term commitment to the conservation of the cotton-top tamarin and the eco-mochila program has had on changing the behavior of local villages from consumers of wildlife and forest products to protector of this precious resource. The commitment to protect the cotton-top tamarin is evident in the village of Los Limites. The village of Los Limites celebrated 50 years of incorporation and, rather than just hold a yearly anniversary celebration, the community created the "Day of the Cotton-top Tamarin Celebration" to honor their commitment to protecting this species and to give thanks for all that Proyecto Tití had helped them to accomplish. It is a day of mutual admiration; a celebration that highlights the plight of the cotton-top tamarin, while demonstrating how cotton-top tamarins are ultimately helping communities prosper. It is now celebrated not only in Los Limites, but also in zoological facilities and schools in Colombia.

The Future

Proyecto Tití and ASOARTESANAS continue to look for new markets to sell our eco-mochilas and share the story our conservation efforts to protect

cotton-top tamarins in Colombia. The program has grown to the point where it has become challenging for the women to store the bags and work from home. In their long-term plan, they have outlined the need for a conservation center, a place where visitors can learn about their commitment to conservation and a place of business where they can come to "work" and store their supplies. As part of the ASOARTESANAS business plan, they have saved money to purchase a small plot of land and Proyecto Tití has worked with them to secure funding to build the first conservation center in the region.

Continuing to invest in the ASOARTESANAS not only empowers a community to take conservation action, but also ultimately helps to conserve some of Colombia's precious wildlife resources. This type of collaborative approach that combines educational programs that increase awareness to the plight of the cotton-top tamarin with opportunities for direct economic benefit results in creating new local champions that are committed to protecting these resources for the future.

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