Can creating sustainable livelihoods with communities impact cotton-top tamarin (Saguinus oedipus) conservation in Colombia?

Lily Maynard1,2 | Anne Savage3 | Johanna Vega4 | Amielle DeWan5 | Leysthen Díaz4 | Zak Gezon2 | Rosamira Guillen4

1Cincinnati Zoo & Botanical Garden, Cincinnati, Ohio
2Disney's Animals, Science, & Environment, Lake Buena Vista, Florida
3Proyecto Tití, Inc., Orlando, Florida
4Fundación Proyecto Tití, Barranquilla, Colombia
5Impact by Design, Takoma Park, Maryland

Correspondence
Lily Maynard, Cincinnati Zoo & Botanical Garden, 3400 Vine St., Cincinnati, Ohio 45220, USA.
Email: lily.maynard@cincinnatizoo.org

Abstract
Conservation and development organizations around the world are increasingly promoting livelihood programs for rural communities as a means of creating sustainable alternatives to activities destructive to remaining wildlife and habitats. In impoverished communities in Colombia adjacent forest patches with critically endangered cotton-top tamarins (Saguinus oedipus), this study evaluates alternative livelihood programs’ impact on participating community members’ income, wellbeing, sustainable resource use, and attitudes about cotton-top tamarin conservation. We surveyed program participants, their neighbors, and members of reference communities nearby for comparison (n = 253). Participants in the alternative livelihood programs had significantly more access to resources and benefits compared to both the non-participating neighbors and people from the reference communities. However, results revealed challenges of scaling up the programs to include more community members. Participants’ attitudes toward sustainable resource use and cotton-top tamarin conservation were not stronger than others who do not receive benefits from the alternative livelihoods programs, and at times were contrary to the conservation goals, revealing a gap in program training for newer participants. Conservation programs using alternative livelihood strategies can apply the lessons learned in our 16 years of implementation and this post hoc evaluation to strengthen the connection between alternative livelihoods and conservation goals.

KEYWORDS
community-based conservation, conservation impact, cotton-top tamarin, human wellbeing, natural resource use, program evaluation, sustainable livelihoods
1 INTRODUCTION

As the global population continues to increase, demands on natural resource extraction are dramatically impacting the long-term survival of wildlife and their habitats. Natural resource depleting activities continue, from the expansion and conversion of natural areas for agriculture, production, and transportation, to the spread of urban development (Miyamoto, 2020). Both urban and rural communities exert pressures that exploit forest resources at an alarming rate, with 10 million hectares of forests destroyed each year across the globe (FAO & UNEP, 2020). Furthermore, over 1 billion people live near to forests and rely on them for sustenance (Muller & Johnson, 2009). As such, rural impoverished communities located near biodiversity hotspots often negatively impact forests and wildlife (Bechtel, 2010; Redford, Levy, Sanderson, & de Sherbinin, 2008). With limited economic options, these vulnerable communities use forests for survival and to create livelihood opportunities from energy collection of firewood or charcoal, gathering food and non-timber forest products, and hunting wildlife for bushmeat for personal or market consumption, as well as sale in the illegal pet trade (Bechtel, 2010). These behaviors, although deemed necessary for survival and human wellbeing, threaten the long-term survival of forests and wildlife and create an unsustainable cycle with rapid declines in natural resource capital.

1.1 Primate conservation and development

Countries in which primates find their native ranges are increasingly threatened by land-use changes driven by global market demands. This, combined with high levels of poverty, income inequality, food insecurity, corruption, and low human development have placed ~65% of primate species threatened with extinction (Estrada, Garber, & Chaudhary, 2020; Redford, Roe, & Sunderland, 2013; Sanderson & Redford, 2003). For Colombia’s endemic primate species, the critically endangered cotton-top tamarin (Saguinus oedipus), extensive habitat loss coupled with the capture for the illegal pet trade has severely reduced the wild populations (Mast, Rodriguez, & Mittermeier, 1993; Miller, Savage, & Giraldo, 2004; Savage et al. 2010, Savage, Guillen, Lamilla, & Soto, 2010; Savage, Thomas, Leighty, Soto, & Medina, 2010; Savage et al., 2016). These direct threats to the survival of cotton-top tamarins combined with more than 27% of the Colombian population living in poverty (World Bank, 2020), and political instability within the historic distribution of cotton-top tamarins provided us with the opportunity to create sustainable livelihood initiatives to support the communities’ needs while facilitating a reduction in threats to cotton-top tamarins. The objective of this study was to evaluate these programs’ impact on participating community members’ income, wellbeing, sustainable resource use, and attitudes about tamarin conservation.

1.2 Conservation programs and sustainable livelihoods

Conservation and development organizations around the world are increasingly promoting livelihood programs for rural communities as a means of creating sustainable alternatives to destructive activities (Wright et al., 2016). Many community-based conservation programs around the world have developed and encouraged local community members to utilize sustainable natural resources and create alternative sources of income (Dudley, Mansourian, Stolton, & Suksuwan, 2008; UNDP, 2013). However, challenges with the scale of local markets and fluctuating supplies seasonally, which can be exacerbated by climate change, make it essential for impoverished communities to maintain a diverse portfolio for survival (Adams et al., 2004; Coomes, 2004; Fisher, Maginnis, Jackson, Barrow, & Jeanrenaud, 2005; USAID, 2017).

Developing effective conservation programs for forests and wildlife requires moving beyond a species focus and addressing the human drivers of threats to wildlife (Nilsson, Fielding, & Dean, 2020). Sustainable development has three interrelated pillars: economic development, social development, and environmental protection (Miller, 2019; Purvis, Mao, & Robinson, 2019). Recognizing the interconnected sociological and ecological features of an ecosystem and the communities within it informs strategic conservation programs (Hariri, Verissimo, & MacMillan, 2015). Sustainable livelihoods, as a means for stakeholder engagement, has been hypothesized to improve conservation outcomes by linking livelihood outcomes to biodiversity (Buchenrieder & Balgah, 2013; Thornton et al., 2020; USAID, 2017). Creating opportunities to connect conservation and sustainable development opportunities may lead to better conservation outcomes if livelihoods can be directly linked to biodiversity (Fisher et al., 2005). This study explores this connection in rural communities in Colombia.

Sustainable livelihood programs can focus on a range of outcomes. First, some conservation programs support alternative livelihoods and engage communities to facilitate buy-in for the programs while promoting positive conservation attitudes within the communities’ norms and culture (Fisher et al., 2005; Savage, Guillen, Vega, & Soto, 2013). These programs advocate for sustainable
livelihoods to encourage local goodwill by generating income and other benefits. Ideally, these programs will develop more benefits than unsustainable behaviors or destructive livelihoods in order to indirectly promote desired conservation outcomes (USAID, 2017). Such community action initiatives first began due to wellbeing issues, with indirect results showing improved conservation conditions and natural resources that benefit both local people and wildlife (Fisher et al., 2005; Pollnac, Crawford, & Gorospe, 2001; UNDP, 2016; West, 2011). Community engagement strategies can utilize education programs to increase knowledge, skills, self-efficacy, and create positive changes linked to conserving species, participatory decision-making processes for community-based conservation, and increased access to resources that assist with food security and stable incomes (Savage et al., 2013).

Alternatively, other conservation enterprises create sustainable livelihoods by directly linking conservation and livelihood outcomes to the product (USAID, 2017). Participants in the livelihood program help to alleviate conservation threats through their participation, as the program connects benefit sharing, community aspirations, and environmental conservation (Kimengsi, Pretzsch, Auch, & Balgah, 2019). Some conservation programs create sustainable extraction programs for non-timber forest products to produce items for sale and reduce destructive logging (Awono et al., 2010; Carr et al., 1993; Jumbe & Angelsen, 2007), while others teach skills to the rural poor that can reduce their demand to consume forest products (Adams et al., 2004; Coomes, 2004; Savage, Giraldo, Soto, & Garcia, 2000; Savage, Soto, & Giraldo, 2000). For example, the African Honey Bee Initiative bolstered rural income through bee farming while halving incidents of forest fires from unsustainable wild honey harvests (Ricketts & Shackleton, 2020). By integrating both people's needs and conservation goals into the planning, both outcomes can be achieved (Thornton et al., 2020).

Communities' values, needs, and preferences must be incorporated into the programs or the sustainable livelihoods may fail to achieve the necessary buy-in and benefit generation (Harihar et al., 2015; Thornton et al., 2020). Effective sustainable development strategies meet at the nexus of the community, economy, and environment to determine quality of life (Miller, 2019). However, conservation programs often fail to incorporate the needs of the poor, rural communities nor support reliable livelihood strategies (Muller & Johnson, 2009). Additionally, many conservation livelihood initiatives are not financially profitable and generate little income benefits (USAID, 2017). Evidence-based analyses of conservation-focused livelihood programs are needed to monitor and improve sustainable livelihood programs' impacts on community attitudes, behaviors, and the target environmental conditions (Sterling et al., 2017). In this study, we conduct an evaluation to assess the effectiveness of sustainable livelihood programs in community-based wildlife conservation.

### 1.3 Program description

Proyecto Titi is a multi-disciplinary conservation program aimed at conserving the cotton-top tamarin in Colombia (Savage, 1997; Savage et al., 2013; Savage, Giraldo, et al., 2000; Savage & Guillon, 2012; Savage, Guillon et al., 2010; Savage, Soto, & Giraldo, 2000; Savage, Thomas et al., 2010). For the past 30 years, Proyecto Titi has worked to protect cotton-top tamarins and their forest home in Colombia through (a) biological and ecological field studies to monitor impacts to the species; (b) protecting and restoring forests to support cotton-top tamarin populations; (c) conservation education programs targeted at rural communities, and (d) sustainable development programs for communities that live near forests where cotton-top tamarins are found.

Proyecto Titi has a long history of working with communities to reduce the use of forest products that are used to maintain livelihoods in rural areas in Colombia. We created opportunities that could provide monetary support and skills building to participants to promote sustainable livelihoods. Proyecto Titi’s community livelihood strategies predicted that by training local community members in skills building and conservation education, then providing communities with alternative income streams, they will reduce their negative impact on the environment and become involved in cotton-top tamarin conservation efforts.

Proyecto Titi’s community income generating programs are varied and are targeted at specific audiences that live near habitat where cotton-top tamarins are found. The programs ranged from (a) Plastic Recycling that enabled income-generation while it was relatively easy to participate in and required a low level of skills training, to (b) Farmer’s Conservation Agreements that promoted sustainable forest management and farming techniques for their agricultural practices, and (c) Artisans’ Programs that promoted learning new skills to create sustainable product (eco-mochilas and plush toys) and manage businesses. For more program details, review the Supporting Information. Several programs were targeted specifically for women, though men were also involved, depending upon the activity and cultural context. As programs linked to tamarin conservation help them meet their daily needs, including food security and wellbeing, we predicted participants will have a more positive attitudes towards conservation and possibly become conservation leaders in their communities.
2 | METHODS

2.1 | Study design

This study was designed to evaluate whether Proyecto Tití's income-generating programs have (a) made a positive difference in supporting livelihoods in target communities and (b) influenced conservation attitudes and practices toward cotton-top tamarins and use of their forest habitat.

A theory of change for each program was created to identify testable assumptions about how programs may lead to short and long-term outcomes (USAID, 2017) and ultimately the goal of reducing threats to cotton-top tamarins and improving their conservation status. For example, the theory of change for the eco-mochila program highlights how participants' increase in skills, income, and attitudes toward conservation leads to a change in wellbeing, empowerment and willingness to commit to conservation actions (Figure 1). Through the steps of participation in this program, participants are predicted to contribute to a reduction in habitat destruction, plastic waste, and the pet trade, followed by positive conservation outcomes for cotton-top tamarins (Figure 1). The theories of change for the additional three programs (e.g., plush toys, plastic recycling, and farmer conservation agreements), are available along with program descriptions in the Supporting Information.

Using the anticipated income and wellbeing outcomes for participants from the theory of change, we wrote a survey instrument to measure respondents' perceptions of the extent to which these metrics increased, remained stable, or decreased in recent years for the program participants. Specifically, respondents answered the question “To what extent have you experienced an increase, decrease, or stable amount of [variables listed in Table 2] in the past few years?” Supportive attitudes toward sustainable resource use and cotton-top tamarin conservation were also expected outcomes from the theory of change. The survey scale measured respondents' agreement, neutrality, or disagreement toward these concepts to evaluate the programs' effectiveness. See Table 2 for variables about sustainable resource use and tamarins used in this study. The 3-point Likert scale used for the survey structured the data for the theory of change indicators and expected outcomes based on respondents' experiences and attitudes. By simplifying the data into high-level categories for levels of change and agreement, we collected comparable data between respondent types to assess any trends across the four different sustainable livelihood programs. Additional qualitative analysis for the programs' evaluation was completed but is not presented here due to the scope of the research question and length of the manuscript. The Supporting Information and Proyecto Tití (2021) have additional information about the programs and the results of this qualitative evaluation.

Data collection included in-person surveys to collect quantitative data from individuals who can be categorized by the following:

- **Participants**: Individuals who are current participants in any of the four community programs.
- **Neighbors**: Individuals in the same community as the Participants who are not involved in the income-generating program.
- **Reference Community**: Responses are from individuals at a comparison site with similar demographics but with no direct Proyecto Tití interventions.
Respondents were selected purposively for the program Participants. Specifically, we conducted census sampling of every current program Participant, though this was dependent on their availability and willingness to participate throughout the data collection period. Respondents in the Neighbor and Reference Community categories were randomly selected via convenience sampling. Target sample sizes were determined using a combination of a representative sampling of total populations (95% confidence level, 5% confidence interval). The survey team traveled in the respective communities and engaged willing participants in the surveys based upon random, convenient encounters until they reached the target sample sizes for the Neighbors and Reference Community.

Surveys were conducted by Proyecto Titi staff trained in conducting survey data collection. Prior to beginning the survey, the data collectors reviewed the informed consent rights of the participants and the adaptive management goals of the evaluation which could only be met by honest and helpful feedback about the programs to improve their efficacy. All surveys were collected in-person and audio recordings were made to ensure the accuracy of coding responses to the questions. We conducted 253 in-person surveys across intervention and comparison sites (Table 1). All respondents ranged from 18 to 65 years of age and had a primary or secondary school education.

2.2 Analysis

Because there was no baseline data for these measures from the beginning of the programs, all inferences are post hoc. To counter the challenges of retrospective questions for program participants, we collected the same data where possible with the Neighbors and Reference Community members as comparison groups. This comparative study design allowed us to determine whether the intervention sites were statistically significantly different in key factors than the control, while also allowing for any maturation effects or changes overtime throughout rural Colombia independent of the program treatments. The survey data was processed in Microsoft Excel and analyzed using chi-square tests for significance to compare scores between the three comparison groups. By comparing each pairing of Participants, Neighbors, and the Reference Community members, we assessed any differences in response patterns for the programs’ impacts predicted by the theories of change (Figure 1; Supporting Information).

3 RESULTS

Participants in the alternative livelihood programs had significantly more access to resources and benefits compared to the non-participants, both their Neighbors and similar others in the Reference Communities (Figure 2). Overall, we saw a significant improvement in the lives of community members versus the Reference Community in 50% of all income and wellbeing aspects investigated. However, respondents’ attitudes toward sustainable resource use and cotton-top tamarin conservation varied across the Participants, Neighbors, and Reference Community members (Figure 3).

3.1 Income

Participants reported significantly more income and steady income in recent years than their non-participating Neighbors in the same community, as well as the control respondents in the similarly sized, Reference Communities (Table 2). The Neighbors and Reference Community members' reported income did not differ from each other.

| Group                              | Number of respondents | Number of female respondents | Number of male respondents |
|------------------------------------|-----------------------|------------------------------|---------------------------|
| Eco-mochila participants           | 46                    | 46                           | 0                         |
| Plush toy participants             | 14                    | 14                           | 0                         |
| Plastic recycling participants     | 13                    | 9                            | 4                         |
| Conservation agreement farmer      | 22                    | 0                            | 22                        |
| Neighbors                          | 58                    | 44                           | 14                        |
| Reference community comparison     | 100                   | 66                           | 34                        |
| Total                              | 253                   | 179                          | 74                        |

TABLE 1 Distribution of respondents by participants of each of the four programs, neighbors, and reference community members
Baseline measures of wellbeing including the number of meals consumed, the ability to buy household items, and access to education did not differ between the Participants and the other groups (Figure 2). Yet, Participants in the alternative livelihood programs reported significantly more access to additional resources for improved wellbeing than those from the Reference Communities, including access to doctors, their ability to help family members, and their ability to buy drinking water (Table 2). Both Participants and Reference Community respondents reported they were significantly more able to invest in new businesses than the Neighbors.

**3.3  |  Sustainable resource use**

Participants of the sustainable livelihood programs reported no increase in the use of resources from the forest in recent years (Figure 2). However, their Neighbors
in the same community reported significantly more forest resource use compared to the Reference Community (Table 2).

Additionally, the importance of moderating the use of forest products was not perceived differently between the groups. Their agreement reinforced the sustainability ethic in the communities (Figure 3).

3.4 | Tamarins

The Reference Community revealed the spread of cotton-top tamarin conservation messages throughout the communities with the sustainable livelihood programs. For example, the Reference Community is significantly less likely to report if they see someone selling a cotton-top tamarin than both the Participants of the livelihood programs and their Neighbors (Table 2). Additionally, the Reference Community reported knowing significantly more people with pet tamarins than the Neighbors, at a similar rate to the livelihood program Participants (Figure 3).

All three groups agreed at similar rates that it is not good for tamarins to be in people's homes (Figure 3). However, Participants in the sustainable livelihood programs reported knowing significantly more people who go into the forest to catch tamarins for the illegal pet trade than the Neighbors or the Reference Community (Table 2).

4 | DISCUSSION

Strategically designed opportunities to promote alternative livelihoods can obviate unsustainable natural resource use while filling the gaps in underserved communities and promoting conservation (Wright et al., 2016). The successes of Proyecto Titi’s four livelihood programs are linked to their design to support Participants’ needs while promoting community-relations and positive attitudes toward conservation. Rather than assuming a substitute livelihood opportunity will automatically motivate participation (Wright et al., 2016), Proyecto Titi engaged communities vulnerable to resource access restrictions as they live next to the forest patches with critically endangered cotton-top tamarins. As such, the farmers’ conservation agreements enhanced Participants’ current livelihoods through increased sustainability.
Alternatively, the artisan programs and plastic recycling provided new sources of income through novel resource processing for customers outside the communities. Overall, these livelihood-focused interventions were successful as they prioritized income and wellbeing while engaging rural Colombians in accessible activities that fit within the local cultural context of acceptable opportunities and roles (Waylen, Fischer, McGowan, Thirgood, & Milner-Gulland, 2010). Furthermore, the programs promoted increased community access to resources and non-cash benefits, which fostered trust and cooperation with Proyecto Titi (USAID, 2017).

### TABLE 2 Chi-square significance test results comparing sustainable livelihood program participants, their neighbors, and reference community members

| Category                  | Question                                      | Participant versus reference community | Participant versus neighbor | Reference community versus neighbors |
|---------------------------|-----------------------------------------------|----------------------------------------|-----------------------------|--------------------------------------|
|                           |                                               | X² | df | p   | X² | df | p   | X² | df | p   | X² | df | p   | Sig |
| Income                    | Increase in income in recent years            | 46.37 | 1 | 9.80E-12  ** | 31.75 | 1 | 1.75E-08  ** | 2.31 | 1 | .13 |
|                           | I have steady sources of income in recent years | 6.19 | 1 | .013  ** | 2.15 | 1 | .14  | 2.01 | 1 | .16 |
| Improved well-being      | Possibility of going to doctor                | 7.08 | 1 | .0078  ** | 15.64 | 1 | 7.67E-05  ** | 2.76 | 1 | .097 |
|                           | Ability to help other family members          | 7.65 | 1 | .0057  ** | 4.26 | 1 | .039  | .87 | 1 | .35 |
|                           | Number of meals consumed                      | 3.47 | 1 | .062  | 3.49 | 1 | .062  | 0.00 | 1 | .98 |
|                           | Ability to buy household items                | 0.26 | 1 | .61  | 1.70 | 1 | .19  | 1.13 | 1 | .29 |
|                           | Access to education for self and family       | 1.64 | 1 | .20  | 0.41 | 1 | .52  | 0.86 | 1 | .35 |
|                           | Ability to purchase school uniforms           | 0.40 | 1 | .53  | 4.20 | 1 | .041  | 3.53 | 1 | .06 |
|                           | Ability to buy drinking water                 | 8.43 | 1 | .0037  ** | 4.28 | 1 | .039  | 1.11 | 1 | .29 |
|                           | Ability to invest in new business             | 0.03 | 1 | .86  | 4.72 | 1 | .029  | 8.59 | 1 | .0034  ** |
| Sustainable resource use  | Use of resources from the forest              | 0.62 | 1 | .43  | 2.90 | 1 | .089  | 6.99 | 1 | .0082  ** |
|                           | Importance of moderating use of forest resources | 0.12 | 1 | .73  | 0.06 | 1 | .81  | 0.02 | 1 | .88 |
| Tamarins                  | It is good for tamarins to be in the home     | 0.24 | 1 | .63  | 0.67 | 1 | .41  | 0.18 | 1 | .67 |
|                           | I know people who have tamarins in their home | 0.11 | 1 | .75  | 2.26 | 1 | .13  | 5.78 | 1 | .016  ** |
|                           | I know people who take tamarins               | 10.00 | 1 | .0016  ** | 16.41 | 1 | 5.10E-05  ** | 0.94 | 1 | .33 |
|                           | If I see someone who is selling a tamarin, I report it | 6.17 | 1 | .013  ** | 0.05 | 1 | .82  | 16.82 | 1 | 4.11E-05  ** |

*p* indicates *p < .05.*

** indicates *p < .00167.*
4.1 Income and wellbeing

Proyecto Titi contributed to significant boosts in income and wellbeing by creating four sustainable livelihood programs with a range of rural community members in Colombia. By diversifying income through new livelihood strategies, impoverished participants face fewer risks and vulnerabilities from access issues or events outside their control (Labao, Naval Jr, Yap, & Yap, 2020). Our evaluation revealed that the sustainable livelihood program women chose to participate in, and how could be a driving factor for which of Proyecto Tití's programs were chosen. The eco-mochila and plush toy businesses had entirely female participants and more women than men participated in plastic recycling. When seeking to alleviate poverty and ecosystem deterioration together through sustainable livelihood programs, women are important community members to prioritize (Gutierrez-Montes, Emery, & Fernandez-Baca, 2012). Women have social, political, ideological, and economic factors that influence their relationship with the environment and conservation programs (Jackson, 1993). Given their role in rural communities and potential vulnerability as the majority of the world’s impoverished, women are more severely impacted than men by environmental degradation (Bechtel, 2010). By supporting women’s financial independence, alternative livelihood programs in developing countries enable local leadership and an innovative, sustainable future for these communities (Raimi et al., 2019).

Furthermore, empowering women to create locally managed enterprises, such as artisanal crafts or farming cooperatives, can provide substantial benefits that challenge the barriers they face, even when total revenues are small (Elliott & Sumba, 2011). In developing countries around the world, women entrepreneurs are becoming more common and are increasingly creating opportunities for independence for themselves and their families through their businesses that often also target social and/or environmental problems in their communities (Bharadia & Panchasara, 2011; Hechavarria, Ingram, Justo, & Terjesen, 2012; Parameshwara, 2011).

Cultural factors of acceptable activities for women could be a driving factor for which of Proyecto Titi’s programs were chosen. The eco-mochila and plush toy businesses had entirely female participants and more women than men participated in plastic recycling. When seeking to alleviate poverty and ecosystem deterioration together through sustainable livelihood programs, women are important community members to prioritize (Gutierrez-Montes, Emery, & Fernandez-Baca, 2012). Women have social, political, ideological, and economic factors that influence their relationship with the environment and conservation programs (Jackson, 1993). Given their role in rural communities and potential vulnerability as the majority of the world’s impoverished, women are more severely impacted than men by environmental degradation (Bechtel, 2010). By supporting women’s financial independence, alternative livelihood programs in developing countries enable local leadership and an innovative, sustainable future for these communities (Raimi et al., 2019).

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Cultural factors of acceptable activities for women could be a driving factor for which of Proyecto Titi’s programs women chose to participate in, and how successful women’s entrepreneurship programs might be in the region. A similar program in Mexico engaged women in new sustainable livelihood opportunities with handicrafts by activating gendered identities that were acceptable in this culture (Radel, 2012). In contrast, community-based conservation programs in other regions have found different divisions of genders involved in the projects. In Kenya, for example, one program found most of the innovative conservation livelihood tasks were performed by men and the women in the community maintained traditional roles and household maintenance (Suda, 2000). Despite some barriers in Colombia like land-ownership by men preventing women from participating in the Farmers’ Conservation Agreements program, Proyecto Titi’s emphasis on women’s participation in the community programs promoted equitable spread of resources throughout the communities. As women determine resource use in the household, conservation programs that prioritize women can lead to significantly greater improvements of the forest conservation efforts compared to other landscapes governed only by men (Agarwal, 2009).

The improved income and indicators of wellbeing (e.g., access to healthcare and education) for the Participants were clear, but they did not spillover into benefits for their Neighbors. Benefit sharing throughout the community beyond direct program participants could reinforce the conservation messages within the programs (Elliott & Sumba, 2011). And yet, despite little spread of benefits, our study found positive and supportive perspectives of tamarin conservation from non-participants and control community members who have no link to the benefits from the programs. Similarly, an evaluation in Ecuador of women-owned tourism businesses found local residents support the businesses as impactful for the overall community, even if they are not employed by the businesses themselves (Beedle, 2011). The good will generated by the programs throughout the community can boost conservation messages.

4.2 Resource use and tamarin conservation

Local community members who are familiar with their ecosystems are best equipped with the knowledge and history to support integrated environmental conservation and sustainable development (Raimi et al., 2019). Across all respondents, the groups responded similarly in disagreement with the idea that it is good for tamarins to be in people’s homes. This pervasive attitude is good news for Proyecto Titi and tamarin conservation, as the pet trade is a major threat to this species (Savage, Guillen, et al., 2010; Savage, Thomas, et al., 2010).

The programs demonstrated some positive impact on cotton-top conservation and forest resource use. The Reference Community is significantly less likely to report if they see someone selling a cotton-top tamarin than both
the Participants and Neighbors; this reinforces the impact Proyecto Tití has had in affecting attitudes toward this behavior. Additionally, the programs enabled the Participants to reduce their use of forest resources in recent years. As the Neighbors confirmed higher levels of forest resource use than the Reference Communities, the demand for forest resources to support their livelihoods is still present in the communities, and Proyecto Tití’s sustainable programs provided viable alternatives that met the Participants’ needs.

However, the connection between alternative livelihood programs and wildlife conservation can be elusive for some Participants if the link is not reinforced. Other sustainable development programs have also struggled to validate the connection between income and conservation outcomes (USAID, 2017). Participants can miss the connection between these initiatives and the benefits they create to their natural resource use behaviors and conservation of wildlife (Wright et al., 2016). Our evaluation of Proyecto Tití’s four programs revealed some gaps between participating in the livelihood programs and understanding the conservation reasoning behind them. For example, program Participants shared that they know significantly more people who capture tamarins from the forest than the Neighbors or Reference Community. Perhaps, they are more aware of this behavior due to their participation in the program, but the significantly higher number of people who know tamarin hunters over their Neighbors suggests the continued presence of this threat to the species in this community. However, they also shared that they agree more strongly that their Neighbors suggests the continued presence of this threat to the species in this community. However, they also agreed that they agree more strongly that they intend to report these individuals compared to the Reference Community. These findings highlight the reasoning for the communities selected for the sustainable development interventions due to the practices of illegal capture of tamarins from the forest in these areas. While we can hope the respondents consistently report these individuals, the potential evidence of continued presence of people threatening cotton-top tamarins suggests the sustainable livelihood programs should continue in these communities to reinforce the connection between income and wellbeing benefits with tamarin conservation.

When creating alternative livelihood programs, we cannot assume they will lead to an increase in conservation behaviors and support for wildlife conservation. For example, the original artisans in the eco-mochila and plush toys programs received training about product creation, business management, and cotton-top tamarin conservation. As a result, these original participants, including the leader of the ASOARTEDESANAS (del Atlantico, 2020), speak openly about tamarin conservation and uphold dual social and environmental entrepreneurship goals (Hechavarria et al., 2012). However, as the programs grew, Proyecto Titi relied on these original artisans to train new Participants. When guiding new community members to join the programs, they primarily focused on training Participants in the skills and the business and not the conservation foundations. Some Participants’ reactions to people capturing tamarins or having them at home are contrary to the conservation intention of the program, which suggests the Participants may be more motivated by the economic and social value created by these programs, than they are about the environmental conservation value that we predicted in this study. We achieved our goal of empowering the women artisans to run their own business, but they did not always pass down the cotton-top tamarin knowledge to new artisans. Participants need ongoing support to connect to the conservation goals of the programs (USAID, 2017).

Complementary education and social marketing programs are needed to guide the community to make these connections. In a similar community livelihood program in Tanzania, women who were trained in weaving handicrafts did not increase their support for marine conservation (West, 2011); without a complementary education program, the women did not understand their role in helping to conserve marine wildlife (West, 2011). Our findings in Colombian communities reinforce the need for guided learning about conservation. Despite the livelihoods programs, the pressure on the wildlife continued without clear conservation logic understood throughout the community (Elliott & Sumba, 2011). As such, community-wide support for tamarin conservation and sustainable resource use from the tropical dry forest were not achieved. We recommend training and education programs continue regularly as long as the livelihood programs continue, in order to maintain these connections and teach new Participants. Furthermore, to ensure conservation good will spreads throughout the community to reach the Neighbors and non-participants, social marketing about the alternative livelihood programs should emphasize conservation behaviors and not just the products of the programs.

Proyecto Titi created a climate for pro-cotton-top conservation in these communities, but livelihood programs did not have direct, long-term conservation behavior training incorporated. Based on these evaluation results, Proyecto Titi has implemented new educational programs for community engagement to create “cotton-top friendly communities.” By ensuring programmatic links between participation and conservation behaviors, more support for cotton-top conservation and the sustainable protection of their tropical dry forest home will be possible.

Proyecto Titi was able to create significant shifts in human wellbeing parameters among their intervention
programs. By starting in areas with long-term field sites and community relationships, the programs were co-created with the community members to fit within the local cultural context. (Adams et al., 2004; Waylen et al., 2010). Future efforts to adapt these programs are considering steps to expand the reach of these efforts and how to bring these benefits to a broader group of individuals in the community. Scalability of the programs is a common issue for livelihood-focused interventions in conservation (Wright et al., 2016). Community ownership of the benefits resulting from the programs can promote scalability, as well as transparent processes for spreading the resources to benefit widespread community members (Elliott & Sumba, 2011). Promoting equity by engaging the poorest community members (Redford et al., 2013), and supporting women's empowerment and reduced discrimination (Macqueen, 2008) are continued foundations for the alternative livelihood programs as they grow. We encourage other conservation organizations considering sustainable livelihood interventions to utilize our evaluation and enhance their impact.

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CONFLICT OF INTEREST
The authors reported no potential conflicts of interest.

AUTHOR CONTRIBUTIONS
Lily Maynard: Conceptualization, methodology, investigation, data curation, analysis, writing—original draft, visualization. Anne Savage: Conceptualization, validation, writing—review & editing, supervision. Johanna Vega: Conceptualization, methodology, validation, investigation, data curation, writing—review & editing. Amielle DeWan: Conceptualization, methodology, investigation, data curation, analysis, writing—review & editing, supervision. Leysthen Diaz: Investigation, data collection, data curation. Zak Gezon: Data curation, statistical analysis, writing—review & editing. Rosamira Guillen: Conceptualization, validation, writing—review & editing, supervision.

DATA AVAILABILITY STATEMENT
No data are publicly shared with this study, but additional qualitative details can be found in the Supporting Information.

ETHICS STATEMENT
The research presented in this article was approved by the Institutional Review Board at the first author’s organization.

ORCID
Lily Maynard https://orcid.org/0000-0003-0443-1580
Anne Savage https://orcid.org/0000-0002-4738-8490

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**SUPPORTING INFORMATION**

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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