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Promoting long-term local ownership of natural heritage through outreach: the case of the endemic Bolivian titi monkeys

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Acknowledgements

We thank the National Directorate for the Protection of Biodiversity and the Institute of Ecology for their help in acquiring necessary research permits. Special thanks to the municipal and education authorities, cattle ranching sector, students, local media, and people of the Santa Rosa del Yacuma and Los Santos Reyes municipalities for their collaboration in the outreach activities. We thank Rebeca Rivero, Silvia Ten, and the entire staff of the Biodiversity and Environment Research Centre (CIBIOMA) for their collaboration on the Trinidad banners exhibition. Thanks to Dr. Patrice Adret for his amazing work to obtain the high-quality video footage of the Bolivian titi monkeys, to Edson (Kayo) Gonzales and Eduardo (Lalo) Fernandez) for their assistance during filming efforts, and to the Nogales family for providing access to ranches to observe the titi monkeys.

Keywords: conservation, schoolchildren, knowledge, learning, protected areas

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Abstract

Adequate knowledge and learning about local biodiversity are a prerequisite for effective attitudinal changes in favour of species protection. Outreach activities are considered a useful tool for sharing information with local stakeholders who play a crucial role in conserving wildlife. We conducted two outreach campaigns focused on schoolchildren in two villages to share information on the natural history of the Bolivian endemic titi monkeys, *Plecturocebus olallae* and *Plecturocebus modestus*, to promote their conservation. We assessed the students' ability to retain new information and their understanding of biodiversity through pre- and post-questionnaires, finding an improvement in the knowledge about these two endemic primates from pre- to post-talk assessments, as well as an increase in their awareness about local efforts to preserve biodiversity between outreach campaigns. We also found signals of appropriate experiential learning on wildlife value and its relationship with human activities. Additional outreach work across two decades resulted in important achievements that reflect positive attitudinal changes in favour of the endemic primates and biodiversity, with a remarkable involvement of local people. In this way, we show how outreach work can promote important local support for biodiversity conservation, how primates can act as flagship species, and the need to reinforce knowledge acquisition and learning processes to consolidate conservation actions in the long-term.

Keywords: conservation, schoolchildren, knowledge, learning, protected areas

Introduction

The loss of biodiversity and natural habitats, such as primates and the forests they inhabit, has increased in the last two decades due to more intense human activities (Boyle, 2014; Estrada et al., 2017). Important advances on generating natural history information on wildlife species have been demanded and achieved, helping to better understand their conservation requirements (Hoffman and O'Riain 2012; Casse and Milhøj, 2013; Nowak and Lee 2013; McLennan et al., 2017; Strum, 2019). Nevertheless, the knowledge generated usually does not reach local actors despite their crucial role in the implementation of conservation actions (Jacobson, 2015; Farwig et al., 2017; Chapman & Peres, 2021).

Following Bloom's taxonomy of educational objectives, the first step for learning is to acquire a basic knowledge on a topic, by means of memorizing facts and figures, which can be assessed by the ability to recognize, identify, define, and recall key elements (Bloom 1956, Anderson et al., 2001). The accomplishment of this step facilitates higher learning levels including evaluation and creation, which in turn can help ensure the desired outcomes from the entire learning process such as attitude change (Anderson et al., 2001; Kuhar et al., 2010). In addition, learning through practical experiences on a given subject generates important criteria for attitude change and this approach has shown great efficiency in the implementation of active learning methods (Balestri et al., 2023). If we consider how an individual interacts with their natural environment, certain practical experiences might be linked to new knowledge and serve to identify higher levels of learning. Thus, by knowing and understanding appropriately the information generated from biodiversity research and conservation initiatives local people could identify themselves with local biodiversity, transforming them into crucial actors for required actions to preserve their natural heritage (Vásquez, 2017; Anderson et al., 2001; Balestri et al., 2023).

A strategic way to share research knowledge is the implementation of awareness-raising activities that can start as informative talks in small meetings, or specific campaigns ranging from broad talks to distinct audiences, including the design and development of a variety of educational materials, to the promotion of environmental education processes (Méndez-Carvajal et al., 2013; Jacobson, 2015; Vásquez, 2017; Van de Wetering et al., 2022). These actions have been included in outreach and education activities for South American primate species such as the Proyecto Mono Tocón in Peru (*Plecturocebus oenanthe*, Gaultier et al., 2015), the Proyecto Tití in Colombia (*Saguinus leucopus*, Bairrão & Wormell, 2012), and the Proyecto Tití Bicolor in Brazil (*Saguinus bicolor*, Gordo et al., 2013), obtaining valuable experience and achievements reflected in how local people were incorporated into several activities of the respective research and conservation projects.

In Bolivia, a project started in 2002 aimed to promote the conservation of the two endemic primate species, Olalla's titi monkey (*Plecturocebus olallae*, Critically Endangered - IUCN) and the Beni titi monkey (*Plecturocebus modestus*, Endangered - IUCN). Research revealed important information on their natural history which established their conservation status and helped better understand their ecological requirements (Wallace et al., 2013; Martinez et al., 2015; Martinez & Wallace, 2021a,b; Martinez et al., 2022a,b). These primates are restricted to the western side of the Llanos de Moxos region, inhabiting an

area of naturally fragmented forests immersed in a grassland matrix where livestock farming is the main economic activity (Martinez & Wallace, 2007, 2021a, 2021b; Wallace et al., 2013). Conservation actions to preserve the populations of these two threatened primate species prioritized the active engagement of local people. The variety of local stakeholders prioritized included indigenous and rural communities, cattle ranchers, public and community authorities, and the educative sector, made the dissemination of information into a significant challenge despite expected high valuations of biodiversity conservation due to their close and constant interaction with wildlife. Nevertheless, ecotourism is the second most important economic activity in the region (GAMSR 2017, GAMR 2021) which created a scenario where local people might be receptive to biodiversity conservation information oriented towards promoting their support for conservation actions for the endemic titi monkeys as an exclusive local natural patrimony, as well as the forests they inhabit.

To promote the required local support for the conservation of the Bolivian endemic and threatened titi monkeys we conducted outreach activities to share the knowledge generated about their natural history. Thus, we present the results of two outreach campaigns focused on schoolchildren with the aim of assessing their technical knowledge retention on conservation through pre- and post-informative talks and questionnaires to assess their understanding level regarding biodiversity conservation. Considering that the information received in the information talks affects the students' level of knowledge, we expected better results in the post-talk questionnaire. Also, as experience is considered an effective way of learning, we expected that students will be able to correctly identify distinct local conservation aspects independently from the outreach campaigns. We also present the results of several complementary outreach activities we conducted to reach a broader audience, aiming to raise awareness on the presence and conservation needs of the endemic titi monkeys as a distinctive patrimony for the region. We share our experience to inspire more people to conduct similar efforts on primate conservation to contribute towards the preservation of tropical forest habitats and the biodiversity they harbour.

Methods

Study area

Since 2009 we conducted outreach activities primarily in the Santa Rosa and Reyes towns which are the capitals of the Santa Rosa del Yacuma and Los Santos Reyes municipalities, respectively. These two municipalities include most of the distribution areas of *P. olallae* and *P. modestus* (Figure 1; Wallace et al., 2013, GAMSR 2017, GAMR 2021), and these towns concentrate around 70% of their respective total human population (4727 habitants in Santa Rosa and 7202 habitants in Reyes, GAMSR 2017, GAMR 2021). We noticed from direct observation, and further confirmation from local people, that the economic activities in the region linked to cattle ranching and tourism are field-based activities, promoting close contact with wildlife. For this reason, we hypothesized the existence of a general knowledge on wildlife in schoolchildren which could be assessed. We also conducted complementary activities in Trinidad, the Beni Department capital city (figure 1), whose inhabitants follow a similar movement pattern to wilderness areas and are likely to have visited the Santa Rosa and Reyes municipalities.

Data collection

Previous contact with local authorities facilitated the primate research activities since 2004 and served as a background to identify strategic potential collaborators to implement the outreach activities in both municipalities. Distinct authorities were then contacted to coordinate distinct outreach activities (table 1), including the educative and culture departments of municipalities, as well as schools' principals, to explain the proposed outreach activities. We did this to involve as many local stakeholders as possible in all activities to increase the probabilities of success of planned tasks, as well as to promote local ownership of them, and to acquire permissions to conduct the project tasks.

Knowledge assessment of school students

We conducted two assessment campaigns focused on schools. We agreed with school principals to spend around 2 hours interacting with different groups of students from distinct levels, so as to reach as many students as possible. Although we aimed to reach a similar number of students in the different survey sessions conducted, differences in the overall number of students between years, as well as unexpected activities scheduled in educational units at the time when our team visited the schools prevented this from being fully achieved. Despite these limitations, we tried to reach as many children as possible in each survey session.

a) Campaign 1

Between 2011 and 2012, we visited five schools in Santa Rosa and the seven schools in Reyes (hereafter Campaign 1). In August 2011, we obtained information anonymously from the students using a brief structured questionnaire that was distributed among them in each visited classroom, reading each question to explain, and providing sufficient time to respond. The questionnaire consisted of five questions aimed to assess the students' knowledge and understanding about local biodiversity, including the endemic titi monkeys, and local efforts to preserve nature. The first three questions were intended to provide correct or wrong responses (yes/no and names), while the last two questions were multiple choice options:

- *Q1. Protected Areas are places where nature is protected. Do you know if there is a Protected Area in this Municipality?*
- *Q2. There are two monkey species who live only in this area and are not present in any other part of the world. Do you know who they are?*
- *Q3. Have you observed the titi monkeys?*
- *Q4. Which of these activities negatively affect forests and the life forms they hold?*
    - *a) Cattle ranching, b) Crops (farming), c) Tourism, d) Forest care, e) Forest or savannah burning, f) Wood extraction, g) Other, h) None*
- *Q5. Complete the sentence on the benefits related to the titi monkeys. The titi monkeys can:*
    - *a) Maintain the forest, b) Raid crops, c) Be a tourism attraction, d) Be pets, e) Other, f) None*

After finishing the questionnaire activity, we used the remaining time with the children to provide them with an informative talk about biodiversity and primate species in Bolivia, emphasizing the endemism concept to introduce the two endemic species of titi monkeys present in the region. Starting from morphological features, all the information available

regarding the biology, ecology, and conservation status of *P. olallae* and *P. modestus* was shared with the students. Special emphasis was placed on the diagnostic morphological features to identify each species, due to their external similarity, as well as their distribution restriction. We followed a participative modality using audiovisual material to show all the information to facilitate content comprehension. The schools were visited again between April and May 2012, applying the same questionnaire to assess the students' knowledge retention regarding the talks carried out in 2011. A complementary brief clarification talk was provided to each group of students after the assessment session.

b) Campaign 2

We visited the same towns again in May 2019 for another outreach effort (hereafter Campaign 2). Considering the time after the previous campaign and that data were collected anonymously, this new visit focused on a distinct audience of children. In addition, this visit was related to a project with distinct objectives and logistics and time limitations made it not possible to reach as broad an audience as in Campaign 1. Therefore, we were only able to work with students in their final years of high school.

We followed the same work style as in the first visit, using the same questionnaire applied and providing similar informative talks to the students. Thus, we shared updated information on the natural history and conservation of the two Bolivian endemic titi monkey species. In October 2019, we visited the towns again to conduct the post-talk assessment and provide a brief clarification talk as in Campaign 1.

Additional outreach activities

In addition to these specific outreach campaigns, we conducted complementary activities oriented to raise awareness on local people about the Bolivian endemic titi monkeys. Since 2004 sporadic informative talks were provided mainly to local municipal and community authorities to share the knowledge being generated through research activities. To reinforce this activity, in 2009 we developed a poster or each species including a large schematic drawing of them to clearly show the distinguishing morphological features, as well as photos of wild titi monkeys and a locally appropriate conservation message (appendix 1a). This material was distributed in public offices and commercial sites in the Reyes and Santa Rosa towns, as well as to community representatives, aiming to inform as many people as possible about the presence of the two endemic titi monkey species.

When visiting the schools in 2011, we complimented the informative talks provided to primary students with a role exchange dynamic to better explain the habitat loss threat to the endemic titi monkeys. In this activity, the forest areas were represented as circles on the ground where some children representing the titi monkeys were situated. Other children represented different threats to forests (e.g. deforestation, uncontrolled fires, and roads) and reduced the forest areas by marking them, which in some cases had children (titi monkeys). Then, we counted how many children (titi monkeys) lost their trees, and how many managed to survive. At the end of the game, a reflection was made on how the titi monkeys and other animals can lose their homes and how they cope with different threats to biodiversity.

At the end of the talks in the schools, we gave each student a notebook with images of the titi monkeys on the covers. We also handed out a CD containing a documentary video

about all the research done on these endemic primates, including supporting bibliography. This last material was given to the teachers of each course, so that they could show it to the students during natural science classes (appendix 1b).

To increase the sense of ownership and responsibility among the local population towards the endemics *P. olallae* and *P. modestus*, we developed a documentary video between 2012 and 2013 from high resolution footage on their behaviour, to show their natural history, threats and conservation needs in a friendly and didactic way for all types of audiences. In 2014 the video was presented and distributed to authorities of the Reyes and Santa Rosa municipalities (https://www.youtube.com/watch?v=MOG5YWB-LUc). Later in 2022, this material was updated based on new information from research activities on both titi monkey species and shared with local authorities to be broadcasted in the region (https://www.youtube.com/watch?v=w6uDveoOMcs).

We identified an opportunity to share information on the Bolivian endemic titi monkeys in Trinidad, the Department capital city, by means of a strategic contact with the Biodiversity and Environment Research Centre (CIBIOMA) of the Autonomous Beni's University (UAB). We worked together with CIBIOMA in the design and implementation of an exhibition of banners showing their biology, ecology, and conservation (appendix 1c). We also provided information about the Bolivian endemic titi monkeys to the exhibit staff so that they can respond appropriately to questions from the public. The exhibition was inaugurated in April 2015 and is permanently open to the public.

Data analysis

We assessed the response variations between pre-talk and post-talk questionnaires according to each campaign conducted, as well as between towns. We used Generalized Linear Mixed Models (GLMM) for the comparison of correct answers (questions 1 – 3) or inclusion of terms (questions 4 – 5), considering pre/post responses (binomial variable), campaign, and town as factors including their interactions, as well as students age as a covariate. As each questionnaire is a datum, the use of GLMM enabled us to deal with sample size differences between survey sessions. We ran pairwise contrasts by means of a Bonferroni-Holm post hoc correction. We conducted all the analyses in the R software (v. 4.3.1), using the packages "glmmTMB" and "emmeans", considering a significance level of $p = 0.05$.

We summarized the results obtained for additional outreach activities with descriptive data. Thus, we provide a general and complete context on the activities conducted during both outreach campaigns in the two main towns.

Results

Knowledge assessment of school students

We obtained 3649 questionnaires in the two outreach campaigns (table 2). In Campaign 1, we assessed 1329 and 1693 students from pre- and post-talk questionnaires, respectively, corresponding to 12 educative units. There were 381 pre-talk questionnaires and 246 post-talk ones in Campaign 2, from 11 schools.

Regarding the results for the first three questions on the questionnaire (Q1 – Q3, figure 2, table 3), we found an overall higher number of correct responses in students from Santa

Rosa than Reyes (P<0.001 in all the cases), and no meaningful interaction effects of towns and campaigns on pre- and post-talk results. We found more correct answers about the existence of municipal protected areas (Q1) in Campaign 2 (P<0.001), in pre-talk assessment (P=0.021), and in older students (P<0.001) (figure 2). Pre- and post-talk results for this question varied between campaigns (P<0.001) with a decrease in correct responses from pre- to post-talk assessment in Campaign 1, while there was an increase in Campaign 2 (figure 2). In both campaigns there were more correct responses in Santa Rosa than in Reyes (figure 2), while pre- and post-talk results show no significant variations between towns.

Regarding Q2 and Q3 (figure 2, table 3), we found more correct responses on the existence of endemic primates in the region in Campaign 1 (P=0.011), in post-talk assessment (P<0.001), and in older students (P=0.012); while more reports of direct contact with them were also found in post-talk assessment (P<0.001) but in Campaign 2 (P<0.001) and in younger students (P=0.007). We found more correct responses on the existence of the endemic titi monkeys and reports of direct interactions with them in Santa Rosa than in Reyes during Campaign 2 (P=0.004 and P=0.002, respectively), while in Campaign 1 the differences were smaller. The increase of correct responses and reports of direct interactions from pre- to post-talk results was clearer in Campaign 1 for both questions (P<0.001 in both cases). A similar increase was also clearer in Reyes than in Santa Rosa for Q2 (P<0.001), but there were no significant variations between towns for Q3.

From question 4, we found that natural habitat (forest and savannah) burning (48.59%, n=2694) and wood extraction (33.18%, n=2024) were the main human activities identified as causing negative effects on biodiversity, while the other activities such as cattle ranching, crops (farming), and tourism accounted for about 6% or less in the responses. These top two human activities were identified significantly more in the second outreach campaign (habitat burning P =0.027, wood extraction P =0.001) (figure 3, table 4) and were more frequently mentioned by older students (habitat burning P <0.001, wood extraction P =0.003). For natural habitat burning, we found a clear increase from pre- to post-talk results in Campaign 2, while this did not occur in Campaign 1 (P =0.015). Wood extraction was more frequently identified in Reyes than in Santa Rosa (P =0.016), and more in the post-talk assessment (P =0.009), while its identification increased from pre- to post-talk results in both towns and campaigns, except by Santa Rosa for Campaign 2 where the opposite occurred (P =0.019). Variations between towns were not significant for this activity between campaigns.

Regarding the benefits that the Bolivian endemic titi monkeys could provide (question 5, figure 4, table 5), their help in maintaining the forest (28.59%, n=1160), and their role as a tourism attraction (20.21%, n=2037) were the most frequent students' responses. Being pets was mentioned by a 11.17% of students (n=453), and other aspects such as raiding crops accounted for around 5% or less. The two main benefits were more reported in the post- than in the pre-talk results (P<0.001 in both cases). While titi monkeys were considered beneficial for forests more frequently in Reyes and by younger students, they were more recognized as tourism attraction by older students and in Santa Rosa (P<0.001 in all the cases). We found more reports of titi monkeys as beneficial for forests in

Campaign 2 (P<0.001), and their role as tourism attractions increased from pre- to post-talk in Reyes but decreased in Santa Rosa (P=0.003).

Additional outreach activities

The distribution of the outreach material covered all the audience types present in the towns. The posters designed in 2009 were placed by inhabitants in schools, public offices, and commercial places, helping to reach the entire population and foreign visitors with a brief but clear information on the exclusive presence of the two primate species in the region. Notebooks were highly appreciated by students as they exposed them to the Bolivian endemic titi monkeys in a close way. The informative CD was also welcomed by teachers as they contained key bibliographic references on the research activities and a documentary video that could be shared with the students with information of the endemic titi monkeys' natural history and associated interviews with relevant local people, including authorities.

The role exchange dynamic applied with young students was well received by them and even observing older students and their teachers were interested on this leaning dynamic. During Campaign 1, young students expressed their concern on how they could call the two titi monkey species apart from using the scientific names, usually difficult to remember and/or pronounce. The name 'lucachi', is a generic local name for any titi monkey species and students suggested to combine this with an easy diagnostic morphological feature to help on differentiate *P. olallae* from *P. modestus*. Thus, students themselves suggested the name of 'reddish lucachi' (lucachi rojizo) for *P. olallae*, and 'ashy lucachi' (lucachi cenizo) for *P. modestus* due to their non-uniform greyish fur coloration. Subsequently, it was decided to promote the implementation of both names suggested by schoolchildren to further identify the two endemic titi monkeys. These names were used on the banners for the exhibition in Trinidad (appendix 1c).

The CIBIOMA banner exhibition reached large numbers of people in the Department capital city of Trinidad. Through the outreach program open to the public, but aimed to receive schoolchildren visits, there were >90,000 visitors to the exhibition of the Bolivian endemic titi monkeys between 2016 and 2023. It is remarkable that attendance to this exhibition has maintained a constant high level with a recent increase related to the upgrade of the exhibition area with updated information provided on the titi monkeys (Figure 5).

Unexpectedly, from the talks provided, teachers and school principals suggested the organization of fairs to improve the effectiveness of the outreach Campaign 1. We found great collaboration and initiative from teachers and municipalities that worked with remarkable efficiency to organize a public fair in each municipality which included different competitions. The municipal authorities showed high commitment with these activities not only helping with the assignment and preparation of a public space for the fairs (the main town squares), but also with the official calls and prizes which provided a formal framework to the initiative. Thus, a fair was conducted in October 2011 in Santa Rosa and September 2012 in Reyes, in which the students presented different artwork allusive to the endemic titi monkeys such as drawings, songs, poems, and theatrical performances; all of them including conservation messages for these primates and the local biodiversity. This led to a massive attendance of people to the fairs where students' work served to spread the

information on the Bolivian endemic titi monkeys, as well as the need to conserve them and the entire regional biodiversity (appendix 2a).

The documentary video showing several aspects of the endemic titi monkeys' behaviour was well received by local people as it provided a close perspective on the lives of these primates, while its high-resolution quality made it even more visually appealing. This material was presented in each town in meetings with the presence of municipal and education authorities. The videos were also broadcast on local television channels to promote support from the local audience for biodiversity conservation in the municipal protected areas.

Another result derived from our outreach activities, was the local support for the creation of two municipal protected areas (MPA): Pampas del Yacuma in Santa Rosa Municipality (2007), and Los Santos Reyes in Reyes Municipality (2008). In both cases, municipal authorities and the private sector were aware of the presence of the endemic primates as an exclusive natural patrimony of the western Beni Department, which greatly facilitated the establishment of the conservation areas. The two MPA's aim to consolidate ecotourism in the region thereby highlighting the natural wealth that represents the main attraction. Later in 2019, an update process of the Reyes MPA resulted in the creation of the Rhukanrhuka MPA, a name which means 'titi monkey' in the Maropa Indigenous language, reflecting the protagonism of the endemic titi monkeys in the local population.

Immediately after Campaign 1, local people promoted the incorporation of the titi monkeys in local symbology (appendix 2b). Thus, a titi monkey drawing representing both endemic species was included in the logos of the Pampas del Yacuma and Los Santos Reyes MPA in 2009, in the revised Rhukanrhuka MPA in 2022, and in the new shield of Santa Rosa Municipality in October 2012. The municipalities also promoted the establishment of paintings and sculptures of titi monkeys in the most iconic places of each town (e.g. main squares, touristic areas) together other local representative wildlife.

Our outreach work received significant media coverage including radio and television interviews in local media and the broadcast of conservation messages by the students (at the end of the school visits) in Santa Rosa and Reyes (appendix 2c). The media also provided coverage during talks, material distribution, and meetings, and extensive coverage during the fairs which helped on reach even more people in the region with information on the Bolivian titi monkeys and the conservation of their forest habitat. The Santa Rosa del Yacuma Municipality granted us a space in the 2011 anniversary magazine to talk about the endemic monkeys, and other department and national press media also reported our work, enabling us to reach a wider audience (appendix 2d). In addition, information on the titi monkeys as flagship species for the regional biodiversity conservation has been shared internationally (appendix 2e).

In 2021, Bolivia's endemic monkey conservation program won first place in the Natural Resources category of the National Science and Technology Award granted by the Bolivian government. This is a national recognition of the overall conservation program initiated in 2002, including outreach activities that are a crucial part of the entire program.

Discussion

Given that acquiring sufficient knowledge is fundamental to promoting accurate learning about a particular subject (Bloom, 1956; Anderson et al., 2001), our findings demonstrate the effectiveness of outreach activities in enhancing knowledge levels and interest in biodiversity conservation. We observed a general improvement in the students' knowledge about the presence of the Bolivian endemics *P. olallae* and *P. modestus* from pre- to post-talk assessments and a higher awareness about the municipal protected areas from the first to the second outreach campaign. We also found indicators suggesting an appropriate learning of students about the interactions between human activities and biodiversity, as well as the role of some wildlife species. Complementarily, there were additional positive results to those expected from our additional outreach activities, as well as other outreach actions promoted by the same local actors to whom information was provided. Thus, we observed how the outreach work together with local knowledge and experience can effectively promote attitudinal changes (Bloom, 1956; Anderson et al., 2001; Kuhar et al., 2010). However, despite the progress observed in the local knowledge and the learning towards conserving Bolivia's endemic primates and their habitat, students' knowledge about local conservation efforts need to be consolidated by means of long-term outreach programs to ensure the success of further biodiversity conservation actions.

Although local people knew about the presence of titi monkeys in the western department of Beni when WCS research began in 2004, they were unaware that there were two species, let alone that both were endemic to the region. The local population's partial lack of knowledge of distinctive wildlife elements has also been observed in other endemic and threatened primate species in Brazil (*Saguinus bicolor*, Gordo et al., 2013), Colombia (*Saguinus leucopus*, Bairrão and Wormell, 2012), Peru (*Plecturocebus oenanthe*, Gaultier et al., 2015), and even with lemurs whose endemism to Madagascar was locally unknown (Dolins et al., 2010; Balestri et al., 2017). In our case, this could be due to the very low level of interaction by residents with individuals of *P. olallae* and *P. modestus*, as they do not raid crops or are a source of food like other primate species (Martinez and Wallace, 2007; Wallace et al., 2013). Furthermore, distribution surveys conducted between 2004 and 2006 found that a significant proportion of the local population had difficulty identifying these primates visually, with vocalisations being the most distinctive feature used to detect their presence (Martinez and Wallace, 2007).

Our results suggest a negative relationship between students' age and direct interaction with the titi monkeys, may be because children no longer engage in outdoor recreational activities as they get older, reducing local awareness on the morphological details of the titi monkey species. Although it was expected that the local population will interact more closely with wildlife, the observation of these species can be particularly challenging due to their cryptic behaviour and the dense vegetation found in their habitat (Martinez and Wallace, 2007, 2010; Bicca-Marquez and Heymann, 2013). Moreover, local understanding of biological and ecological concepts such as endemism, biodiversity and conservation may be limited, making it difficult to understand their relevance. In this sense, the shared knowledge served as an important contact for schoolchildren and local people with these important technical aspects for biodiversity conservation, which should be continuously reinforced (Brooks et al. 2006, Balestri et al., 2017). The information provided on the taxonomic identity, biology, and ecology of *P. olallae* and *P. modestus*, as well as different conservation concepts, has contributed to increasing the local population's knowledge of

the biodiversity with which they interact, thereby promoting their support for its conservation.

Although we observed an initial lack of technical knowledge about the municipal protected areas as local efforts for biodiversity conservation, the students' perception of conservation seems quite realistic as they correctly identified human activities that threat nature such as the burning of natural habitat and timber extraction. The increase of correct identifications of the most threatening human activities between outreach campaigns might be related to the additional outreach activities we conducted to improve the local knowledge on conservation threats to forest habitats, but also with the students' direct experience given the better results in older students. In addition, the students' questionnaires reflected a general adequate understanding of the fundamental value of wildlife, as they recognised the role of the titi monkeys in maintaining the forests and their potential as tourist attractions. Overall, this seems to reflect an adequate level of knowledge and understanding on the topic based on direct experience (Balestri et al., 2017, 2023), which should be translated into actions aimed at better management of natural resources.

Considering that ecotourism can contribute to the conservation of biodiversity (Schwitzer et al., 2014), the identification of Bolivian endemic titi monkeys as a potential tourist attraction demonstrates the students' understanding of this activity and its benefits to the environment, as well as the impact of ecotourism on the local population. Our results suggest that older students, as well as students in Santa Rosa, are more likely to recognize the tourism value of titi monkeys over their ecological role in forest habitats, which seems more valued in Reyes and by younger students. This finding reflects the long-term tourism activity in Santa Rosa del Yacuma municipality, providing economic benefits and information on biodiversity to society, while Reyes is working to reach a similar status. This finding is also reflected in the overall better results of Santa Rosa students to the first three questions. Nevertheless, a misperception of the economic benefits of tourism activities must be avoided as it could marginalise the primary objective of biodiversity conservation, leading to a misguided and unsustainable tourism activity (Wright et al., 2014; Balestri et al., 2017). Currently, community-based enterprises are promoting tourism focused on the endemic Bolivian titi monkeys in both municipalities, aiming to raise local awareness of biodiversity conservations and to generate economic benefits while minimising environmental impacts, following the most recommendable tourism approach regarding economic and natural sustainability (Neudert et al., 2016).

In general, we found a positive retention of knowledge acquired by students after several months of receiving information during each outreach campaign, but also between them with better responses in general found in the second campaign. Long-term retention capacity has been reported in other similar evaluations (Rakotomamonjy, et al., 2015; Richter et al., 2015; Balestri et al., 2017) and is an important reference for future awareness-raising activities aimed at promoting attitudinal changes based on appropriate learning (Bloom, 1956; Anderson et al., 2001). Regarding the information transfer, potential language and cultural differences between senders and receivers represent an important barrier (Wallis and Londsdor, 2010). In this respect, the fact that all dissemination and awareness-raising activities were conducted by a team of Bolivians and in the same language as the audience (Spanish) may have positively influenced the knowledge transfer and retention observed in the questionnaires. The lack of groups with a different

local language facilitated our work, but also highlights the importance of using translators when necessary to ensure effective transfer of information and avoid significant bias in evaluations.

Despite the limitations to collect a similar amount of data from the questionnaires between the dissemination campaigns, the results obtained are encouraging. As a new activity type, carried out in collaboration with the municipal and educational authorities of Reyes and Santa Rosa, various logistical aspects were a challenge. Also, because the work with students was part of another project, the second campaign had a much smaller sample size than the first one. Despite the above context, we expected better results in the second campaign because of the different dissemination activities carried out after the first campaign. Moreover, the amount of time between the two outreach campaigns suggests that students of the second campaign may have received information on the titi monkeys and biodiversity from the additional outreach activities as opposed to the talks during the first campaign. The improved knowledge we found in students in the second campaign shows the relevance of the additional outreach activities promoting important changes in local people attitudes towards their support to biodiversity conservation, although their impact was not quantitatively assessed. This also highlights the need for permanent awareness-raising and educational programmes on local biodiversity, including the endemic titi monkeys, to ensure adequate and constant technical knowledge in favour of conservation of the local natural heritage (Padua, 2010; Kuhar et al., 2010; Erhabor and Don, 2016).

Obtaining an adequate level of knowledge about a topic is a fundamental step in the process of changing attitudes and improving communication, as this promotes empathy or ownership towards the subject of interest, facilitating the expected changes towards the pursued objective (Anderson et al., 2001; Jenks et al., 2010; Kuhar et al., 2010). Since 2004, our work with students and the recurrent complementary activities has led to an increase in knowledge among the local population, resulting in a strong commitment to the conservation of the Bolivian endemic titi monkeys, which has facilitated the achievement of several conservation goals such as the creation of the two municipal protected areas. This result can be considered an overall success reflecting the relevance of regular outreach work for a long period of time. However, we must not ignore the need for a local outreach, communication, and environmental education programme to consolidate higher learning stages and ensure substantial long-term achievements in favour of the biodiversity in the Reyes and Santa Rosa del Yacuma municipalities (Blooms 1956; Anderson et al., 2001; Jenks et al., 2010; Balestri et al., 2017). The observed understanding of biodiversity conservation needs in students based on their day-to-day experience observing the interaction of wildlife and human activities, suggests potential success of active learning processes that could help to ensure the success of this recommendation (Balestri et al., 2023).

The primary objective of environmental outreach activities is to effectively promote wildlife conservation, which can be measured both quantitatively and qualitatively. Thus, in table 2 we provide a simple qualitative self-evaluation for distinct aspects of our project. Firstly, we achieved a high level of success in the design of our outreach activities, successfully accomplishing the tasks conceived with the objective of sharing information on endemic titi monkeys with a high level of collaboration from key local stakeholders. However, the

overall success in both the design and implementation phases was hampered by the design conditions of the second campaign, which was smaller in scale than the first. About short-term outputs, the pre- and post-talk questionnaires were successful in reflecting a significant level of knowledge retention among the students. Furthermore, the establishment of the municipal protected areas is a significant normative achievement for the regional biodiversity conservation. Although we did not aim to promote eco-friendly human activities, we did take the opportunity to highlight the value of tourism in the area as an ecologically sustainable local development alternative.

Among the long-term achievements (table 6), the increased local knowledge about the existence of two endangered primate species endemic to the western Beni department represents a complete success of the outreach activities we have carried out. This is not only related to the work done in the region inhabited by these endemic and threatened primates, but the successful permanent exhibition in Trinidad is also an invaluable addition to the scope of our outreach work. The validity of this knowledge is demonstrated by the actions taken by various local actors over the years, such as including the endemic primates in the local symbology and their increased value for the municipal protected areas, including the name of Rhukanrhuka. Moreover, the presence of the endemic lucachis acting as flagship species for the conservation of local biodiversity influenced in the recognition received by the National Tourist Destination Rurrenabaque Madidi Pampas to be listed among the 100 best destinations for ecotourism by Green Destinations in 2022.

Our activities have facilitated the understanding of the relationship between primates and forests, and both endemic titi monkey species were incorporated into the zoning of the municipal protected areas, with implications for further development of environmentally friendly activities. Also, although the main threat to endemic titi monkeys is forest habitat loss, we have shared information with local people on commercial hunting and illegal trade to facilitate specific initiatives in the municipal protected areas. Moreover, the good relationship established with local stakeholders has facilitated the expansion of the Wildlife Conservation Society's efforts with a new conservation programme focused on the vast region of the Llanos de Moxos (Llanos de Moxos Biocultural Landscape), which includes the distributional range of *P. olallae* and *P. modestus* and aims to benefit other wildlife species.

The above activities are the first outreach initiative undertaken in Bolivia for the conservation of primate species and their habitats. Through our work, we have been able to reveal the potential of outreach activities to promote biodiversity conservation and to confirm that primates can be effective flagship species for conservation (Chapman et al., 2020). In this way, we hope that similar work focused on primates can be used to build local stakeholder support for the conservation of forest habitats through increased knowledge of their importance, thereby generating support for the establishment of ecologically sustainable development initiatives.

Acknowledgements

We thank the National Directorate for the Protection of Biodiversity and the Institute of Ecology for their help in acquiring necessary research permits. Special thanks to the municipal and education authorities, cattle ranching sector, students, local media, and

people of the Santa Rosa del Yacuma and Los Santos Reyes municipalities for their collaboration in the outreach activities. We thank Rebeca Rivero, Silvia Ten, and the entire staff of the Biodiversity and Environment Research Centre (CIBIOMA) for their collaboration on the Trinidad banners exhibition. Thanks to Dr. Patrice Adret for his amazing work to obtain the high-quality video footage of the Bolivian titi monkeys, to Edson (Kayo) Gonzales and Eduardo (Lalo) Fernandez) for their assistance during filming efforts, and to the Nogales family for providing access to ranches to observe the titi monkeys.

Statement of ethics

We conducted our research in accordance with national and international laws regulating the protection of endangered species. We obtained consent of local authorities and relevant actors before conducting our work.

Conflicts of interest

The authors have no conflicts of interest to declare.

Funding sources

This work was financed by the Wildlife Conservation Society, Gordon and Betty Moore Foundation, BP Conservation Leadership Programme, Primate Conservation Inc, Conservation International Primate Action Fund, PUMA Foundation, Margot Marsh Biodiversity Foundation, Rainforest Trust Foundation, and the International Primatological Society.

Author contributions

In addition to the tasks listed below, JM organized the data and co-wrote the manuscript. RW, ZP, PC, CFT, CJ, HLS, LL conceived the research, conducted the project activities, organized the data, and co-wrote the manuscript. MC conducted the statistical analyses, provided the related outputs and figures, and co-wrote the manuscript.

Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

References

Anderson LW, Krathwohl DR, Bloom BS (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York, Longman.

Balestri M, Campera M, Nekaris KAI, Donati G (2017). Assessment of long-term retention of environmental education lessons given to teachers in rural areas of Madagascar. *Applied Environmental Education & Communication* 16:(4), 298-311. https://doi.org/10.1080/1533015X.2017.1348275.

Balestri M, Campera M, Budiadi B, Imron MA, Nekaris KAI (2023). Active learning increases knowledge and understanding of wildlife friendly farming in middle school

627 students in Java, Indonesia. *Knowledge* 3: 401–413.
628 https://doi.org/10.3390/knowledge3030027

629 Boyle S (2014). Pitheciids in fragmented habitats: land cover change and its implications
630 for conservation. *American Journal of Primatology* 78(5):534-49.
631 https://doi.org/10.1002/ajp.22325.

632 Bairrão RE, Wormell D (2012). The international conservation programme for the White-
633 footed tamarin *Saguinus leucopus* in Colombia. *International Zoo Yearbook* 46(1): 46-
634 55. https://doi.org/10.1002/ajp.23431

635 Bicca-Marques JC, Heymann EW (2013). Ecology and behavior of titi monkeys (genus
636 *Callicebus*). In *Evolutionary biology and conservation of titis, sakis and uacaris* (Veiga
637 LM, Barnett AA, Ferrari SF, Norconk MA, eds.), pp. 196–207. Cambridge, Cambridge
638 University Press.

639 Bloom BS (1956). *Taxonomy of educational objectives: The classification of educational*
640 *goals: Handbook I, Cognitive domain*. New York, McKay.

641 Brooks TM, Mittermeier RA, da Fonseca GAB, Gerlach J, Hoffmann M, Lamoreux JF,
642 Mittermeier CG, Pilgrim JD, Rodrigues ASL (2006). Global biodiversity conservation
643 priorities. *Science* 313(5783): 58–61. https://doi.org/10.1126/science.1127609.

644 Casse T, Milhøj A (2013). While waiting for the answer: a critical review of meta-studies of
645 tropical forest management. *Journal of Environmental Management* 131: 334–342.

646 Chapman CA, Peres CA (2021). Primate conservation: Lessons learned in the last 20
647 years can guide future efforts. *Evolutionary Anthropology: Issues, News, and Reviews*
648 30(5):345-361. https://doi.org/10.1002/evan.21920.

649 Chapman CA, Bicca-Marques JC, Dunham AE, Fan P, Fashing PJ, Gogarten JF, Guo S,
650 Huffman MA, Kalbitzer U, Li B, Ma C, Matsuda I, Omeja PA, Sarkar D, Sengupta R,
651 Serio-Silva JC, Tsuji Y, Stenseth NC (2020). Primates can be a rallying symbol to
652 promote tropical forest restoration. *Folia Primatologica* 91:669–687.

653 Dolins FL, Jolly A, Rasamimanana H, Ratsimbazafy J, Feistner A, Ravoavy F (2010).
654 Conservation education in Madagascar: Three case studies in the biologically diverse
655 islandcontinent. *American Journal of Primatolology* 72(5): 391–406.
656 https://doi.org/10.1002/ajp.20779.

657 Erhabor NI, Don JU (2016). Impact of environmental education on the knowledge and
658 attitude of students towards the environment. *International Journal of Environmental*
659 *and Science Education* 11(12): 5367–5375.

660 Estrada A, Garber PA, Rylands AB, Roos C, Fernandez-Duque E, Di Fiore A, Nekaris KAI,
661 Nijman V, Heymann EW, Lambert JE, Rovero F, Barelli C, Setchell JM, Gillespie TR,
662 Mittermeier RA, Arregoitia LV, de Guinea M, Gou-veia S, Dobrovolski R, Shanee S,
663 Boyle SA, Fuentes A, MacKinnon KC, Amato KR, Meyer ALS, Wich S, Sussman RW,
664 Pan R, Kone I, Li B (2017). Impending extinction crisis of the world's primates: why
665 primates matter. *Science Advances* 3:e1600946.

Farwig N, Ammer C, Annighöfer P, Baur B, Behringer D, Diekötter T, Hotes S, Leyer I, Müller J, Peter F, Riecken U, Bessel A, Thorn S, Werk K, Ziegenhagen B (2017). Bridging science and practice in conservation: Deficits and challenges from a research perspective. *Basic and Applied Ecology* 24:1-8. https://doi.org/10.1016/j.baae.2017.08.007.

Gobierno Autónomo Municipal de Santa Rosa del Yacuma (GAMSRY) (2017). *Plan de Manejo del Área Protegida Municipal Pampas del Yacuma (Resumen Ejecutivo)*. Beni-Bolivia, GAM Santa Rosa del Yacuma y WCS-Bolivia.

Gobierno Autónomo Municipal de Los Santos Reyes (GAMR) (2021). *Plan de Manejo Área Protegida Municipal Rhukanrhuka*. La Paz-Bolivia, Wildlife Conservation Society.

Gaultier A, Huashuayo-Llamocca R, Boveda-Penalba A, Vermeer J (2015). Le Proyecto Mono Tocon: recherche, éducation et conservation, au Pérou. *Revue de primatologie* (6). https://doi.org/10.4000/primatologie.2335.

Gordo M, Calleia FO, Vasconcelos SA, Leite JJ, Ferrari SF (2013). The challenges of survival in a concrete jungle: conservation of the pied tamarin (*Saguinus bicolor*) in the urban landscape of Manaus, Brazil. In *Primates in fragments: Complexity and resilience, Development in primatology: progress and prospects* (Marsh LK, Chapman CA, eds.), pp. 357-370. New York, Springer Science.

Jacobson SK, McDuff MD, Monroe MC (2015). *Conservation education and outreach techniques*. Oxford, Oxford University Press.

Jenks B, Vaughan PW, Butler PJ (2010). The evolution of rare pride: Using evaluation to drive adaptive management in a biodiversity conservation organization. *Evaluation and Program Planning* 33(2):186–190.

Hoffman TS, O'Riain MJ (2012). Landscape requirements of a primate population in a human dominated environment. *Frontiers in Zoology* 9:1–17.

Kuhar CW, Bettinger TL, Lehnhardt K, Osuo T, Cox D (2010). Evaluating for longterm impact of an environmental education program at the Kalinzu Forest Reserve, Uganda. *American Journal of Primatology* 72(5):407–413.

Martinez J, Wallace RB, Arnez A, Barreta J, Carvajal P, Domic E, Flores-Turdera C, Jurado C, Lopez L, Lopez-Strauss H, Morrison L, Porcel Z, Reinaga A, Siles T (2015). Línea base para la conservación de los monos lucachi endémicos de Bolivia: *Callicebus olallae* y *C. modestus*. *Revista Científica Agrociencias Amazonía* 5:1-11.

Martinez J, Wallace RB (2007). Further notes on the distribution of endemic Bolivian titi monkeys, *Callicebus modestus* and *Callicebus olallae*. *Neotropical Primates* 14:47–54.

Martinez J, Wallace RB (2010). Pitheciidae. In *Distribución, ecología y conservación de los mamíferos medianos y grandes de Bolivia* (Wallace RB, Gómez H, Porcel ZR, Rumiz DI, eds.), pp. 305–330. Santa Cruz-Bolivia, Centro de Ecología Difusión Simón I. Patiño.

Martinez J, Wallace RB (2021a). *Plecturocebus modestus*. The IUCN Red List of Threatened Species 2021: e.T41550A17972778. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T41550A17972778.en. Downloaded on 03 December 2023.

Martinez J, Wallace RB (2021b). *Plecturocebus olallae*. The IUCN Red List of Threatened Species 2021: e.T3554A17975516. https://dx.doi.org/10.2305/IUCN.UK.2021-1.RLTS.T3554A17975516.en. Downloaded on 03 December 2023.

Martinez J, Wallace RB, Domic E, López L, Nekaris KAI (2022a). Seasonal ecological flexibility of a threatened Bolivian Endemic: Olalla's titi monkey (*Plecturocebus olallae*). *International Journal of Primatology*, https://doi.org/10.1007/s10764-021-00276-6.

Martinez J, Wallace RB, Domic E, Carvajal P, Arnez A, Morrison L, Nekaris KAI (2022b). Feeding ecology of the Beni titi monkey (*Plecturocebus modestus*): an endangered Bolivian endemic. *International Journal of Primatology*, https://doi.org/10.1007/s10764-022-00306-x.

McLennan MR, Spagnoletti N, Hockings KJ (2017). The implications of primate behavioral flexibility for sustainable human–primate coexistence in anthropogenic habitats. *International Journal of Primatology* 38:105–121.

Méndez-Carvajal PG, Ruiz-Bernard I, De León G, González Y, Miranda E, Loría L, Berguido G, Cortes A, Soto E (2013). Activities towards primate conservation in Panama. *Wildlife Biology in Practice* 9(2):91-97. https://doi.org/10.2461/wbp.2013.9.10.

Neudert R, Ganzhorn JU, Watzold F (2016). Global benefits and local costs–The dilemma of forest conservation: A review of the situation in Madagascar. *Environmental Conservation* 44(1):1–15. https://doi.org/10.1017/S0376892916000552.

Nowak K, Lee PC (2013). "Specialist" primates can be flexible in response to habitat alteration. In *Primates in fragments: Complexity and resilience, Development in primatology: progress and prospects* (Marsh LK, Chapman CA, eds.), pp. 199-211. New York, Springer Science.

Padua SM (2010). Primate conservation: Integrating communities through environmental education programs. *American Journal of Primatology* 72(5):450–453. https://doi.org/10.1002/ajp.20766.

Rakotomamonjy SN, Jones JPG, Razafimanahaka JH, Ramamonjisoa B, Williams SJ (2015). The effects of environmental education on children's and parents' knowledge and attitudes towards lemurs in rural Madagascar. *Animal Conservation* 18(2):157–166. https://doi.org/10.1111/acv.12153.

Richter T, Rendigs A, Maminirina CP (2015). Conservation messages in speech bubbles - Evaluation of an environmental education comic distributed in elementary schools in Madagascar. *Sustainability* 7(7):8855–8880. https://doi.org/10.3390/su7078855.

Schwitzer C, Mittermeier RA, Johnson SE, Donati G, Irwin M, Peacock H, Ratsimbazafy J, Razafindramanana J, Louis JrEE, Chikhi L, Colquhoun IC, Tinsman J, Dolch R,

LaFleur M, Nash S, Patel E, Randrianambinina B, Rasolofoharivelo T, Wright PC (2014). Averting lemur extinctions amid Madagascar's political crisis. *Science* 343(6173):842–843. https://doi.org/10.1126/science.1245783.

Souza-Alves JP, Boyle SA, Barnett AA (2023). Knowledge shortfalls for titi monkey: a poorly known clade of small-bodied South American primates. *Biological Conservation* 286:110256. https://doi.org/10.1016/j.biocon.2023.110256.

Strum SC (2019). Why natural history is important to (primate) science: a baboon case study. *International Journal of Primatology* 40:596–612.

Van de Wetering J, Leijten P, Spitzer J, Thomaes S (2022). Does environmental education benefit environmental outcomes in children and adolescents? A meta-analysis. *Journal of Environmental Psychology* 81:101782. https://doi.org/10.1016/j.jenvp.2022.101782.

Vásquez N (2017). *Comprometa-monos, una herramienta de educación ambiental para la conservación de primates en Colombia*. BSc dissertation, Universidad El Bosque.

Wallace, R.B., J. Martinez, H. López-Strauss, J. Barreta, A. Reinaga & L. López. 2013. Conservation challenges facing two threatened endemic titi monkeys in a naturally fragmented Bolivian forest. In *Primates in fragments: Complexity and resilience, Development in primatology: progress and prospects* (Marsh LK, Chapman CA, eds.), pp. 493-501. New York, Springer Science.

Wallis J, Lonsdorf EV (2010). Summary of recommendations for primate conservation education programs. *American Journal of Primatology* 72(5):441–444. https://doi.org/10.1002/ajp.20764.

Wright PC, Andriamihaja B, King SJ, Guerriero J, Hubbard J (2014). Lemurs and tourism in Ranomafana National Park, Madagascar: Economic boom and other consequences. In *Primate tourism: A tool for conservation?* (Russon AE, Wallis J, eds.), pp. 123–146. Cambridge, Cambridge University Press.

Figure 1. Location of the Santa Rosa and Reyes towns and the Trinidad city with respect to the distributional ranges of *Plecturocebus olallae* and *Plecturocebus modestus* and the municipal protected areas (MPA) Pampas del Yacuma and Rhukanrhuka in the Beni Department.

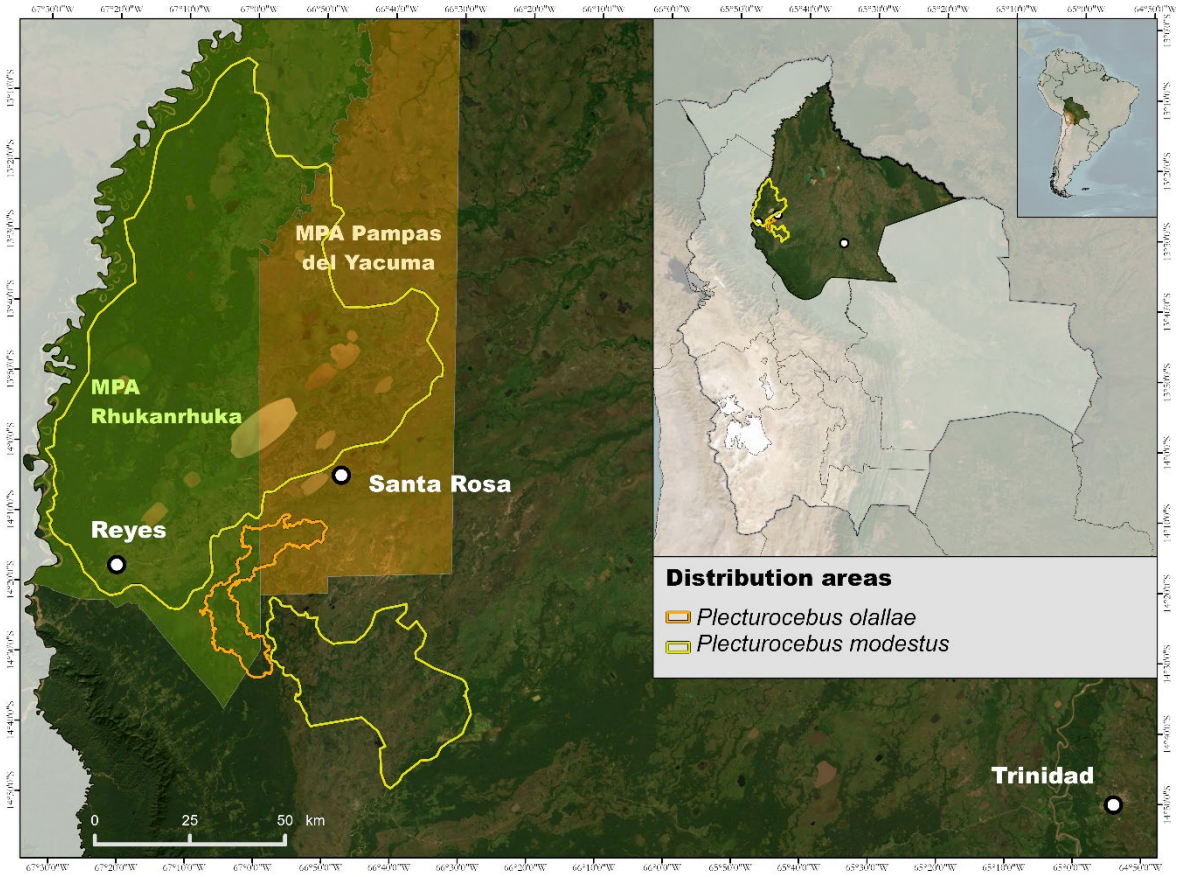
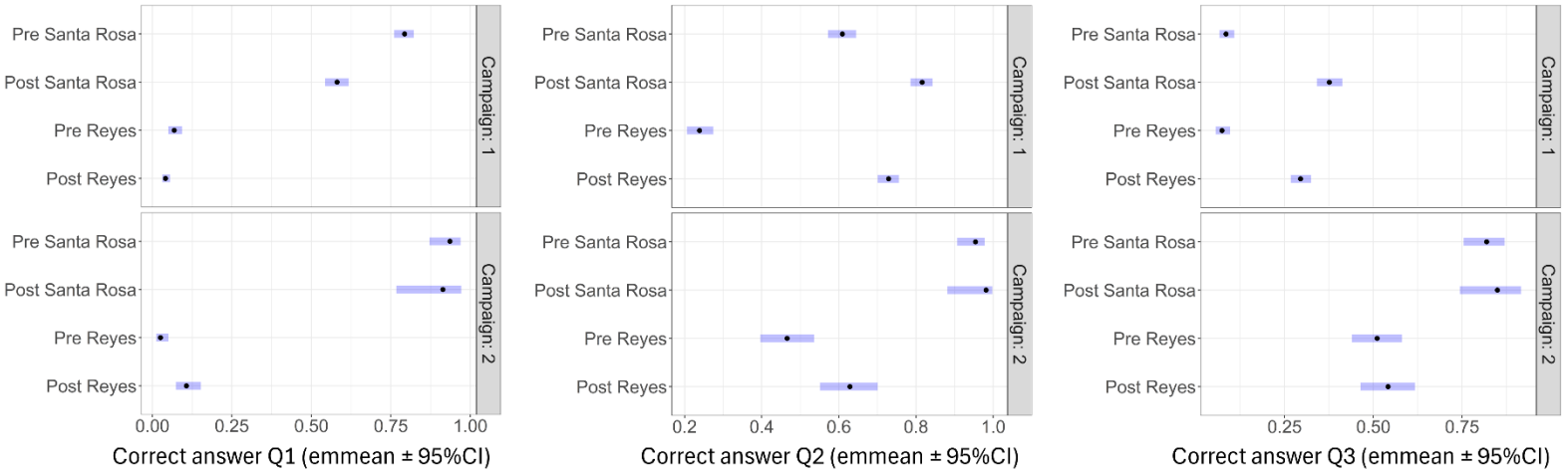


Figure 2. Variations in correct responses of school students to the first three questions of the questionnaire, according to pre- and post-talk assessment, outreach campaigns, and



towns.

Figure 3. Variations in the two main human activities negatively affecting biodiversity identified by students according to pre- and post-talk assessment, outreach campaigns, and towns.

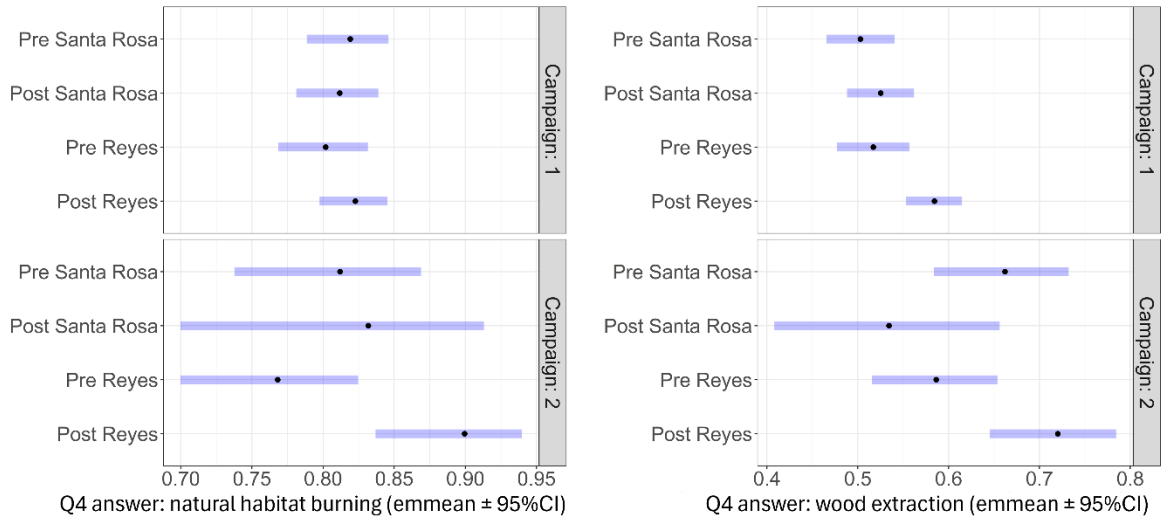


Figure 4. Variations in the two main benefits attributed to titi monkeys by students according to pre- and post-talk assessment, outreach campaigns, and towns.

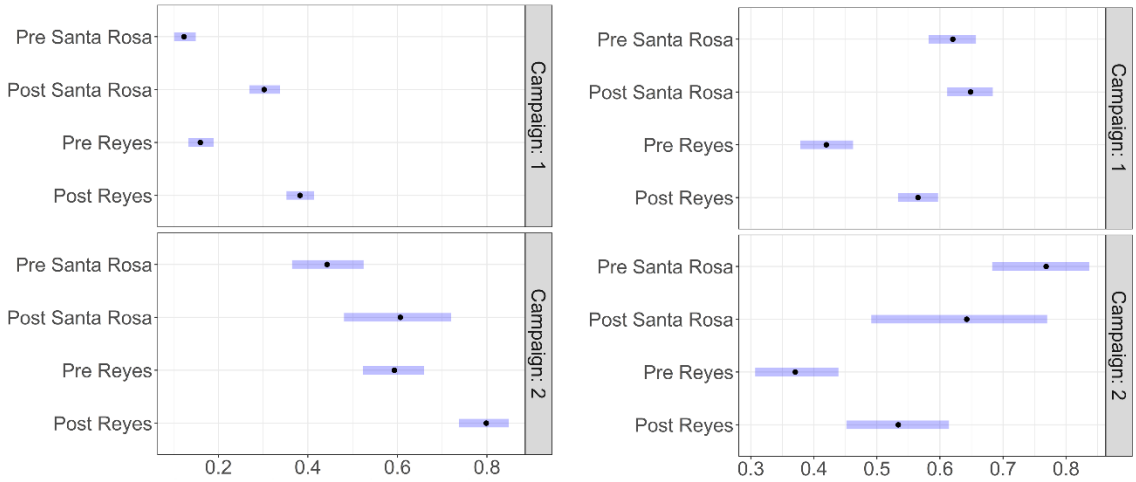


Figure 5. Number of national and international visitors per year to the exhibition of the Bolivian endemic titi monkeys in the Biodiversity and Environment Research Centre (CIBIOMA) of the Autonomous Beni's University (UAB).

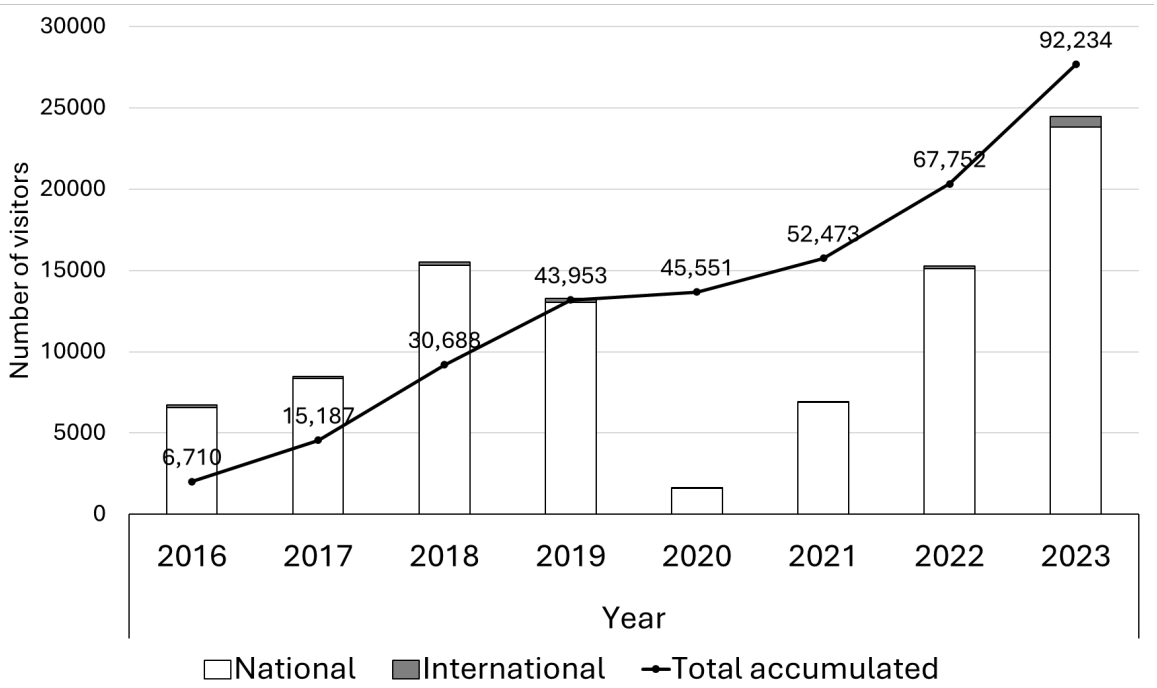


Table 1. Timeline showing how the distinct outreach work to promote the conservation of the Bolivian endemic titi monkeys was conducted.

Activities	Sub activity	Year																			
		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Outreach campaigns	Campaign 1								X	X											
	Campaign 2																X				
Additional outreach activities	Sporadic informative talks	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Posters						X														
	Informative CD									X											
	Fairs								X	X											
	Banner exhibition												X	X	X	X	X	X	X	X	X
	Documentary video									X	X	X					X	X	X		
	Inclusion of titi monkeys in protected areas logos and other local symbology						X			X										X	

796

Table 2. Number of pre- and post-talk questionnaires obtained from students of the distinct educative units visited in the two outreach campaigns carried out in 2011-2012 and 2019.

Campaign	Town	School name	Pre	Post	Total
1	Reyes	Adolfo Rodriguez Castedo	90	126	216
		Humberto Safade Sánchez	77	63	140
		Jesús Álvarez Rodriguez	122	135	257
		Monseñor Alfonso Tscherrig	169	227	396
		Nacional Reyes	44	318	362
		René Barrientos Ortuño - Fe y alegría	96	47	143
	Santa Rosa	San Silvestre	44	73	117
		Elma Asbun de Simon	100	121	221
		Gerardo Reyes	66	142	208
		Germán Bush Becerra	251	262	513
		Santa Rosa I	151	95	246
		Umbelina Claure de Cuellar	119	84	203
	Total 1		**1329**	**1693**	**3022**
2	Reyes	Adolfo Rodriguez Castedo	15	12	27
		Humberto Safade Sánchez	24	7	31
		Jesús Álvarez Rodriguez	19	21	40
		Monseñor Alfonso Tscherrig	37	39	76
		Nacional Reyes	71	65	136
		René Barrientos Ortuño - Fe y alegría	23	6	29
	Santa Rosa	San Silvestre	22	33	55
		Elma Asbun de Simon	18	3	21
		Gerardo Reyes	-	34	34
		Germán Busch Becerra	113	26	139
		Santa Rosa I	39	-	39
	Total 2		**381**	**246**	**627**
TOTAL			**1710**	**1939**	**3649**

Table 3. Estimates for the GLMMs with correct answers to questions 1-3 as response variables.

Question	Factor[a]	Estimate	Std. Error	Z-value	p-value
Q1: Protected Areas are places where nature is protected. Do you know if there is a Protected Area in this Municipality?	Intercept	-5.960	0.377	-15.799	<0.001
	Campaign	1.026	0.256	4.010	**<0.001**
	Town	3.474	0.177	19.652	**<0.001**
	Pre/post	0.537	0.233	2.306	**0.021**
	Age	0.198	0.023	8.614	**<0.001**
	Campaign*Town	1.008	0.648	1.555	0.120
	Campaign*Pre/post	-2.064	0.472	-4.378	**<0.001**
	Town*Pre/post	0.480	0.261	1.836	0.066
	Campaign*Town*Pre/post	1.368	0.858	1.594	0.111
Q2: There are two monkey species who live only in this area and are not present in any other part of the world. Do you know who they are?	Intercept	0.363	0.256	1.421	0.155
	Campaign	-0.463	0.181	-2.561	**0.011**
	Town	0.500	0.120	4.153	**<0.001**
	Pre/post	-2.150	0.120	-17.965	**<0.001**
	Age	0.044	0.018	2.500	**0.012**
	Campaign*Town	2.958	1.027	2.879	**0.004**
	Campaign*Pre/post	1.486	0.241	6.177	**<0.001**
	Town*Pre/post	1.104	0.173	6.402	**<0.001**
	Campaign*Town*Pre/post	-1.389	1.113	-1.248	0.212
Q3: Have you observed the titi monkeys?	Intercept	-0.104	0.286	-0.362	0.717
	Campaign	1.038	0.176	5.909	**<0.001**
	Town	0.365	0.104	3.495	**<0.001**
	Pre/post	-1.660	0.164	-10.111	**<0.001**
	Age	-0.054	0.020	-2.716	**0.007**
	Campaign*Town	1.199	0.379	3.168	**0.002**
	Campaign*Pre/post	1.535	0.260	5.897	**<0.001**
	Town*Pre/post	-0.212	0.226	-0.939	0.348
	Campaign*Town*Pre/post	0.116	0.489	0.237	0.812

[a] reference category: campaign (2); Town (Santa Rosa); Pre/post (Pre).

805 **Table 4.** Estimates for the GLMMs for the main responses to question 4 on the main
806 human activities identified causing negative effects on biodiversity.

Response	Factor[a]	Estimate	Std. Error	Z-value	p-value
Forest/savanna burning	Intercept	0.091	0.289	0.320	0.749
	Campaign	**0.657**	**0.298**	**2.208**	**0.027**
	Town	-0.074	0.126	-0.582	0.560
	Pre/post	-0.137	0.128	-1.065	0.287
	Age	**0.101**	**0.020**	**5.031**	**<0.001**
	Campaign* Town	-0.520	0.487	-1.068	0.286
	Campaign*Pre/post	**-0.857**	**0.352**	**-2.435**	**0.015**
	Town *Pre/post	0.186	0.187	0.996	0.319
	Campaign* Town *Pre/post	0.672	0.576	1.166	0.243
Wood extraction	Intercept	-0.311	0.228	-1.364	0.172
	Campaign	**0.604**	**0.189**	**3.204**	**0.001**
	Town	**-0.240**	**0.099**	**-2.414**	**0.016**
	Pre/post	**-0.273**	**0.104**	**-2.623**	**0.009**
	Age	**0.0459**	**0.016**	**2.937**	**0.003**
	Campaign* Town	-0.568	0.322	-1.761	0.078
	Campaign*Pre/post	-0.324	0.245	-1.323	0.186
	Town *Pre/post	0.183	0.149	1.228	0.219
	Campaign* Town *Pre/post	**0.948**	**0.405**	**2.340**	**0.019**

807 [a] reference category: campaign (2); town (Santa Rosa); Pre/post (Pre).

808

Table 5. Estimates for the GLMMs for the main responses to question 5 on the benefits that the Bolivian endemic titi monkeys provide.

Response	Factor[a]	Estimate	Std. Error	Z-value	p-value
Maintain the forest	**Intercept**	**1.538**	**0.269**	**5.724**	**<0.001**
	Campaign	**1.856**	**0.189**	**9.804**	**<0.001**
	Town	**-0.357**	**0.105**	**-3.385**	**<0.001**
	Pre/post	**-1.182**	**0.124**	**-9.543**	**<0.001**
	Age	**-0.142**	**0.019**	**-7.575**	**<0.001**
	Campaign* Town	-0.587	0.320	-1.832	0.067
	Campaign*Pre/post	0.182	0.249	0.732	0.464
	Town *Pre/post	0.056	0.185	0.300	0.764
	Campaign* Town *Pre/post	0.282	0.414	0.681	0.496
Be a tourism attraction	**Intercept**	**-3.093**	**0.247**	**-12.544**	**<0.001**
	Campaign	-0.127	0.182	-0.694	0.487
	Town	**0.351**	**0.104**	**3.372**	**<0.001**
	Pre/post	**-0.586**	**0.109**	**-5.370**	**<0.001**
	Age	**0.236**	**0.017**	**13.828**	**<0.001**
	Campaign*Town	0.100	0.367	0.273	0.785
	Campaign*Pre/post	-0.080	0.240	-0.331	0.740
	City*Pre/post	**0.464**	**0.157**	**2.948**	**0.003**
	Campaign* Town *Pre/post	0.814	0.464	1.753	0.080

[a] reference category: campaign (2); town (Santa Rosa); Pre/post (Pre).

Table 6. Self-assessment of the project success (scores from 1 least success, to 5 high success) according to distinct indicators for each stage of the project.

Stage	Indicator	Success
Design	Two rounds of informative talks to students of Reyes and Santa Rosa for each outreach campaign to be conducted	4
	Development of outreach materials	5
	Dynamics for informative talks in schools	5
Implementation	Proportion of planned informative talks effectively conducted	4
	Assessment of information retention by schoolchildren	5
Short-term outcome	Pre- and post-talk questionnaires	5
	Approval of normative for wildlife conservation	5
	Increase knowledge on eco-friendly practices	1
Long-term outcome	Increase knowledge regarding both species of monkeys	5
	Actions carried out by local actors regarding the conservation of biological diversity of the site	5
	Involvement of regional actors in outreach activities	5
	Region-wide implementation of eco-friendly practices	3
	Reduction in hunting and pet trading	2

Appendix 1.

1a. Design of the two posters on *Plecturocebus olallae* and *Plecturocebus modestus* distributed to local people in 2009.

1b. Didactic support material about the Bolivian endemic titi monkeys used and distributed in outreach activities with students.

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Los Lucachis Endémicos
del Beni
WILDLIFE CONSERVATION SOCIETY
CONSERVATION INTERNATIONAL
Primate Action Fund
Primate Conservation, Inc.

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PRIMATES DE BOLIVIA

1c. Banners designed for the permanent exhibition about the Bolivian endemic titi monkeys in the CIBIOMA interactive museum in Trinidad.

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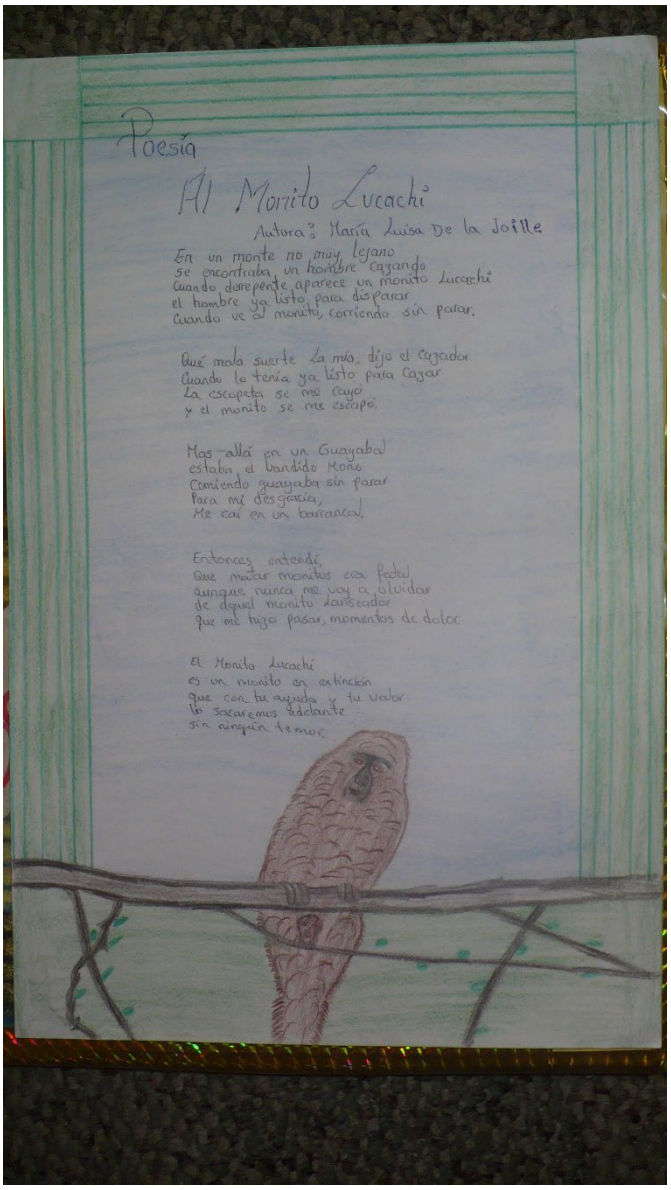
Appendix 2.

2a. Students' participation and their artwork exhibited during the fairs organized in the Reyes and Santa Rosa towns.


NO
LINGÜÍSTICA

841



Poesía

Al Monito Lucachi

Autora: María Luisa De la Jolle

En un monte no muy lejano
se encontraba un hombre cazando
Cuando de repente aparece un monito Lucachi
el hombre ya listo para disparar
Cuando ve al monito, corriendo sin parar.

Qué mala suerte la mía, dijo el cazador
Cuando lo tenía ya listo para cazar
La escopeta se me cayó
y el monito se me escapó.

Mas allá en un Guayabal
estaba el bandido Moño
Comiendo guayaba sin parar
Para mi desgracia,
Me caí en un barranco.

Entonces entendí
Que matar monitos era fatal
aunque nunca me voy a olvidar
de aquel monito Lanseador
que me hizo pasar momentos de dolor

El Monito Lucachi
es un monito en extinción
que con tu ayuda y tu valor
lo sacaremos adelante
sin ningún temor.

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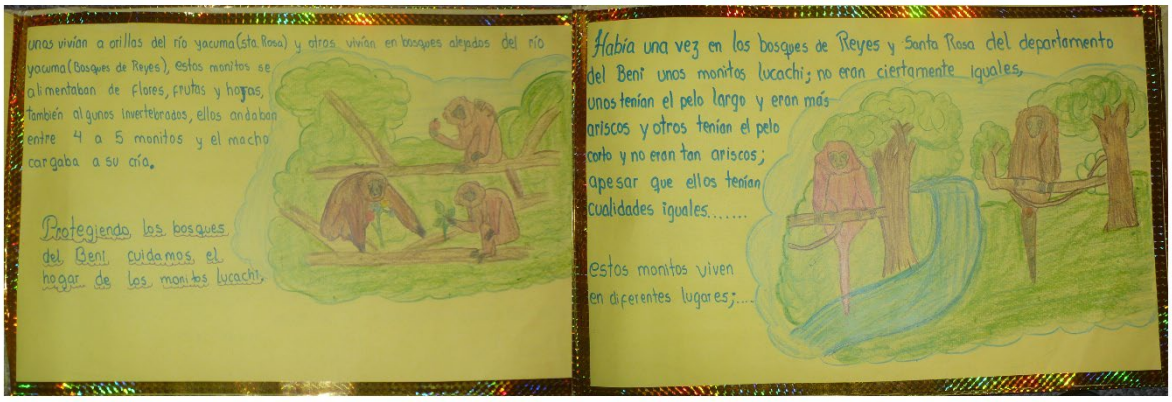


unas vivían a orillas del río yacuma (Sta. Rosa) y otros vivían en bosques alejados del río yacuma (Bosques de Reyes), estos monitos se alimentaban de flores, frutas y hojas, también algunos invertebrados, ellos andaban entre 4 a 5 monitos y el macho cargaba a su cría.

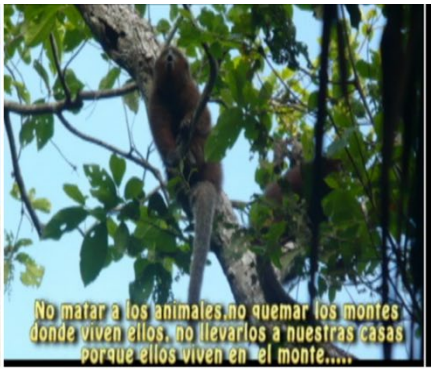
Protegiendo los bosques del Beni cuidamos el hogar de los monitos lucachi.

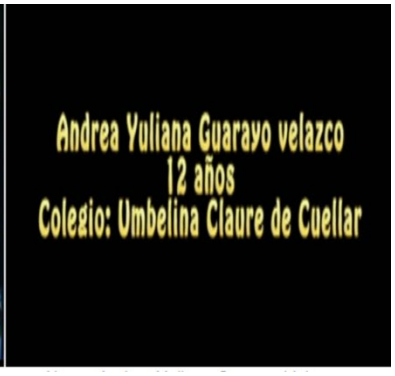
Había una vez en los bosques de Reyes y Santa Rosa del departamento del Beni unos monitos lucachi; no eran ciertamente iguales, unos tenían el pelo largo y eran más ariscos y otros tenían el pelo corto y no eran tan ariscos; apesar que ellos tenían cualidades iguales.....

estos monitos viven en diferentes lugares;....

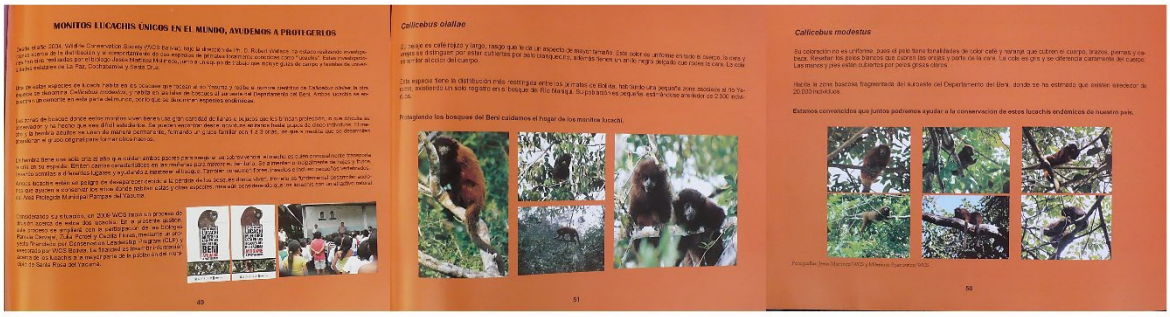
2b. The Santa Rosa del Yacuma Municipality shield and the logos of the Municipal Protected Areas of Pampas del Yacuma and Rhukanrhuka as examples of the incorporation of the Bolivian endemic titi monkeys into local symbology.

2c. Examples of local radio and television media coverage of the outreach activities, showing a radio interview with our team and examples of conservation messages from students broadcasted on local television.





2d. Press coverage of the local, departmental, and national outreach campaigns at local and national scale.



MONITOS LUCACHIS ÚNICOS EN EL MUNDO, AYUDEMOS A PROTEGERLOS

Callicebus olallae

Callicebus modestus

LA PALABRA DEL BENI

Edición Especial

Monitos Lucachis

Únicos en el mundo, ayudemos a protegerlos

En Santa Rosa, el río Yacuma es una de las grandes atracciones turísticas que, dependiendo de la temporada, se llena de visitantes. Sin embargo, están naciendo nuevas alternativas para que los turistas vean otra clase de riqueza en cuanto a flora y fauna de esta zona.

Entre estas rutas está el Lago Rogagua, a 18 kilómetros de Santa Rosa; La Laguna "las Palomas", donde existe el cocodrilo picado; el Río Yata, -con más animales que el río Yacuma- la Laguna da Bravo, con su cabaña turística. También encontramos a Las Mancornadas, lagunas unidas por un arroyo, en donde se puede apreciar un gursero inmenso, así como grandes cantidades de caimanes que lo rodean. Dentro de todas estas maravillas de la naturaleza, también encontramos la ruta del mono "Lucachi ".

Desde el año 2004, Wildlife Conservation Society (WCS Bolivia), bajo la dirección del Ph. D. Robert Wallace, ha estado realizando investigaciones acerca de la distribución y el comportamiento de dos especies de primates localmente conocidas como "Lucachis". Estas investigaciones han sido realizadas por el biólogo Jesús Martínez Mollinedo, junto a un equipo de trabajo que incluye guías de campo y tesistas de universidades estatales de La Paz, Cochabamba y Santa Cruz.

Una de estas especies de "Lucachis", habita en los bosques que rodean el río Yacuma y recibe el nombre científico de *Callicebus olallae*; la otra especie se denomina *Callicebus modestus*, y habita en las islas de bosques al suroeste del Departamento del Beni. Ambos se encuentran únicamente en esta parte del mundo, por lo que se denominan especies endémicas.

Las zonas de bosques donde estos monitos viven, tienen una gran cantidad de lianas o bejucos que les brindan protección, lo que dificulta observarlos y estudiarlos. Se pueden encontrar desde individuos solitarios, hasta grupos de cinco. El macho y la hembra adultos se unen de manera permanente, formando un grupo familiar con 1, 2 y hasta 3 crías, los que a medida que se desarrollan, abandonan el grupo original para formar otros nuevos.

La hembra tiene una sola cría al año, sin embargo, son ambos padres que la cuidan para asegurar su sobrevivencia. El macho es quien principalmente transporta la cría en su espalda. Emiten cantos característicos en las mañanas para marcar su territorio. Se alimentan principalmente de hojas y frutos, de los cuales llevan sus semillas a diferentes lugares, ayudando a mantener el bosque. También consumen flores, insectos e incluso pequeños vertebrados.

Ambos Lucachis están de desaparecer debido de los bosques donde fundamental desarrollo conservar su hábitat de aún considerando que natural del Área Protegi

Considerando su sin proceso de difusión a presente gestión, este p de las biólogas Pamela mediante un proyecto Programa (CLP) y ase trasmitir información a la población del munic

Características del

Su coloración no es u café y naranja que cub los pelos blancos que c

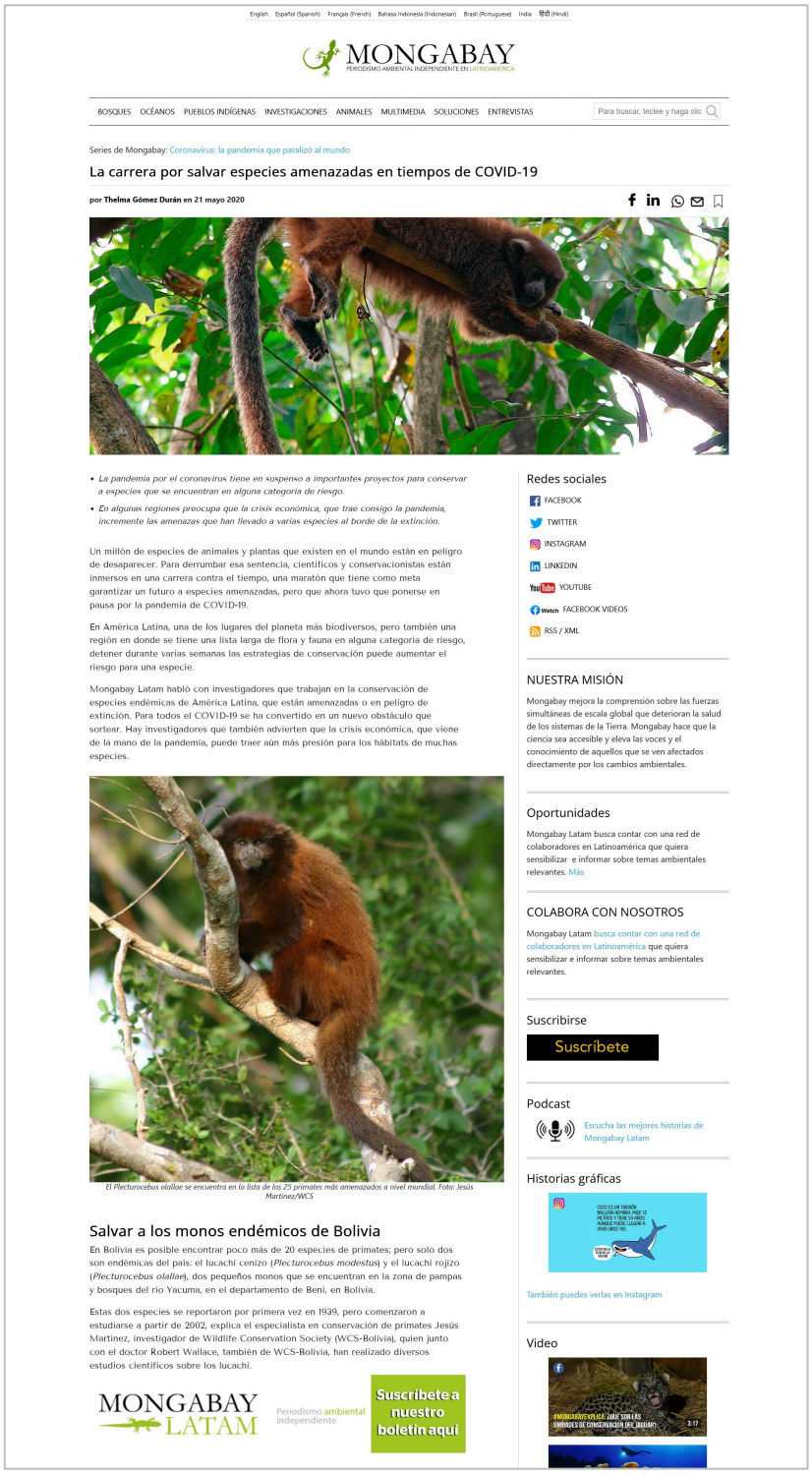
Se estima que existen

Características del Callicebus Olallae

Su pelaje es café rojizo y largo, rasgo que le da un aspecto de mayor tamaño. Este color es uniforme en todo el cuerpo y cara, mientras que las orejas se distinguen por estar cubiertas de pelo blanquecino. Además, tienen un anillo negro delgado que los rodea la cara. La cola es de color similar al cuerpo.

Su población es pequeña, estimándose la existencia de alrededor de 2.000.

2e. Report available on an international renowned website on the activities for the conservation of the Bolivian endemic titi monkeys *Plecturocebus olallae* and *Plecturocebus modestus* (https://es.mongabay.com/2020/05/la-carrera-por-salvar-especies-amenazadas-en-tiempos-de-covid-19; https://eju.tv/2019/07/reyes-crea-un-area-para-salvar-a-dos-especies-de-monos-amenazadas-de-bolivia).



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Series de Mongabay: Coronavirus: la pandemia que paralizó al mundo

La carrera por salvar especies amenazadas en tiempos de COVID-19

por **Thelma Gómez Durán** en 21 mayo 2020

- *La pandemia por el coronavirus tiene en suspenso a importantes proyectos para conservar a especies que se encuentran en alguna categoría de riesgo.*
- *En algunas regiones preocupa que la crisis económica, que trae consigo la pandemia, incremente las amenazas que han llevado a varias especies al borde de la extinción.*

Un millón de especies de animales y plantas que existen en el mundo están en peligro de desaparecer. Para derrumbar esa sentencia, científicos y conservacionistas están inmersos en una carrera contra el tiempo, una maratón que tiene como meta garantizar un futuro a especies amenazadas, pero que ahora tuvo que ponerse en pausa por la pandemia de COVID-19.

En América Latina, una de los lugares del planeta más biodiversos, pero también una región en donde se tiene una lista larga de flora y fauna en alguna categoría de riesgo, detener durante varias semanas las estrategias de conservación puede aumentar el riesgo para una especie.

Mongabay Latam habló con investigadores que trabajan en la conservación de especies endémicas de América Latina, que están amenazadas o en peligro de extinción. Para todos el COVID-19 se ha convertido en un nuevo obstáculo que sortear. Hay investigadores que también advierten que la crisis económica, que viene de la mano de la pandemia, puede traer aún más presión para los hábitats de muchas especies.

El Plecturocebus olallae se encuentra en la lista de los 25 primates más amenazados a nivel mundial. Foto: Jesús Martínez/WCS

Salvar a los monos endémicos de Bolivia

En Bolivia es posible encontrar poco más de 20 especies de primates; pero solo dos son endémicas del país: el lucachi cenizo (*Plecturocebus modestus*) y el lucachi rojizo (*Plecturocebus olallae*), dos pequeños monos que se encuentran en la zona de pampas y bosques del río Yacuma, en el departamento de Beni, en Bolivia.

Estas dos especies se reportaron por primera vez en 1939, pero comenzaron a estudiarse a partir de 2002, explica el especialista en conservación de primates Jesús Martínez, investigador de Wildlife Conservation Society (WCS-Bolivia), quien junto con el doctor Robert Wallace, también de WCS-Bolivia, han realizado diversos estudios científicos sobre los lucachi.

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Mongabay mejora la comprensión sobre las fuerzas simultáneas de escala global que deterioran la salud de los sistemas de la Tierra. Mongabay hace que la ciencia sea accesible y eleva las voces y el conocimiento de aquellos que se ven afectados directamente por los cambios ambientales.

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