Articles

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THE CHALLENGES OF PRIMATE RESEARCH AND CONSERVATION IN PARAGUAY

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Abstract

The primate fauna of Paraguay consists of just five species (*Sapajus cay*, *Alouatta caraya*, *Aotus azarae*, *Plecturocebus pallescens* and *Mico melanurus*) and has been largely overlooked by the international primatological community. Notwithstanding, Paraguay currently has the second highest deforestation rate in Latin America and the threats facing Paraguayan primates are as severe as anywhere else on the continent. Primate conservation in Paraguay is complicated by the complete absence of a homegrown primatological research community and the country lacks the solid biological research foundation required for the development of robust management strategies. Only one university degree in biology is available in the country (with the Universidad Nacional de Asunción), and opportunities for postgraduate education in biological sciences require studying abroad, whilst the limited number of career opportunities upon graduation mean that those receiving such training frequently prefer to pursue their career elsewhere rather than return to the country to practice. No higher education courses in primatology are currently available in Paraguay. Fundación Para La Tierra (PLT) is a Paraguayan conservation and education NGO (80086144-2), founded in 2010. PLT focuses on conservation of Paraguay's natural habitats through scientific research, community engagement and education, and implements Paraguay's only long-term primatology research projects: the "Hooded Capuchin Project" conserving *Sapajus cay* in what little remains of the Upper Paraná Atlantic Forest and the "Urban Howler Monkey Project" researching the behavioural ecology of *Alouatta caraya* inhabiting the city of Pilar. The PLT primate projects adopt a multi-faceted approach: long-term scientific research, training and supporting local people with an interest in primates, supervision of international students and environmental education in schools. In this article we will discuss the challenges of developing such a project, and a vision for the future of primatology in Paraguay.

Keywords: Challenges, community development, Latin America, primatology, scientific development

Ñemombyky

Ka'ikuera Paraguai pegua oī po laja (*Sapajus cay, Alouatta caraya, Aotus azarae, Plecturocebus pallescens* ha *Mico melanurus*) ha tetã okaragua oheja tapy kuepe tekombo'e ka'ikuera Paraguai pegua. Ha Paraguai ejetopa mokoī haguape la ombyai veva ika'aguykuera Latino America apytepe ha pe amenaza orekova umi ka'ikuera paraguai pegua peteichaitente umi ambue hendape tetãnguera Latino America pe guaicha. Ka'aguyre ñeñangareko ndoguerekoī peteī tekombo'e umi ka'i kuera rehegua ko tetãme ha upevare ndorekoi peteī mberete añete ojegueraha hagua tendonde gotyo pe ñeñangareko hesekuera. Ko tetãme oī peteī mbo'ehao herava Universidad Nacional de Asunción, ha eñembo'aranduseveramo katu eho va'era ambue tetãrehe, ha avei sa'i oī la juruja ha umi ohova oñemo'arandu tetã ambuere katu ndouseveima pe hetame ogueraha hagua tenonde pe iñarandu. Ko'arape ndaipori peteī ñemo'aranduha tekovekuaaty rehegua paraguipe. Fundación Para La Tierra (PLT) ha'e peteī ONG ombo'eva la conservacion rehe Paraguaigua (80086144-2) eñepyru va'ekue 2010 pe. PLT eñenfoca la conservacion umi jeikoha natural Paraguai pegua rehe ojapo rupi hikuai la estudio cientifico, ha avei omba'apo hikuai yvypora aguiguandive ha ombo'apova avei hikuai ñemo'aranupe, ha ha'ekuera añonde omba'apova o oñemo'aranduva umi ka'i rehegua ko tetãme: el Proyecto Ka'i oheka oñangareko hagua pe *Sapajus cay* sa'ima oiva ka'aguy pe Alto Parana ha pe mba'apo ''Mono Aullador Urbano" ostudiava pe caraja oikoha ha teko kuera rehegua *Alouatta caraya* oikova tava Pilarpe. Tembiapo de primates PLT ogueroko petei enfoque heta mba'ere: investigacion cientifica ipukuva, ñemo'arandu yvypora aguiguape ka'ikuera rehegua, ombo'e avei ambue tetã guape ikatu haguaicha ijapo studio Paraguaipe ha avei tekombo'e mbo'e haope. Ko articulope ñeñe'ẽta mba'epa la hasy veva la jajapo hagua tembiapo peichagua paraguaipe ha jahecha peteī ñepytyvomby pe primatologia Paraguaipe guara.

Ñe'e okendavoka: Mbyteamérika ha Ñembyamérikagua, cientifico ñemogenda, tavaygua ñemogenda, emoranandu ka'ikuera rehegua, pa'akuera

Resumen

La fauna de primates de Paraguay consta de solo cinco especies (*Sapajus cay, Alouatta caraya, Aotus azarae, Plecturocebus pallescens* y *Mico melanurus*) y su estudio ha sido ignorada en gran medida por la comunidad primatológica internacional. No obstante, Paraguay tiene actualmente la segunda tasa de deforestación más alta de América Latina y las amenazas que enfrentan los primates paraguayos son tan graves como en cualquier otro lugar del continente. La conservación de primates en Paraguay se complica por la ausencia total de una comunidad de investigación primatológica local y el país carece de la base sólida de investigación biológica requerida para el desarrollo de estrategias de gestión efectivos. En el país existe solo un título de grado universitario en biología (con la Universidad Nacional de Asunción), y las oportunidades de educación de posgrado en ciencias biológicas requieren estudiar en el extranjero, mientras que el número limitado de oportunidades de carrera al graduarse significa que quienes reciben dicha formación con frecuencia prefieren seguir sus carreras en otros lugares en lugar de regresar al país para ejercer. Actualmente no hay cursos de educación superior en primatología disponibles en Paraguay. Fundación Para La Tierra (PLT) es una ONG de educación y conservación paraguaya (80086144-2), fundada en 2010. PLT se enfoca en la conservación de los hábitats naturales de Paraguay a través de la investigación científica, la participación comunitaria y la educación, e implementa los únicos trabajos de investigación de campo en primatología a largo plazo en el país: el "Proyecto Capuchino Encapuchado" que busca conservar el *Sapajus cay* en lo poco que queda del Bosque Atlántico del Alto Paraná y el "Proyecto Mono Aullador Urbano" que investiga la ecología del comportamiento de las poblaciones de *Alouatta caraya* que habitan en la ciudad de Pilar. Los proyectos de primates de PLT adoptan un enfoque multifacético: investigación científica a largo plazo, capacitación y apoyo a la población local interesada en los primates, supervisión de estudiantes internacionales y educación ambiental en las escuelas. En este artículo discutiremos los desafíos enfrentados en desarrollar un proyecto de esta clase en Paraguay y una visión para el futuro de la primatología en el país.

Palabras clave: América Latina; Desarrollo científico; Desarrollo comunitario; primatología; retos

Introduction

Primatological research in Paraguay is limited to a small number of studies punctuated by large periods of publishing inactivity (Azara 1801; Rengger 1830; Stallings and Mittermeier 1983; Stallings 1983, 1984, 1985; Stallings et al. 1989; Wright 1994; Smith and Briggs 2015; Cartes et al. 2017; Smith 2017a, b; Smith and Payne 2017; Cartes et al. 2018; Smith et al. 2018; Smith and Kane 2020; Smith et al. 2020; Smith et al. 2021a; Smith et al. 2021b; Wellian and Smith 2021; Smith 2021; Duffy et al. 2022; Smith et al. 2022; Smith and Lusseau 2022a). The country is home to five species of non-human primates (hereafter primates), one each from the five platyrrhine primate families: Cebidae – the hooded capuchin (*Sapajus cay*), Atelidae – the black and gold howler monkey (*Alouatta caraya*), Aotidae – Azara's night monkey (*Aotus azarae*), Pitheciidae – Chacoan titi monkey (*Plecturocebus pallescens*) and Callitrichidae – the black-tailed marmoset (*Mico melanurus*). While this is a lower number of species compared to other South American countries such as Brazil, Peru and Bolivia, Paraguay has comparable or higher diversity of species than some other countries with a thriving primatological research (both national and international) community including Argentina (five species: two *Alouatta*, two *Sapajus* and one *Aotus*) and Mexico (two *Alouatta* and one *Ateles*). It is probable that a lack of infrastructure for research is the principal factor that has contributed to the country being overlooked by foreign researchers, but this does not adequately explain the absence of a local primatological research community, or the near total absence of data-generating primatological publications produced by Paraguayan researchers – a country with one of the longest histories of natural history publication on the continent (Azara 1801; Rengger 1830).

In recent years Paraguay has had one of the highest deforestation rates in the world (Da Ponte et al. 2017a, b, 2018; Smith 2021; Smith and Lusseau 2022b) but popular opinions as to the importance of conservation of natural habitats are rarely reflected in the legislature. The Upper Paraná Atlantic Forest (BAAPA) that once spread across almost the entire eastern side of the country has been decimated by industrial agriculture, principally soybean plantations (Da Ponte et al. 2017a). Between 2000 and 2019 more than 58% of BAAPA considered highly suitable for capuchin monkeys was lost in Paraguay (Smith 2021). Annually from 2019-2021, the little that remains of the Paraguayan Atlantic Forest was ravaged by fires, with Área para Parque Nacional San Rafael (one of only two areas of BAAPA with an area of more than 50,000 ha) losing over 45% of its cover in 2020 alone (MADEs 2020). Theoretically a zero deforestation law (Ley 2524/2004) exists for the BAAPA region, but in many areas charcoal production and other clandestine and destructive forestry practices continue unabated. The Occidental region of Paraguay, the Gran Chaco, is a vast xeric forest, originally around 240,000 km^2 (Soto et al. 2015), that is now one of the world's fastest disappearing terrestrial habitats, with hundreds of thousands of hectares being lost every year to make way for cattle ranches. Only around 197 km^2 of

this region has any sort of formal protection (Cartes et al. 2015). In 2010, 281,210 ha (2812.1 km^2) were destroyed with this increasing by 21% by 2014 (Soto et al. 2015). At the current rate of deforestation, the Chaco Forest is predicted to be completely gone before 2035 (Muller et al. 2020). Paraguay clearly faces serious ecological and social challenges that require urgent action if they are to be addressed.

In recent years it has become popular amongst some sections of "western" academia to view the presence of foreign scientists (including primatologists) working in developing countries as a negative influence, taking opportunities that might otherwise be taken advantage of by local primatologists (Blair 2019; de Vos 2020; Gokken 2018; Mecca 2020; Nkomo 2020; Waters et al. 2021; Rodrigues et al. 2021, 2022). This is not the case in Paraguay, where while the limited primatological research of note has been carried out by foreign scientists, there have been long latent periods where no foreign primatologists have been active at all and the field still failed to flourish. More than 30 years of primatological research inactivity passed between the last primatological research that was carried out in Paraguay in the 1980's by Jody Stallings (a survey of the primate species present in Paraguay and their ranges: Stallings 1985) and the initiation of the Para La Tierra Hooded Capuchin Project in 2013.

The issue in Paraguay is not one of opportunities being taken from or denied to local researchers so much as such opportunities being non-existent in the first place. Why this might be the case requires an honest evaluation of the relevance of primatology to developing societies, and a reappraisal of the factors that limit opportunities for potential primatologists. This includes identifying those which are unique to primatology and can be addressed by the primatological community, those which are common to science in the developing world in general and therefore require a broader community approach, and those which are economic or political (either globally, regionally or nationally) and for which the root causes cannot be addressed separately from other social issues that afflict developing nations.

In this paper we address the principal issues as we see them. All authors are citizens or residents of Paraguay and in combination have spent many decades working in biological and primatological research fields in the country. Although the first author is the only trained primatologist on the author line, the manuscript is very much a product of all three of our experiences and opinions. All authors have previously published papers related to primatology in Paraguay which are relevant to the development of primatology in the country. We warn against the seductiveness of simple solutions to complex problems which are invariably more effective at achieving popularity on social media than real change.

Education

According to available metrics, the Paraguayan primary education system is amongst the worst in world and in 2018 Paraguay was ranked at 137/138 globally for the quality of its maths and science education (World Politics Review 2018). Early education about conservation issues has been shown to influence the extent to which students will be interested in conserving nature later in life (Caro 2003; Hossain Bhuiyan 2010). However, the standard Paraguayan national curriculum includes little to no environmental or biological science teaching. This lack of mainstream environmental education has historically robbed generations of Paraguayans of the opportunity to become inspired to work towards the conservation of their country's fragile ecosystems. In recent years the Internet has contributed to a wider understanding of conservation issues, but there are additional educational, political and economic barriers to be overcome by anybody who wishes to dedicate their career to pushing for meaningful change through academia.

There is currently only one biology undergraduate degree ("Bachelors in Sciences – Mention in Biology") in Paraguay, provided by the FACEN (Facultad de Ciencias Exactas y Naturales), Universidad Nacional de Asunción (UNA). The UNA, ranked 137/411 universities in Latin America (64 places above the next Paraguayan institution (QS Rankings 2021)), has a small research budget and, as a result, a comparatively low research output. Although the number of students who can be accepted to this course is capped at 50 per year (25 per term), it is frequently the case that the available places are not filled, and of those students that begin the course, a significant proportion fail to complete the full four-year degree (González-Barrios, pers. comm. 2020).

In 2008 the FACEN began the first Master's degree program in Biology (with a focus on Conservation Biology). The program opens for new students every two years. In 2008-2010 nine students enrolled and six graduated (66.6% graduation), 2011-2014, 14 students enrolled and seven graduated (50% graduation) and in 2015, 23 students enrolled, demonstrating that interest in this program is slowly increasing. However, neither the FACEN's undergraduate nor Master's programs include specialisations in primatology, as none of the faculty staff have experience in primatology and, understandably, the specialist skills required of the primatologist are of limited application in a wider sense in Paraguay.

While it is a positive step forward that these types of degrees now exist in Paraguay, they have been a long time coming and involve significant financial hurdles that must be overcome by any prospective student. For 2021 the undergraduate degree requires a registration fee paid per semester (increasing every semester) of ~$25 American dollars (176,000 Guaraníes) and then class

participation fees of $3/class (18,000 Guaraníes) with a basic requirement of five classes per semester. The two-year master's degree fees reach around $2446 (17 million Guaraníes). In addition to the university fees, completing these degrees requires further financial investment including purchase of all textbooks required for each class (this can be done in a cheaper way by purchasing photocopies of the required books), paying to sit exams, a fee to receive a degree certificate, a fee to defend one's thesis and, for those who do not have a residence in the capital city, additional costs of travel, housing and living. These costs are significant in a country where the minimum wage (in 2021) was ~$330/month (1,824,055 Guaraníes) (or $132/month (917,532 Guaraníes) if you are a domestic worker). The fees charged by the university have caused controversy in the past as the UNA is a public university that, on paper, should not charge any fees (ABC Color 2020a, b, c). However, in reality all potential students are obliged to make this considerable financial sacrifice in choosing to study biology. A large number of potential primatologists from lower-income backgrounds can be priced out of their future careers at the first hurdle, either by the geography of where they live (70% of Paraguay's population lives outside of the greater Asunción area), or the economic status of the household into which they were born, or a combination of both. In 2020, it was estimated that the UNA has a dropout rate of around 45%, in part a result of significant financial burden caused by the fees (ABC Color 2020c).

No biology Ph.D. courses are currently available in Paraguay, and any students wishing to continue their studies to doctorate level (and indeed to take their first steps in studying primatology at all), must have access to the considerable financial resources required to continue their studies outside of the country. Programs that were originally designed to alleviate the financial pressures associated with academic study in Paraguay (or for Paraguayan students to study abroad) such as BECAL, Becas Don Antonio Carlos Lopez, a program that provides scholarships for overseas postgraduate studies to university students, have failed to solve this problem, and have been mainly taken advantage of by students from families in the top income decile (World Politics Review 2018). A significant section of Paraguayan society is therefore financially excluded from ever even attempting to obtain the academic education required to become a primatologist.

Of course, the relative lack of interest in pursuing a career in biology cannot be blamed solely on these economic barriers. It is also a reflection on what "type of knowledge" is prioritised by Paraguayan society. This is likely a factor in the failure of the FACEN to fill its biology course, and is also an indication of how biology is viewed more widely in terms of its "contribution to society". Throughout the country there are several universities offering courses in "Environmental Engineering", however these courses have a strong focus on livestock and agriculture (pursuits that are considered "valuable" to an agricultural economy) and little emphasis is given to ecological research or conservation (which often generate results which might be considered unfavourable to an agricultural economy that is heavily invested in soy and cattle production).

In 2020, the FACEN awarded 33 "Financial hardship" fee-waiver scholarships for undergraduate students. None of these were awarded to students studying biology and over a third were awarded to students of the *Tecnología de Producción* – Bachelor of Production Technology, a degree that aims to "*Train professionals to interpret the problems that arise in companies linked to productive activities in the country, so that at their level of responsibility can effectively assist in solving them, as well as collaborate to produce goods and services*" (FACEN, 2020a). In addition, 13 scholarships for "Academic Excellence" were awarded and again, none of these were awarded to biology students (FACEN, 2020b). No data is available to us on how many applicants requested this financial support for the biology course, but there are only three realistic possibilities: 1) no students applied for support for the biology course (suggesting either a lack of societal interest or an appeal only to students of high income families, or both); 2) all the potential biology students that did apply had weaker applications than the 33 awardees (suggesting that the most gifted students are not choosing to study biology) or 3) financial support for biology students is not considered a priority for scholarships (suggesting that a biology qualification is not valued by Paraguayan academia). Clearly none of these possibilities are consistent with an imminent explosion of primatological opportunities.

Employment prospects

Perhaps equally important in discouraging students from studying biology through to postgraduate level are the limited job prospects available to them after graduating. Opportunities for permanent work for biologists are few and far between in Paraguay, and where they do exist these tend to have a strong focus on habitat conservation rather than behavioural or ecological research. While there are several conservation NGOs operating in Paraguay, paid work for biologists offered by them is often on a by-project basis, and the job requirements of the biologists are defined by the needs of the project. The ability to compete for such contracts thus rewards the generalist biologist far more so than the specialist. Given that only one of the five Paraguayan primates is currently considered to be of conservation concern by IUCN (the hooded capuchin was reclassified as Vulnerable in 2022, partly as a result of the PLT Capuchin Project (Rímoli et al. 2022)), a specialisation in primatology is of limited value in terms of making a person more attractive in the competition for such contracts (which commonly have a strong conservation focus). By consciously over-adapting to a habitat that does not exist, the Paraguayan primatologist

must be prepared to knowingly and willingly reduce their own chance of finding economically viable employment.

Independent financing

The financially-secure Paraguayan primatologist who has successfully received their qualification and found their employment opportunities limited still has the opportunity to go it alone. Independent financing for emerging biologists is difficult to get, but it is out there. While most of this financing comes from abroad, there are limited sources of funding available nationally – if you can convince the local funders that primatology is worth funding.

In 2011, the Consejo Nacional de Ciencia y Tecnología (CONACyT) began the Programa Nacional de Incentivo a los Investigadores (PRONII). This program is designed to promote and expand the scientific community within Paraguay by offering financial incentives that complement the base salary of Paraguayan-based (permanent resident or citizen) scientists. The aims of the PRONII program are "*To strengthen, consolidate and expand the scientific community of the country. Categorize, through periodic evaluation processes, researchers by hierarchical levels according to their scientific production, their international relevance and their impact on the training of other researchers. Establish a system of financial incentives for researchers that makes possible, facilitates and encourages dedication to scientific production in all areas of knowledge, which will be awarded by competitive procedures*" (CONACyT 2020a). There are four different categories for which researchers can apply, and as a biological science, primatology falls under the category of "Agricultural, Natural and Botanical Sciences".

The PRONII program consists of five levels (*Candidato*, 1, 2, 3, *Emérito*), each of which has a distinct set of academic requirements and is rewarded with an increasing pay scale. To qualify for *Candidato* (Candidate - the basic entry level into the program) you need to prove participation in research groups or projects and attendance at congresses (another financial barrier), be affiliated to a government or non-governmental organization, have at least one scientific publication in a peer reviewed journal or at least three presentations at a scientific congress in the last three years. While the basic requirement is a completed bachelor's degree, it is preferred that you have (or are in the process of completing) a Master's or a doctorate. If you are not doing so, or do not have a Master's or doctorate level degree, then you must have published a minimum of six articles in peer reviewed publications in the last three years. Access to the level 1 and 2 of the PRONII scheme requires at least a Master's degree and access to 3 and *Emérito* require a Ph.D.

In 2020, the category of PRONII *Ciencias Agrarias, Naturales y Botánicas* (Agricultural, Natural and Botanical Sciences) contained only 175 people, of which 87 (49.71%) researchers were *Candidato* level, 61 (34.86%) were Level 1, 19 (10.86%) were Level 2, four (2.29%) were Level 3 and four (2.29%) were *Emérito* (CONACyT 2020b). Of these recipients, only around a third of these researchers are biologists and only one (the first author of this paper) is a primatologist, a stark reflection of the small number of people in Paraguay working in the biological sciences (CONACyT 2020b). In addition to the overall small number of biologists, the alarming lack of researchers qualifying for the higher levels of the scheme reflects not only the limited higher education opportunities within the country, but also the limited pool of nationally-based professionals qualified to offer training or development opportunities to their fellow professionals and students.

Logistics

In terms of land distribution, Paraguay is one of the most unequal countries in Latin America, with a thriving *latifundi* system, and over 80% of the land being owned by around 5% of the people. This creates obstacles for anybody intending to engage in independent (or even NGO or university-affiliated) scientific research and/or conservation programs, and introduces unavoidable uncertainties for anybody seeking to set up a long-term field research program. Of course whilst a researcher may have little choice but to trust private landowners who may be unlikely to commit their land entirely to the economically unrewarding (in comparison to soy or cattle production) pursuit of studying primate behaviour, convincing donors and grant-givers to invest their money is rather more difficult.

The only alternative to this is to work in the public sector within the national parks system. On paper this looks like a viable option. There are 16 state-managed national parks throughout the country. However, the national park system is chronically underfunded and understaffed, conditions are poor and the national parks where three of the five species of monkey occur (in the Chaco and Pantanal regions in the north of the country) are so remote that without access to a costly 4x4 vehicle any project would be impossible (distribution maps of the five species are included in Smith et al. 2021). Beyond permission to use their facilities there is no support from the government, meaning one must still generate one's own financial support. Many grant-giving agencies do not allow the payment of wages in the terms of their funding and so even if you succeed in getting the studies off the ground, you are still some distance from turning it into a job that pays a person (or any team one might need) a living wage. Even with a costly education and a cutting-edge project plan you are still faced with significant financial barriers to be able to carry out research (before even considering earning a wage). Nor are these the end of the logistical challenges, with project-specific hurdles such as the habituation of study subjects still ahead. Unlike neighbouring Brazil and Argentina, Paraguay has never benefitted from the set-up of long-term

field stations, and as a result there are few areas with even semi-habituated primates.

Para La Tierra Primate Projects and the development of primatology in Paraguay

In this section, the authors recount our own experience of the difficulties of establishing primatology programs in Paraguay. Since 2013 Fundación Para La Tierra (PLT) (a Paraguayan conservation NGO 80086144-2) has run Paraguay's first, and currently only, long-term behavioural studies of wild primates. Between 2010 and 2017 PLT was based at the privately-owned property Rancho Laguna Blanca in San Pedro department. It took approximately 2.5 years to habituate the capuchin monkeys at this locality. In May 2017 the site fell under legal embargo as the result of a landowner family dispute that required all work on the property to be suspended indefinitely. Five years later the legal dispute is still unresolved. Following the loss of Laguna Blanca, PLT moved to the City of Pilar in Ñeembucú and the capuchin research project moved to Nueva Gambach, a private property at the tip of Areá para Parque San Rafael (Tekoha Guasu). The capuchin research continues at this site and in Pilar we established the first study of the black and gold howler monkey (*Alouatta caraya*) in Paraguay in urban and Humid Chaco environments.

Challenges and accomplishments in the development of Paraguayan primatology

That any primatological research was possible was because of the business non-profit model adopted by PLT. Through the PLT internship program students pay bench fees to design and carry out their own research project in Paraguay under the supervision of PLT scientists, providing an educational experience, with room, board and equipment use included, that involves all aspects of the scientific process from study design and proposal writing to submitting their results for publication in a peer-reviewed journal and/or applying for conference presentations. To date, students have come from over 40 countries and six continents.

This non-profit business model of generating income for the primatological (and other scientific) studies, community engagement and environmental education programs through these international student bench fees was attacked by northern hemisphere academics on social media in September 2020 and accused of being exploitative. PLT's only source of consistent funding (which is invested into the completely non-profit scientific, environmental and social programs) is student bench fees, and much of its advertising takes place on social media. All three authors interpreted these attacks as true academic colonialism, as no constructive solutions for alternative means of funding were offered, and the intent was defamatory and destructive, with no effort made to be constructive or engage in useful debate. No alternative means of funding long-term primatological research that did not depend on foreign capital were proposed by any of the commentators, aside from the ill-considered suggestion that "the government will pay for it" which sadly, the Paraguayan government does not do. Nor did they demonstrate any familiarity with the country or the institution, or any concern for, or understanding of, the social or conservation issues faced by Paraguay and Paraguayans. The dogmatic nature of these indiscriminate criticisms, blindly misapplied concepts of "colonialism" and "exploitation" were without nuance or self-awareness. No interest was shown in the much vaunted "local knowledge" of problems, because it failed to fit the pre-established narrative. When these scientists (many of them through official university lab accounts in the global north) targeted PLT, they attacked the only consistent funding that the only primatology projects in Paraguay receive. Their disinterested and misguided pseudo-morality was thus converted into yet another factor oppressing the development of primatology in Paraguay. We include this example to illustrate not only the hypocrisy of such charges of exploitation (when for-profit higher education fees dwarf the cost of the non-profit bench fees of the PLT internship program) but to highlight the damage they can do to grassroots projects in developing countries by weaponizing social media. It is an inescapable fact that true colonialism is reflected by a person's attitude and actions, not their nationality, and one might justifiably argue that its defining character is the imposition of the ideas of "educated" society onto perceived "less-educated" societies, fuelled only by self-righteous conviction and with scant regard for the cultural or social fall-out of their ideas and actions.

To date, the small multinational staff at PLT has published over 180 peer-reviewed scientific papers in its 13-year existence in the fields of primatology, entomology, herpetology, ichthyology, ornithology, botany and mammalogy. Of these, 16 are a direct result of the primatology projects (with a further three currently under review and 13 in preparation). A total of 17 fee-paying international primatology students have authored or co-authored primatological research papers published or under review in peer-reviewed journals through PLT and 18 (national and international) students have presented their research at national and international primatological (and biological) society conferences, a huge boost to the development of primatology in Paraguay. Again, none of this would have been possible without international students and payment of bench fees.

If primatology as a discipline is going to take off in Paraguay then investment in training opportunities from both national and international parties is essential, and opportunities for putting primatology theory into practice need to be created. Supported by the Latin American Primatological Society (SLAPrim) and Para La Tierra (PLT), "Ka'i Paraguay", a novice primatology interest group was formed following the 1st Paraguayan Zoology conference in 2019 and is encouraging young Paraguayans to take

their first steps into the world of primatology. Whilst this is a positive attempt to create conscience, the group had just 12 active members (all Paraguayan citizens) until 2022 when a call for volunteers expanded membership to 23. The group is mentored mainly by three foreign-born and trained primatologists, including the first author who is the only one who lives in Paraguay. Only a small minority of these members are active (mainly on social media), there is no budget for field work and the group's existence does not ameliorate the lack of a formal primatological training and a near total lack of practical primatological experience amongst its members.

A pressing issue holding back primate conservation in Paraguay is a basic lack of knowledge about the primates that are found in the country. In 2016 the Para La Tierra primate team conducted a survey of visitors to Asunción Zoo. Few participants demonstrated awareness of the species occurring in the country, and several expressed the belief that exotic species such as orangutans or chimpanzees were native to the Paraguayan Chaco. To address this lack of basic knowledge PLT developed a primary school education program to promote familiarity with the country's primates in schools across the country, with the express aim of planting the seeds of a passion for their conservation. This is achieved via two distinct projects:

1. The PLT program "*Voces de la Naturaleza*" (Voices of Nature) (Figure 1) aims to address the lack of environmental education that children receive in schools via the establishment of 36 eco-clubs across eight political departments. The education team have developed an open-access curriculum of over 400 games, arts and crafts activities and lesson plans all designed to teach young children about nature in a participatory manner, encouraging them to ask questions and think through problems, in contrast to the rote-learning mainstream educational method. In 2018 an agreement was reached with the American Peace Corps for their Environment volunteers to establish additional eco-clubs in additional rural localities, employing the "*Voces de la Naturaleza*" curriculum, in an attempt to reach even more primary school children. Part of this curriculum is a series of lessons, developed with the support of the International Primatological Society Lawrence Jacobsen Education Development Award, focusing on Paraguayan primates and discouraging the pet trade. More than 1000 Paraguayan children (7 to 15 years old) in four political departments have so far participated in these lessons. This program has gained international recognition including PLT's Jorge Damián Ayala Santacruz receiving the Charles Southwick Education Commitment Award from the International Primatological Society in 2019 for his dedication to conservation education in Paraguay.

2. In 2018 the PLT primate team began a program of primate conservation focused environmental education in 22 primary schools in four impoverished communities in areas of conservation concern (Caazapá and Itapúa departments) that border the Área para Parque Nacional San Rafael (Tekoha Guasu) (Figure 2). The lessons developed

Figure 1. The *Voces de la Naturaleza* program run by Jorge Ayala has introduced hundreds of Paraguayan children to participatory environmental education since 2016. The curriculum is currently under consideration for inclusion into the national school curriculum.

Figure 2. The Atlantic Forest conservation education program involves 26 rural and indigenous Mbyá Guaraní schools and uses the participatory *Voces de la Naturaleza* curriculum.

for the *Voces de la Naturaleza* eco-clubs were adapted for a classroom setting and have so far reached 587 children aged 6 to 17 in rural, *campesino* and indigenous Mbyá Guaraní schools. In the beginning, some of these lessons were assisted by forest guards from NGO Pro Cordillera San Rafael (PRO COSARA) and the Ministerio de Ambiente y Desarrollo Sostenible (MADEs: Ministry of the Environment and Sustainable Development), in a capacity building manner that would enable them to conduct additional participatory education in other areas. Though it was interrupted by the COVID-19 pandemic, this program restarted in August 2021 and expanded into more schools (including four more Mbyá Guaraní schools) in the area and the implementation of a series of teacher training workshops focused on participatory education techniques supported by both the International Primatological Society and the Primate Society of Great Britain.

The deficiency in primary education is reflected in a lack of a knowledge base amongst adults, that also needs addressing. Para La Tierra runs a variety of primate programs for both national and international students of diverse ages. In December 2018, with the support of the National Geographic Society and the International Primatological Society, the primate team ran a week-long intensive training course in biological field research techniques and participatory environmental education for 42 forest guards from MADEs and five conservation organisations from across Paraguay (PRO COSARA, Fundación Moises Bertoni, Guyra Paraguay, Organización Paraguaya de conservación y desarrollo sostenible, and the Guardaparques Voluntarios), covering all participation costs and subsidising travel costs for participants (Figure 3). This course built a community connected through WhatsApp that is working together to build the first survey of primates in Paraguay's protected areas for more than 30 years. The Para La Tierra Primatology and Primate Conservation online course, launched in June 2020 is free of charge to Latin American students, subsidised by the course fee charged to northern hemisphere participants. Since the launch of this project seven students from five countries across Latin America (including three from Paraguay - one of whom is a member of the Ka'i Paraguay Group) signed up for the course. We are currently working to have the course translated and subtitled in Spanish and ideally, in the future, in Portuguese in order to make the course more accessible to Latin American students.

However, whilst these steps are laying the groundwork for the future, there is a pressing need in the present to develop study opportunities and generate data on Paraguayan primates, so that any capacity building might have an outlet. Para La Tierra runs two long-term primatological research projects (the only such projects that have ever been established in the country): The "Hooded Capuchin Project" and the "Urban Howler Monkey Project".

The "Hooded Capuchin Project" focuses on determining the ecological requirements of the hooded capuchin in what remains of the Upper Paraná Atlantic Forest, examining this species adaptability to anthropogenic habitat destruction. The project began in January 2013 at Laguna Blanca (San Pedro department) and continues at Estancia Nueva Gambach (Itapúa department) at the southern tip

Figure 3. Images from the 2018 Forest Guard training course.

of Área para Parque Nacional San Rafael (Tekoha Guasu) (with the logistical support of Hostettler S.A, the Hostettler family and, until January 2020, the Paraguayan NGO PRO COSARA). Through this project, both national and international students can participate in ten-day field trips as an educational experience to learn about behavioural data collection, field primatology techniques and conservation in the Atlantic Forest.

The "Urban Howler Monkey Project" is based in the town of Pilar (Ñeembucú department). It looks at the behaviour and ecology of Pilar's large and unusual population of urban-dwelling black and gold howler monkeys and aims to determine how they are adapting to the anthropogenic environment with comparisons to populations in nearby natural environments. Students from across the world are invited to design and carry out their own research projects on these monkeys, and they are encouraged to present and publish their findings with the necessary supervision and support of the PLT primatologist. To date over 40 students (including 28 undergraduate and masters level students) from eleven countries including Paraguay have carried out research projects on topics including parasitology, social networks, vocalisations, activity budgets, risk awareness, home ranges and diets. The bench fees that the international students pay to carry out their study and live in the PLT research station partially fund the small salaries of the scientific staff, the "Hooded Capuchin Project" and all the primatological environmental education and community engagement programs. As we have already stated, without the bench fees paid by international students, none of these projects would exist at all.

The long-term aim of these two projects is not only to generate behavioural and ecological data on the species but to develop viable and self-sustaining projects that can one day be taken over by a future Paraguayan primatologist – a longer term plan to play a small part in addressing the lack of employment opportunities.

Final thoughts

The issues affecting the development of primatological science in developing countries are considerably more complex than the simple, but superficially persuasive, arguments that destructive academic colonialism might infer, and the extent to which such arguments are applicable must not only be viewed on a country by country basis, but also in combination with, and not *in lieu* of, other factors that also inhibit the development of local scientists. The charge that foreign scientists cannot have a net positive impact on the communities with which they work must also be challenged, and the failure to entertain the validity of this notion is a betrayal of the stated aims of the anti-colonialist movement. Anti-colonialism can only be anti-interventionist if the conditions for success already exist and are being actively impeded. If they do not exist, and one refuses to assist in creating them, or they do exist and are not being actively impeded but abetted, then such attacks are themselves colonialist, acting to preserve those opportunities solely for the countries that already enjoy a healthy and self-sustaining primatological community.

Paraguay has been predicted to be the first country in the world that will lose all of it moist forests, likely by 2028 (European Commission, 2019), a devastating prospect for primate conservation. If primatology as a discipline is going to be encouraged in Paraguay then it is essential

that the challenges be addressed productively, actively and in cooperation with stakeholders. There are many opportunities to plant the seeds of primatology in this country that is so desperately in need of increased conservation measures, but history has already demonstrated that these are not going to happen organically, or at least not fast enough to address the serious conservation issues Paraguay faces.

Collaborations between international universities and NGOs (such as SLAPrim and PLT's support of the Ka'i Paraguay group) have the potential to make a positive difference, but are unfairly handicapped by the unjustified, rote-learned attacks of comfortable idealists on social media many thousands of kilometres away from the problem, and who need never give a second thought to those who live with the effects of their trite and sometimes vitriolic words. International universities or societies establishing working relationships with Paraguayan universities or NGO's could set up long-term field sites in the country, and such external financing would provide training opportunities in the short term, and potentially employment in the longer term. This can create opportunities for Paraguayan science students with an interest in primatology, such as the members of the Ka'i Paraguay group, helping them to overcome the economic and logistical barriers that are currently insurmountable. Such action is not colonial unless its intentions are colonial, disinterested inaction on the other hand is absolutely colonial, as it preserves the opportunities for the few – there are after all no native monkeys in the USA, Canada or most of Western Europe.

Paraguay is a proud country of proud people. Partnerships between local and international academic and conservation institutions in a strategic plan to develop primatology are essential for the development of the science. Such efforts provide the fledgling primatology community with the tools and opportunity to help themselves, and they deserve everybody's support.

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All of PLT's research is approved by the Ministerio de Ambiente y Desarollo Sostenible (MADEs) and complies with all local laws. All primatological data is collected in a non-invasive manner and complies with the American Primatological Society Best Practices. All work with communities and schools is based on informed consent, mutual agreement of aims and following invitation by the school directors and all photographs are used with full permission. For more information on the primatology projects of, or partnering or collaborating with Para La Tierra or supporting the development of primatology in Paraguay please do not hesitate to contact Dr. Rebecca Smith at rebecca@paralatierra.org or if you would like more information about the *Voces de la Naturaleza* education program or to use our curriculum contact Jorge Ayala at jorge.d.ayala@gmail.com.

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