



Fig. 3. Charcoal pits were recorded in all fragments. This one had already been used, but many that we observed were still covered and smoking.

system, specifically between Bemanasa and Grand Lavasoa. These appear to be the closest in proximity, and still maintain the largest lemur populations remaining here. Though our time was severely limited in the Ambatotsirongorongo fragment, it was unlikely that many individuals of any lemur species are still there. Therefore, if tough decisions need to be made, we would recommend that future actions (e.g. reduction of timber extraction, forest edge stabilization, and corridor creation) focus on the Bemanasa and Grand Lavasoa fragments.

It is due to our recent findings that we are urging immediate conservation actions to take place here. At the very least, the local community management and patrolling system should be supported and reorganised. Many organisations have been interested in protecting this site in the past, but for various reasons have ultimately pulled out. The incredible biodiversity of this site coupled with the unrestrained rate at which the forest is being lost should inspire both conservation actors and funding organizations to help protect this unique site.

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## Short-term impact of conference scholarships on Malagasy tropical biology researchers

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### Background

It is widely recognized that increasing diversity in science - and ensuring the inclusion of under-represented groups in science - is critical for the production of better research (Nature Editorial, 2018). At the same time, achieving diversity in science is difficult because of the dominance of the English language, lack of accommodations to parents (particularly mothers), subconscious bias, and various other factors (Nature Collection, 2019). Research from developing countries is underrepresented in high-impact journals (e.g. Sumathipala *et al.*, 2004), and when papers are published from these areas of the world, the vast majority are produced in collaboration with a partner from outside the region (Nelius, 2009). In addition, non-English speaking researchers from developing countries often do not get appropriate credit for their work because: 1) many international journals are written in English, 2) authorship guidance does not mitigate the power differences between researchers in high and low-middle income countries, 3) there can be real (or perceived) editorial bias in favor of western authorship, and 4) there can be cultural differences between researchers from low-middle and high income countries on approaches to authorship and publications (Smith *et al.*, 2014).

In Madagascar, in addition to the issues noted above, there are many hurdles facing Malagasy researchers and scientists, aiming to build successful careers in the STEM fields. A study conducted with science and math teachers in 2012 in primary, secondary, and university-level institutions, found that, "crowded classes, limited resources (pedagogical and infrastructural), an average student range in age of seven years per classroom (suggestive of grade repetition and/or late school starting age), and discontinuities in the language of instruction explain why teachers estimated that almost

25% of their students would not finish school” (Wills *et al.*, 2014). Even at the university level, there are significant financial, administrative, and language barriers to student success (Venart and Reuter, 2014), with university teachers estimating that “just one-third of students could fully understand” French, the language of instruction (Wills *et al.*, 2014). Female university students also face discrimination and sexual harassment (reviewed by Vernart and Reuter, 2014).

After Malagasy scientists and researchers graduate from university, they continue to face hurdles in their journeys to building careers in STEM. As one example, as of mid-2019, there is not a single Ethical Review Board for human studies in the entire country (in contrast to the hundreds that are constituted in North America alone); this is problematic given that it is a standard requirement for peer-reviewed journals, and for many funders as well, that research with human subjects be signed-off by an independent Ethical Review Board before the onset of data collection. In practice, this means that any Malagasy person undertaking research involving people – be it biomedical or social science research – either needs to seek an affiliation with a non-Malagasy research institution, or collaborate with a non-Malagasy researcher. Hurdles faced by Malagasy researchers are also evidenced in the scientific literature: a survey of 4000 publications on Madagascar’s biodiversity found that more than 90% had first authors affiliated with institutions outside of Madagascar (Waeber *et al.*, 2016).

The 56th Annual Association for Tropical Biology and Conservation (ATBC) meeting took place in Antananarivo, Madagascar from July 30th to August 4th 2019. ATCB 2019 brought 712 delegates from 55 countries together to discuss biodiversity conservation and sustainable development. This annual conference is held in different countries throughout the world. Prior to the start of the conference, it became clear that the costs of registration even for those paying non-high income country (as per World Bank classifications) fees were prohibitively high. Fees for developing country non-ATBC members were USD\$475 and for non-students USD\$280. For context, the monthly minimum wage in 2018 was USD\$45 for non-agricultural workers (168,019 MGA; Ernst and Young, 2018). Becoming an ATBC member for developing country nationals is USD\$25, which reduced the costs of registration by USD\$50, but even this amount was prohibitively high for many (although these fees were waived for a small number of Malagasy applicants). As a result, weeks before the conference, there were 55 Malagasy students and professionals with accepted presentation abstracts without the means to pay for their conference registration.

In order to improve Malagasy representation at the conference, a number of organizations mobilized - particularly in the final two months before the conference took place - to raise additional funds that could cover the registration costs for Malagasy attendees with accepted presentation abstracts. Here, we discuss the short-term impact of these scholarships on 29 Malagasy environmental scientists whose participation was subsidized by Lemur Love (a small US registered non-profit, [www.lemurlove.org](http://www.lemurlove.org)) and Global Wildlife Conservation (GWC; via a small grant to KR). It is worth noting that a number of other entities in Madagascar, such as Association Vahatra sponsored the attendance of a significant but unknown number of Malagasy delegates. Moreover, several other organizations such as Centre Val-Bio, sponsored the participation of their own Malagasy researchers and staff. These other sponsored participants, however, are not the subject of this report.

## Methods

### Post-conference survey

In the days immediately after the completion of the conference, we sent out a short 10-question survey to all 29 individuals whose ATCB participation was sponsored by Lemur Love or GWC.

## Results

### Survey respondents

17 people responded to our survey within three weeks of the conference, of which 65% were female and 35% were male. Regarding their employment status, one-third (35%) did not have a paying job, 24% had a full-time job, 18% were a consultant with a contract, 18% were students, and 5% were in some kind of temporary employment.

Of the 11 respondents who indicated they were either in school or in some kind of employment (whether temporary or permanent), 73% were working/studying in areas related to environmental conservation, 36% were working/studying in STEM subjects, and 36% were working/studying in areas related to sustainable development (respondents could indicate more than one area of study/work focus).

### Type of respondent participation in the conference

Of the 17 respondents, 16 confirmed they had presented at the conference (with most indicating they presented a poster).

*Previous experience in a similar conference:* 65% had previously participated in a similar conference (though we did not ask for more information as to what kind of conferences they had participated in) and 35% had not participated in a similar conference before.

*Short-term impact of the conference on sponsored participations* Before the conference, respondents ranked themselves a  $2.82 \pm 1.07$  (mean  $\pm$  SD) on a scale of 1 to 5 on their knowledge of career opportunities in STEM. This increased significantly to  $4.18 \pm 0.95$  after the conference ( $Z=10.7940$ ,  $p=0.001$ ; Fig. 1a).

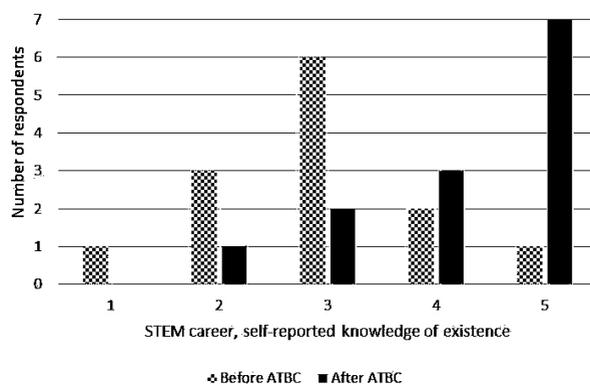


Fig. 1a: Self-reported knowledge of the existence of STEM career opportunities in Madagascar before and after the conference.

Before the conference, respondents ranked themselves a  $3.11 \pm 1.32$  on a scale of 1 to 5 on their perceived ability to have a career in STEM. This increased significantly to  $4.24 \pm 0.90$  after the conference ( $Z=6.5031$ ,  $p = 0.011$ ; Fig. 1b).

Finally, before the conference, only 24% of respondents reported knowing seven or more people that they felt would be able to help them in their career progression. After the conference, this number increased significantly to 65% of respondents, of which 18% said they knew more than 15

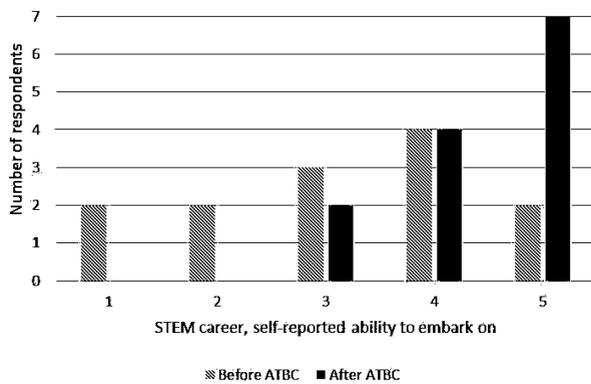


Fig. 1b: Self-reported rating of respondents' ability to embark on a career in STEM before and after the conference.

people who could help them ( $\chi^2(1)=5.846$ ,  $p=0.016$ ); respondents grouped into those who knew 6 or less people and those who knew 7 or more people; Fig. 1c).

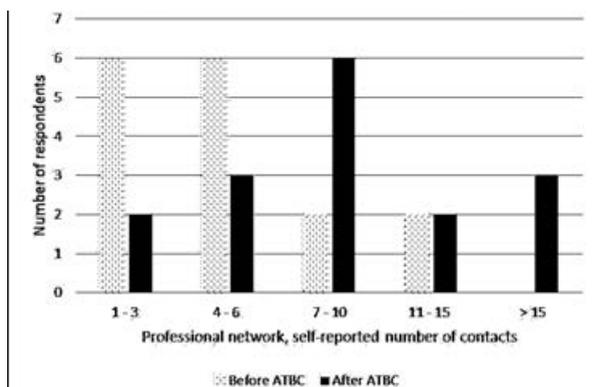


Fig. 1c: Self-reported number of professional relationships (people) that respondents thought could help them in their career search before and after the conference.

## Discussion

While attendance to the ATCB conference was not going to single-handedly launch or turbo-charge the careers of Malagasy scientists, this six-day event presented a unique opportunity for career and research training at a price point unlikely to be matched by any other conference in the coming years (as so few international conferences on this subject are held in Madagascar). At a cost of USD\$71/day and USD\$38/day for Malagasy professionals and students, respectively, the short-term return-on-investment on the 29 sponsored students is substantial. As a result of the conference, sponsored participants were more aware of STEM career opportunities, felt more capable of launching a career in STEM fields, and substantially increased the number of professional relationships that they felt could help them in their careers. One of the participants sponsored by Lemur Love, Miatrana Rasamoelina (a veterinary student at the University of Antananarivo), won the 2019 Alwyn Gentry Award for Best Poster Presentation for her presentation on West Nile Virus in Malagasy birds all award winners can be found here. All of these delegates were supported with a relatively small amount of funding (USD\$5000 from Global Wildlife Conservation and USD\$3555 from Lemur Love) that was fundraised last-minute by individuals who were not part of the conference organizational team.

While it is true that a substantial number of the conference participants were Malagasy (about one month before the conference was due to start, one-third of conference

registrations were Malagasy people). Nevertheless, with a planning lead time of at least one year, more could have been done to ensure that no Malagasy person was dissuaded from submitting a presentation abstract because of the cost of registration. For context, the ATCB conference itself was sponsored by some of the world's biggest conservation and development agencies in the world including the World Resources Institute, WWF, and Conservation International. Other notable sponsors included Ambatovy (one of the world's largest nickel mines), the French Embassy in Madagascar, and numerous smaller international and national foundations and conservation organizations.

Looking forward, and specific to the Malagasy conservation and environmental sector, we urge the following:

- 1) any international conferences taking place in Madagascar should seek to maximize Malagasy participation, offering, at a minimum, highly discounted registration options to qualified Malagasy applicants. It is not unusual for other events and opportunities in Africa to price tickets based on ability to pay (e.g. in Kenya, national park fees are ten times higher for non-residents compared to Kenyan citizens). Alternatively, fees from researchers from high-income countries could be increased to cover the cost of Malagasy delegates. A similar model is used in Madagascar for research, wherein foreign researchers are legally obligated to include, train, and pay Malagasy students as part of their studies.
- 2) entities funding conservation programming in Madagascar, should take note of the need to support individual capacity building within the country, so that Malagasy researchers can continue to grow and share the international research stage as equals to their foreign counterparts. Few entities are willing to fund individual bursaries, scholarships, and conference fees. We understand that conservation funding is limited, but we contend that targeted support of talented Malagasy researchers is a cost-effective and impactful way to improve the long-term sustainability of conservation programming in the country. Moreover, lasting effects of *not including* these talented Malagasy scholars are certain to negatively impact conservation and relationships between foreign and domestic researchers.

## Conclusion

In sum, ATCB 2019 was successful in Madagascar in that over 300 Malagasy students and scholars were able to present their research, highlight their abilities, and network with an international audience. We encourage organizers of this and other international conferences to consider the needs of local scholars (including the cost of attendance in relation local income) into their planning, and how inclusion (or lack thereof), may impact conservation and development in these locations in the years following conferences.

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## Articles

### Introducing the Lemur Portal: a tool to improve research and conservation in Madagascar

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#### Introduction

Madagascar is a global treasure chest of biodiversity with extremely high levels of species and higher order endemism among terrestrial taxa (Goodman and Benstead, 2005; Crotini *et al.*, 2012). Madagascar is known as one of the world's poorest countries, which has resulted from decades of weak governance, declining rule of law, political crises (mainly between 2009 – 2013), networks of corruption and a lack of commitment of the government at several levels (Jones *et al.*, 2019; Ratsimbazafy *et al.*, 2019). These challenges contribute to driving the loss of Madagascar's biodiversity and a continuing increase in threats for protected areas and species, leaving only 10 - 15% of the country's original natural forests standing, with the remaining forested areas highly fragmented and at the brink of extinction (Kull, 2000; Vieilledent *et al.*, 2018). The biodiversity resources found in Madagascar are under extreme pressure from activities generated by a predominantly rural, natural resource dependent population. The most significant impacts arise from habitat loss through slash-and-burn agriculture, however hunting and fuelwood

extraction also have significant impacts in many locations throughout Madagascar. A 2014 study concluded that the Central Menabe dry forest may disappear completely before 2050 if the current rate of deforestation holds. Indeed, between 2008 and 2010, the average annual deforestation rate in the Menabe-Antimena was estimated at 1820ha or 2.55% (Zinner *et al.*, 2014). More recently, it has been reported that Madagascar has lost 44% of its natural forest between 1953 and 2014, primarily resulting from the deforestation attributable to human activities (Vieilledent *et al.*, 2018).

The most emblematic species, the 113 lemur species found in Madagascar represent a clear and well-known example of the high diversity and endemism affected by dynamic threats across the island (Mittermeier *et al.*, 2014). Madagascar's lemurs have the dubious honor of representing 20% of the species listed on the World's 25 Most Endangered Primates List. As a result of a recent Red-Listing workshop in Antananarivo in 2018, 34% of lemur species are now listed as Critically Endangered on the IUCN Red List, while 40% are Endangered and 21% Vulnerable (C. Schwitzer, pers. comm.). It is estimated that a large number of species will face extinction in coming decades if significant steps are not taken to reverse current trends (Allnut *et al.*, 2008). Many species have extremely small distribution areas and are restricted to fragmented and threatened forest remnants. In addition, the life history characteristics of lemurs, including highly specific habitat niches and feeding behavior, mean that they are amongst the species in Madagascar that will potentially be the most affected by the manifestations of climate change including changes to wet season precipitation, higher intensity cyclones, and more frequent droughts in coastal zones. Such climate related threats will exacerbate the prevailing anthropological threats faced by these species (McAllister *et al.*, 2017).

Despite awareness in conservation and research circles of the growing threats experienced by lemur species, in addition to a passionate international and national conservation community that has leveraged significant support for investment in research and field-based conservation actions, efforts to date have failed to reverse negative trends in lemur conservation statuses (Schwitzer *et al.*, 2013; Schwitzer *et al.*, 2014). The increasing incidences of illegal wildlife trafficking and capture of lemurs as pets are a clear illustration of the increasing gravity of threats these animals are facing in Madagascar (Reuter *et al.*, 2016). Between 2010 and 2015, more than 28,000 lemurs were estimated to have been illegally kept not only in various villages near protected areas but also in cities (Reuter *et al.*, 2015). A prominent example of poaching occurred in 2018 in the Andasibe region near the Antavolobe Forest, where 11 lemurs were killed (Lemur Conservation Network, February 2018). Conservation experts have confirmed that restaurants serve lemur meat across multiple regions, despite ongoing efforts to end the illegal bushmeat trade and protect these emblematic species (LaFleur *et al.*, 2019).

While concrete efforts remain underway, such as various community-based conservation programmes, there exists a strong need for capacity building for local communities, especially those living near protected areas. It is clear that individuals, communities and organizations must acquire a diverse set of skills, knowledge and attitudes in order to achieve biodiversity conservation goals. Enhancing local capacity will increase biodiversity stewardship and ownership, thereby positively impacting local conservation and development.

In accordance with these observations and recommendations, a technical workshop with over 40 representatives of