Tamarin Tales

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Newsletter of the Lion Tamarins of Brazil Fund

Yellow fever threatens the successful recovery of Golden Lion Tamarins

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The recovery of golden lion tamarin (GLT) populations in captivity and in the wild is seen as a conservation victory. In the 1980s, research on captive breeding of GLTs improved survival and reproduction ex situ. The number of GLTs and holding institutions increased to ca. 500 and 150, respectively, with the management goal of maintaining 90% of the genetic diversity of native GLTs. In 1983, the Smithsonian Institution's U.S. National Zoological Park and Brazilian partners initiated the Golden Lion Tamarin Conservation Program in Poço das Antas Reserve (Fig 1), initially consisting of field research on GLTs and community education using GLTs as a flagship species for habitat preservation. Program staff and partners held workshops to set conservation goals with a desired outcome of an in-situ GLT population with 0% probability of extinction and 98% retention of genetic diversity using VORTEX simulation software. Results from the modeling indicated that at least 2,000 GLTs in 25,000ha of connected and protected forest would be necessary to meet those demographic and genetic criteria.

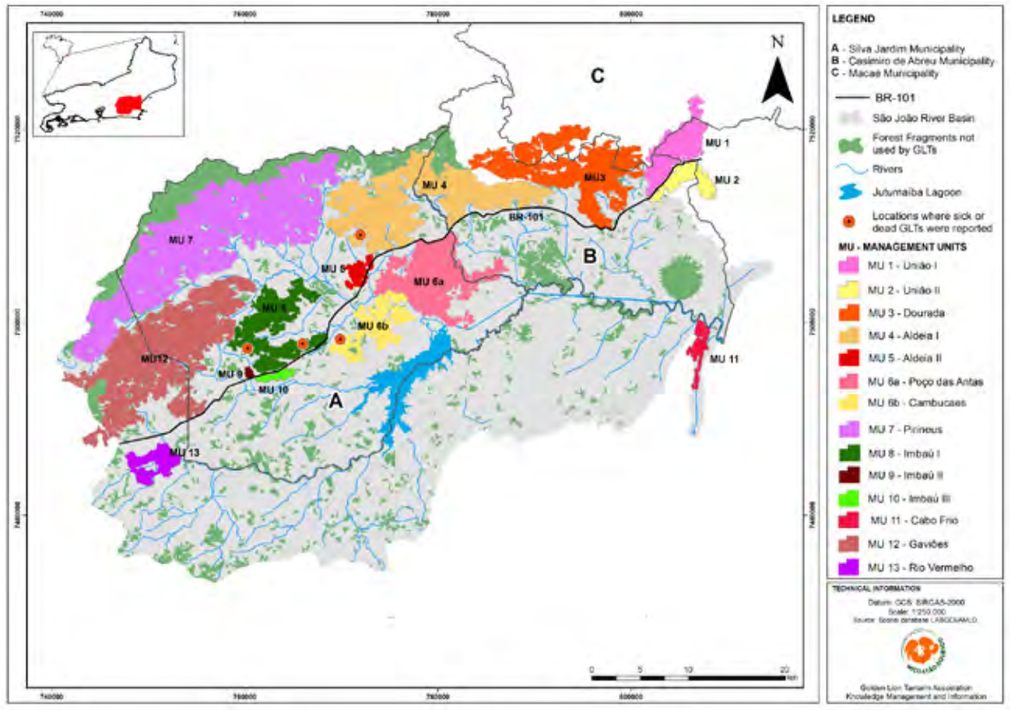

Figure 1. São João river basin, geographic range of most golden lion tamarins, 80 km northeast of the city of Rio de Janeiro, Brazil. Management units (MUs) are fragments of forest used by tamarins (i.e. below 500m elevation) that are partially or completely isolated from other fragments of tamarin habitat.

From 1984-2001, program staff and assistants from the local community reintroduced 146 zoo-born GLTs, the majority on 40 private properties in the São João river basin, Silva Jardim Municipality (Fig 1). Reintroduced GLTs were chosen from 43 institutions in 8 countries with the objectives of reintroducing a significant portion of the genetic diversity represented in the captive population and increasing numbers in the wild.

Descendants of reintroduced GLTs flourished and increased to ca. 1,100 individuals. From 1994-1998, 42 native GLTs, i.e., animals not descended from zoo-born individuals were rescued from small forest fragments and translocated to a large fragment that would become União Biological Reserve. Descendants of these translocated GLTs soon occupied all suitable habitat in that forest fragment. In 1992, the U.S. National Zoological Park's GLT Conservation Program was transformed into the Associação Mico-Leão-Dourado (AMLD; the golden lion tamarin association), a Brazilian non-governmental organization with the mission of achieving the science-based conservation goals of 2,000 GLTs in 25,000 ha of connected and protected forest. In 2003, the IUCN conservation status of GLTs was changed from "critically endangered" to "endangered". In 2014, AMLD completed a census of GLTs throughout their geographic distribution. Results (available here: GLT 2014 census, PLOS One 2019) indicated that ca. 3,706 GLTs lived in 41,411 ha of forest, albeit not all connected and protected. GLTs were found in 13 forest fragments, which we refer to as management units (MUs), that are completely or partially isolated from one another (Fig 1).

The yellow fever virus is endemic to regions of Africa and the Americas. It is transmitted to humans or non-human primates (NHP) through the bite of infected mosquitoes. All Brazilian primates are susceptible to it, including *Callithrix*, *Leontopithecus*, *Sapajus* and *Alouatta*, the four genera co-occurring in the São João river basin. In the sylvatic cycle, mosquitoes become infected with yellow fever by biting infected people or NHPs. The bite of infected mosquitoes can transmit the virus to other people or NHPs. Increased travel of people in forests near urban areas in southeastern Brazil increases the risk of humans contracting yellow fever from infected mosquitoes and/or spreading the disease to NHPs. Most people infected with yellow fever experience mild or no symptoms. A small minority of infected people develop a more serious form of the disease resulting in severe symptoms or death. An effective vaccine provides life-long immunity to the disease in humans. The mortality rate in NHPs infected with yellow fever virus is high in howler monkeys, medium in marmosets and lion tamarins, and low in capuchin monkeys. Lack of howler monkey vocalizations and grouped temporal and spatial patterns of deaths have been a signal to local health authorities of the presence of the disease and the need to vaccinate people in the region.

Beginning in November 2016, southeastern Brazil experienced the most severe yellow fever epidemic/epizootic in the country in 80 years. From July 2017 to May 2018, 752 NHP deaths were attributed to yellow fever in Rio de Janeiro state as confirmed by laboratory analyses. Relatively few monkeys that die in the forest are recovered and delivered to laboratories to determine cause of death, thus the number of deaths associated with yellow fever underestimates actual losses, especially in small primates such as GLTs.

In April 2018, AMLD received a report of a sick GLT unable to climb trees. AMLD field staff visited the location but were unable to find the animal. In April 2018, AMLD staff found three recently dead howler monkeys in Poço das Antas (MU 6a), a dead GLT in Cambucaes (MU 6b), and a dead GLT in Imbaú I (MU 8). In May 2018, AMLD staff found a second dead GLT in Imbaú I (MU 8). AMLD delivered the three dead GLTs to a Rio de Janeiro state health department laboratory. Cause of death was not determined for two GLTs. In May 2018, the laboratory determined that the GLT found in Cambucaes was infected with yellow fever (MU 6b). This was the first documented case of a GLT dying of yellow fever. In August 2018, AMLD recovered skeletons of four more howler monkeys in Poço das Antas (MU 6a,) and received reports of dead howler monkeys in nearby forest fragments. One of the howler monkeys tested positive for yellow fever. In April 2019, a landowner reported two dead GLTs and three dead howler monkeys in Cambucaes (MU 6b). AMLD recovered part of the skeleton of one howler monkey but found no sign of the dead GLTs.

"...experienced the most severe yellow fever in the country in 80 years."

In 2018, AMLD field staff repeated part of the 2014 playback survey to estimate reductions in GLT populations relative to estimates done in 2014. Results indicate that tamarin numbers declined 32%, with ca. 2,516 individuals remaining in situ. Tamarin losses were significantly greater in forest fragments that were larger, had less forest edge and had better forest connectivity, factors that may favor the mosquito vectors of yellow fever. While we cannot rule out other diseases, yellow fever is the mortality factor most likely to have caused the reductions in GLT populations in 2018. We reach this conclusion because of the rapid and widespread disappearances of GLTs, the positive laboratory diagnostic testing for yellow fever in one dead GLT, and the temporal and spatial coincidence with deaths of howler monkeys, some confirmed to have been caused by yellow fever. During January – April 2018, eight groups of GLTs disappeared from their

territories in the Poço das Antas Reserve. From October to December 2018, AMLD researchers saw only 5 GLT groups in that Reserve. Group sizes were abnormally small and only one infant was observed. One lone adult male spent eight months moving around the Reserve, apparently looking for a mate, and disappeared in 2019. We conclude that yellow fever is the most likely explanation for the near-complete decimation of the GLT populations in Poço das Antas Reserve and Pirineus (MU 7).

Losses of GLTs in 2018 highlight the importance of conservation efforts in the 1980s and 1990s. Descendants of reintroduced zoo-born GLTs and translocated rescued native GLTs comprised ca. 41% of the in-situ population in 2014, and 72% in 2018. If AMLD and partners had not done reintroductions and translocations of GLTs in vacant habitat decades ago, we estimate that only 675 GLTs would remain in four isolated MUs in 2018. Reintroductions of zoo-born GLTs would have been necessary.

The future of conservation of GLTs depends on whether populations suffer additional losses to yellow fever in coming years. GLT populations have the potential to grow 13-14% per year and can quickly repopulate areas of adequate habitat if the mortality rate is not high. Regardless, the impact of yellow fever on GLT populations will significantly increase the cost of reaching AMLD's science-based conservation goal. The number of GLTs remaining in the wild, estimated at 2516 individuals, is just adequate to meet management goals. However, heavy losses of GLTs in what were two of the largest populations will make it much more difficult to reconnect forest fragments holding at least 2000 GLTs. Prior to the onset of yellow fever, connection of three MUs would meet management goals. In light of current GLT population size estimates, it will be necessary to connect eight MUs. The cost of planting these additional forest corridors will be significant. For example, AMLD estimates the cost of completing planted forest connections between MUs 7 and 12 at US$138,216. Additional funds also will be necessary to monitor and manage small populations of GLTs by translocations until forest connections are in place. Continuous monitoring will be necessary to detect future losses to yellow fever and adapt strategies as appropriate. Additional research will be necessary to explain the differences in impact of yellow fever on GLT populations in MUs, and whether some GLTs survived the disease and acquired immunity to it. AMLD partners developed a safe and effective vaccine to protect GLTs from yellow fever. If yellow fever persists in forests occupied by GLTs, this vaccine may make the difference between losing this endangered species and keeping it from extinction.

How your zoo can help keep GLTs safe from extinction.

- Make financial contributions earmarked for GLTs through the Lion Tamarins of Brazil Fund.
- Encourage your staff (educators, keepers, communications, collection managers, exhibit designers, vets, etc.) and volunteers to follow current information on GLT conservation on these websites and social media (English: http://www.savetheliontamarin.org/ and Facebook; and Portuguese: www.micoleao.org.br, Facebook) and to share it with your public.
- Share current information about GLT conservation and how your zoo is helping in your exhibits, websites and social media.
- If you participate in the GLT cooperative breeding program, follow the recommendations of the GLT Studbook Keeper and provide him/her with updated information.

The following institutions have made multi-year commitments in support of AMLD's strategic plan to conserve Golden Lion Tamarins (in alphabetical order and without regard to size of financial contribution). We are grateful for your support!

- Atlanta Zoo
- Copenhagen Zoo
- Disney Conservation Fund
- EDF—Norte Fluminense
- DOB--Ecology
- Dublin Zoo
- Gaia Zoo
- Philadelphia Zoo
- Save the Golden Lion Tamarin
- Saving Nature (formerly Saving Species)
- Smithsonian's National Zoo & Friends of the National Zoo
- Wellington Zoo

If you would like additional information about AMLD's progress in achieving its strategic plan please download AMLD's 2019 annual report here AMLD/SGLT 2019 annual report.

Stakeholders Unite for the Bahian Lion Tamarin

- a Strategic Planning Workshop to save *Leontopithecus chrysomelas*

Kristel De Vleeschouwer[1,2], Ana Claudia Fandi[1,2], Leonardo Oliveira[2], Becky Raboy[1], Peter Galbusera[1], Kristin Leus[3] and Lou Ann Dietz[4]

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[3] CPSG Europe; Copenhagen Zoo; European Association of Zoos and Aquaria
[4] Save the Golden Lion Tamarin

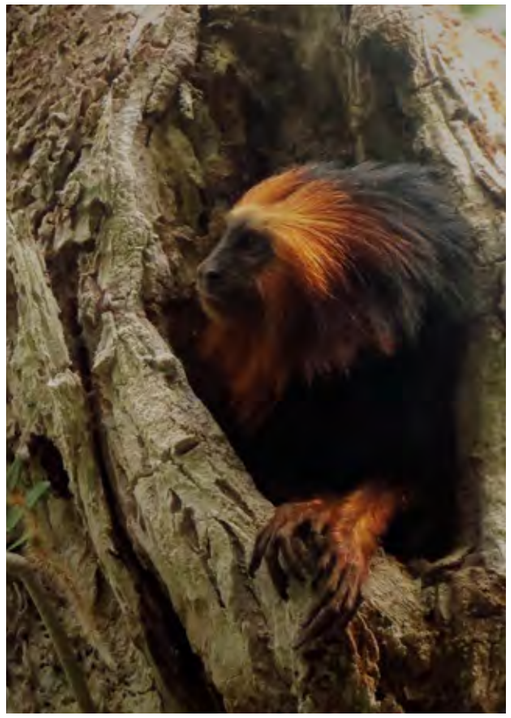
Though more numerous than originally thought, there is strong evidence that golden-headed lion tamarin (*Leontopithecus chrysomelas*) numbers have been continuously declining and that the high degree of fragmentation of their habitat has led to local extinctions and range contraction. Moreover, there is deep concern for their health due to rapid urbanization and intensifying agriculture. The main threat to the species' long-term survival is the ongoing loss and fragmentation of its habitat, reducing connectivity between forest fragments.

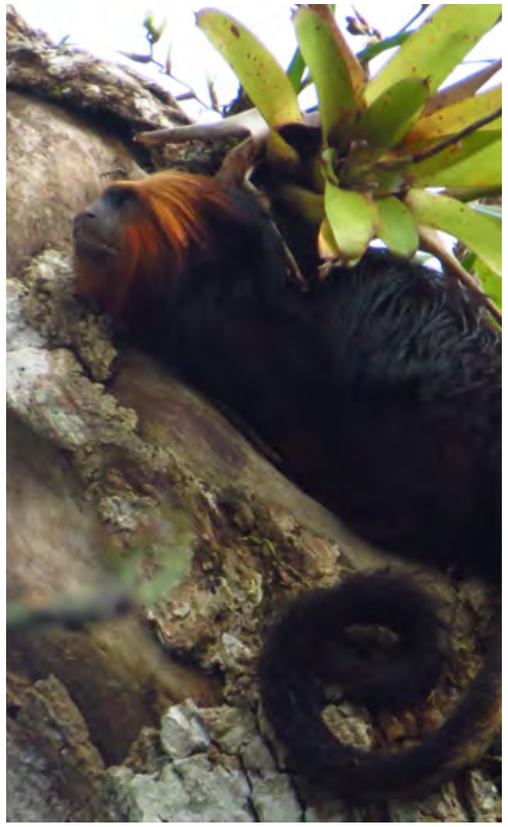
Deforestation and degradation of the remaining forest habitat occurs as the result of a variety of pressures associated with selective logging, hunting of seed dispersers, sand and gravel mining, urban expansion, slow implementation of conservation units, and alteration of natural vegetation on rural properties. Shade cocoa plantations (cabruca), the principal habitat ensuring connectivity between remaining forest fragments, are also increasingly under siege from the conversion to sun-grown coffee, while new regulations and the introduction of sun-tolerant cocoa clones reduce the requirement for shade trees which are important for GHLTs. Furthermore, the possibility of vector-borne diseases like yellow-fever decimating the remaining wild populations of GHLTs, similar to what has happened to GLTs, is a potential threat, as is transmission of other zoonoses and predation by dogs.

Historically, conservation efforts for GHLTs focused on strengthening protected areas, public education, and research, yet integrating these efforts into a broader conservation vision has lagged. Coordinating conservation efforts for GHLTs is particularly challenging given the large number of stakeholders involved.

Southern Bahia has many stakeholders and institutions with relevant expertise in local conservation of forest, wildlife, traditional agricultural systems and associated culture heritage. While these actors share a common goal of protecting the Atlantic Forest, each has been working largely in isolation, resulting in disjointed conservation action and limited results. Ensuring the involvement of all interested parties, especially local communities, is an important step to develop and implement actions that have positive long-term impact on the viability of the GHLT species. Further, existing relevant scientific information needs to be made more readily available to practitioners. A high level of communication and commitment among all parties – local, regional, national, and international - is critical to benefit fully from existing expertise to achieve effective and efficient actions to ensure a viable population of GHLTs into the future.

Therefore, we, as a group of concerned professionals, mounted the Bahian Lion Tamarin Conservation Initiative, with the aim of advancing golden-headed lion tamarin conservation through science-based planning and action. In particular, the Initiative aims at capitalizing on expertise that is already present and complementing, improving and reinforcing it through the development of a coordinated institutional network committed to conservation of the species and the landscape in which it resides. We opted to use the name Bahian Lion Tamarin, calling attention to the fact that, since this species has its main distribution in Bahia, it depends on the pride and responsibility of the Bahian people to help save it as part of their cultural and regional heritage.





Researchers, practitioners and local representatives jointly developing a Theory of Change on how to achieve financial and political resources to support conservation actions for GHLTs.

The Royal Zoological Society of Antwerp, with its historic involvement in conservation efforts for this species, in collaboration with Bicho-do-Mato Instituto de Pesquisas, held a Strategic Planning Workshop in Ilhéus, Bahia, 20 to 25 October 2019 to launch the Initiative. Through participatory planning involving all stakeholders, the workshop aimed to develop a 10-year Strategic Plan for the conservation of the GHLT species.

Thirty-five participants from 23 local, national and international institutions participated. After a field trip to the BioBrasil study site to see wild GHLTs and their landscape, participants used the Open Standards for the Practice of Conservation to develop the Strategic Plan. They analysed direct and indirect causes and associated factors for five threats: reduction of shade trees in the cabrucas; hunting of seed dispersers; conversion of cabruca and forest into coffee plantations; sand and stone mining; and lack of implementation in conservation units and other protected areas.

Next, participants identified key factors in this situation analysis related to devaluation of cabruca, insufficient knowledge on environment and environmental legislation, the slow process of land regularization, lack of financial resources, and the existing managed international captive population as potential intervention points from which to build strategies for change. Subsequently, the participants formed working groups to elaborate complete theory of change models to show how they thought each of these strategies would reduce the critical threats and contribute to maintaining the viability of GHLTs over the next ten years.

The resulting Strategic Plan contains three major strategies involving actions in the region aiming at safeguarding the species habitat, by reducing deforestation and degradation and maintaining cabruca plantations as principal connecting habitat. These strategies are:

- Appreciation of Land, Territory and Cabruca: a series of actions focusing on restoring cabruca as a valued regional cultural identity inspiring local pride, creating a GHLT-friendly certification for cabruca cocoa, training of cocoa producers in adequate cabruca management to produce quality cocoa meeting the requirements of the certification, and finding markets to sell the certified products at prices that serve as an incentive for producers to maintain cabruca on their land.
- Environmental Outreach: a series of actions targeting both producers and the general public, to increase their insight regarding environmental issues, improve their understanding of environmental legislation, and increase their awareness of the human well-being benefits of conservation of GHLTs and their forest habitat, thus aiming at increased local support for protected areas and compliance with environmental legislation.
- Land Tenure Regularization: a series of actions focusing on obtaining the necessary information to regularize land tenure of decreed conservation units, and to complete obligatory registration of private rural properties to monitor their compliance with environmental legislation.

Three additional strategies support the implementation of the three above:

- Ex Situ management: aiming at involving zoos in conservation efforts for the species, both by securing a back-up population that can provide animals for reintroduction in the case of depletion of wild populations (e.g. due to yellow-fever), and by conducting education and fund-raising to support conservation actions.
- Financial and Political Resources: aiming at finding and mobilizing existing and new financial and political resources to support implementation of specific actions.
- Communication and Institutional Network, to maintain and increase the level of communication among stakeholders, and to establish an institutional network that can coordinate implementation of the Strategic Plan.

At the end of the five days, participants were exhausted, but extremely satisfied with the Strategic Plan and new connections made. The most important achievement was that for the first time, all stakeholders (scientists, landowners, local producers – small and large, protected area managers, municipal environment officials, educators, international zoo community) met face-to-face, presented and listened to each other's ideas, and developed a level of mutual respect and trust that resulted in a Strategic Plan to which all are committed to carrying out.

Under the Bahian sun and with the support of the Bahian people, the future for golden-headed lion tamarins looks a lot brighter!

Acknowledgements:

We sincerely thank Jim Dietz for many contributions, including translation during the workshop, and his lifelong support for the GHLT cause. We warmly thank all participants for continued attendance, constructive contributions and discussions. We also thank Igor Inforzato for logistic support and photographing the event, and Lara, Islândia, Claudia and the entire team of Hotel Aldeia da Praia for excellent logistic organization and catering. This workshop was funded by the Antwerp Zoo Foundation.

ABUN - Artists & Biologists Unite for Nature

Kitty Harvill

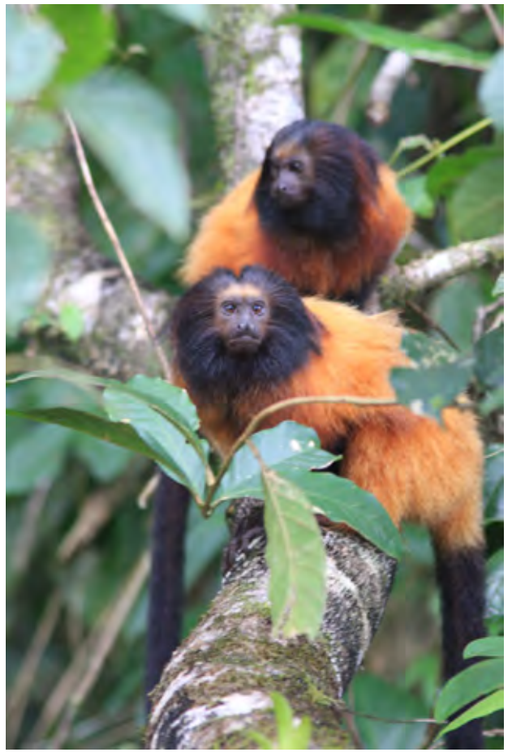
ABUN is a collection of nature and wildlife artists, serving the biology and conservation community with images for their use in promoting awareness. The group was founded in 2016 by professional wildlife artist, Kitty Harvill, and her husband Christoph Hrdina, a pioneer in ecotourism in Brazil and Naturalist. ABUN uses Artwork to raise awareness of endangered species by providing images to biologists and their organizations for educational and marketing purposes. With membership at more than 1,000 members worldwide, ABUN's Projects have served the biology communities in Brazil, Africa, Bolivia, Peru, Sumatra, Romania, Asia, India, Vietnam, Costa Rica, St. Lucia, Mongolia, the USA and currently the southern seas where all 22 species of Albatross fly.

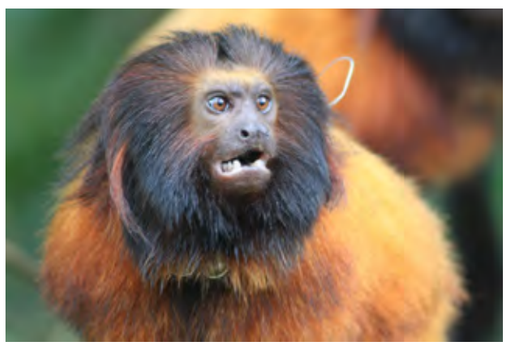
Painting by Kitty Harvill

The final Project of 2019 was in collaboration with SPVS (Sociedade de Pesquisa em Vida Selvagem e Educação Ambiental) to serve their current Project for the Black-faced Lion Tamarin. The SPVS team's overarching goal is to set the basis for the long-term management of Black-faced Lion Tamarins in the two protected areas where they are present in both the states of Paraná and São Paulo. All four species of Lion Tamarins are endemic to the Atlantic Forest of Brazil, the forest itself can be considered an endangered ecosystem and SPVS is playing a major role in its conservation with their strategy for the Grande Reserva Mata Atlântica (http://grandereservamataatlanitca.com.br/en/home/).

Clóvis Borges, Executive Director of SPVS, had this to say about ABUN's collaboration:

"The drawings and paintings of the Black-faced Lion Tamarin by ABUN artists will inspire people to respect and value the species and biodiversity. There is much beauty, sensitivity and dedication in each artwork presented by the group. We were very moved. For the project, this work will be very valuable! We will create educational activities in schools with children, youth and teachers and we will use ABUN's material. We will also use the Artwork in lectures, and in educational and communication materials. It's an incredible partnership : conservation and art complement each other."





Photos by Kitty Harvill

Lion Tamarins of Brazil Fund

- an update

Bengt Holst, co-custodian of the LTBF

From July 2017 to December 2019 the Lion Tamarins of Brazil Fund received a total of 152.619 US$. The money was received from 15 different donors from Europe and the United States, including 90.000 US$ that was sent directly to the Golden Lion Tamarin programme, but initiated through the LTBF. 15.000 US$ was earmarked to specific species in the framework of “adopt a group” arrangements – arrangements where each zoo contributes an amount of at least 5.000 US$ a year to a specific conservation programme and receives in exchange regular reports from the field that they can use in their conservation interpretation activities in the zoo.

During the same period 5.000 US$ was granted to the Niteroy project described in the last edition of Tamarin Tale in support of the removal of invasive Golden-headed Lion Tamarins from the Golden Lion Tamarin distribution area. As described in the present volume of Tamarin Tales an outbreak of yellow fever in Brazil has had a huge impact on the Golden Lion Tamarin population, resulting in the death of many tamarins. The heavy reduction in the number of Golden Lion tamarins surviving and their distribution in the landscape makes it necessary to adapt the existing conservation action plan for the species, and new surveys are needed. All this costs money, and if we want to continue the success of this programme we need to raise enough funds for making the necessary changes happen.

It is thus my sincere hope that your generous support will continue in the coming years. Conservation is a question of long term commitment, and a loyal group of supporters is the best one can wish for serious conservation projects. I thus want to thank all institutions and single persons cordially who have contributed to the Lion Tamarins of Brazil Fund during the reporting period. A special thank to those who have indicated to continue their valuable support also in the years to come. All contributions, big and small, are most appreciated and are earmarked for field projects supporting Lion Tamarin conservation.

From July 2017 till December 2019 the following institutions have contributed to the Lion Tamarins of Brazil Fund:

Donations over $10,000

Beauval Nature

Copenhagen Zoo

Dublin Zoo

Donations $5000 to $10,000

La Vallée des Singes, Romagne

Donations $1000 to $5000

Besancon Zoo

Calviac Zoo

Drusillas Zoo, Sussex

Jeremy Mallinson

La Palmyre Zoo

Stichting APCT, Apeldoorn

Zoo d’Asson

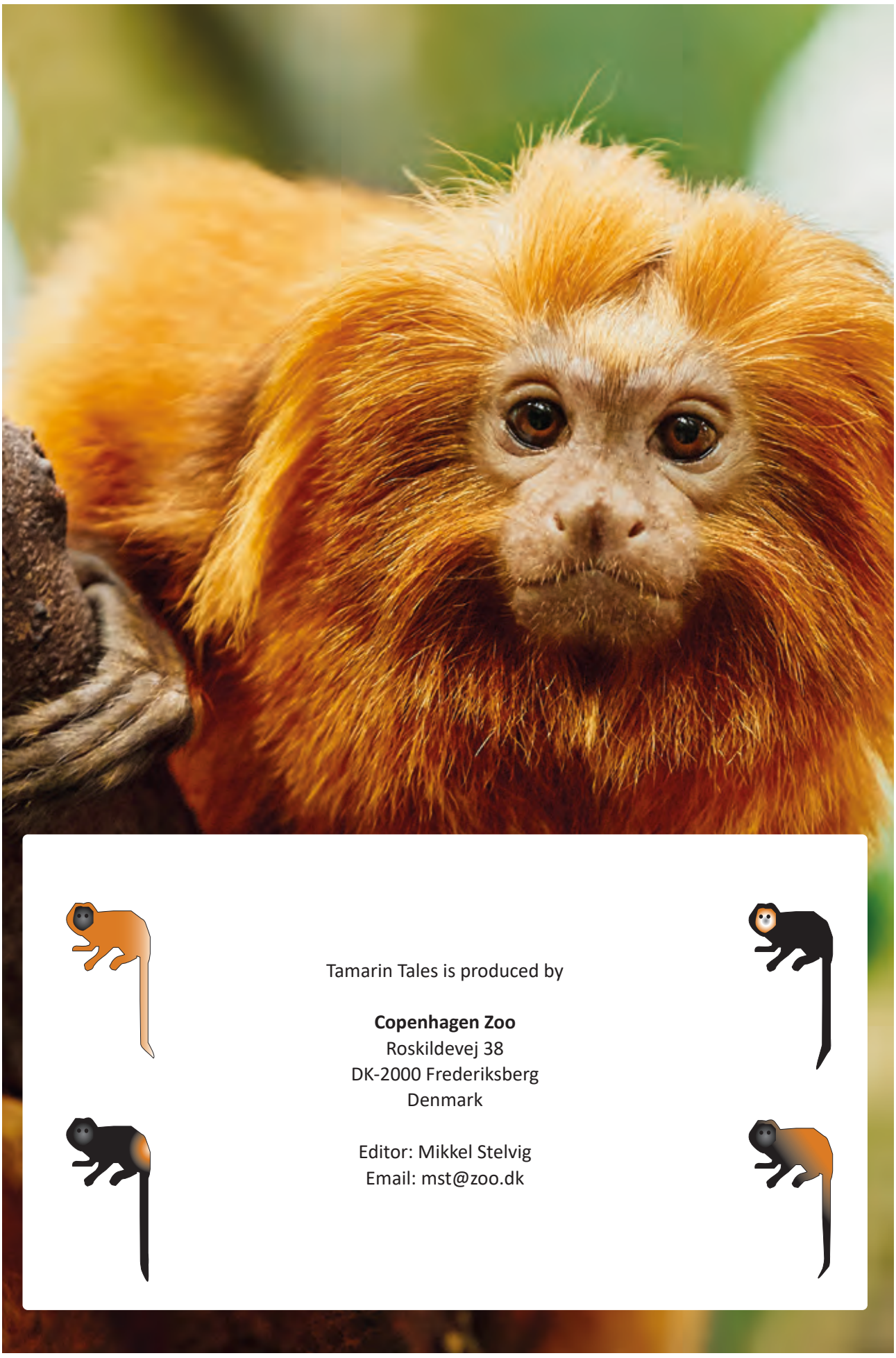
Donations $100 to $1000

Belfast Zoo

Jerusalem Zoo

Kristiansand Dyrepark

Shaldon Wildlife Trust



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