GIANT ARMADILLO CONSERVATION PROGRAM

2023 | *ANNUAL PROGRESS REPORT*

ICAS | Wild Animal Conservation Institute

www.icasconservation.org.br

Arnaud Desbiez, president and founder of ICAS, checking a camera trap in the Pantanal.

Executive Summary

The giant armadillo (*Priodontes maximus*) is the largest armadillo species, reaching up to 150 cm and weighing up to 50 kilograms. They range over much of South America, yet due to their cryptic behavior and low population densities, they are rarely seen. Unfortunately, this enigmatic species is threatened with extinction and is currently classified as Vulnerable (A2cd) by the IUCN/SSC Red List of Threatened Species. Basic information about the species was lacking when we initiated the Giant Armadillo Conservation Program (GACP) in 2010. Our project successfully established the first long-term ecological study of giant armadillos in the Brazilian Pantanal and has now expanded to three other biomes, using the species as a catalyst for promoting biodiversity conservation.

The main objectives of the GACP are to investigate the natural history, biology, ecology, health and genetics of giant armadillos, to understand their function in the ecosystem and utilize field data to inform conservation outreach and planning, as well as to influence public policies and decision-making. The project's goal is to

make giant armadillos ambassadors for biodiversity conservation, particularly in highly threatened biomes like the Cerrado and Atlantic Forest. The project has pioneered methodologies to investigate giant armadillos, promoted conservation awareness through environmental education and outreach programming, influenced public policies and is now one of the leading projects in capacity building for aspiring conservationists (with over 95 Brazilian wildlife biologists and veterinarians trained).

The GACP began in June 2010 at the Baia das Pedras Ranch in the Brazilian Pantanal wetland and since then has obtained a variety of excellent results. In 2023, six new scientific papers were published, meaning we have now published over 35 scientific papers about giant armadillos. In addition to our long-term project in the Pantanal, where 4 new animals were caught, this year we expanded our community firefighting brigade to include 22 ranches covering 1,600 km^2. In the Cerrado of Mato Grosso do Sul, we have consolidated our work in a municipal park, the only protected area for giant armadillos in our state. We also expanded our camera trap grid (N=85), and even registered two species of tegu lizards and the seven-banded armadillo, none of which had been registered in our state. New funding opportunities will allow us to greatly expand this work in 2024. We now have 150 certified beekeepers who are coexisting with giant armadillos. Sixteen of these beekeepers have been certified in four other Brazilian states. Giant armadillo-friendly honey can be found in many of the supermarkets and stores in Mato Grosso do Sul and more recently even in the state of Pará. We have provided 140 queen bees to 10 beekeepers and tested three new methodologies to prevent giant armadillo attacks. At Rio Doce State Park, where the last population of giant armadillos in the Atlantic Forest has survived, we held our third species conservation workshop, expanded our work outside the park, started a sustainable livelihood project and initiated work with beekeepers.

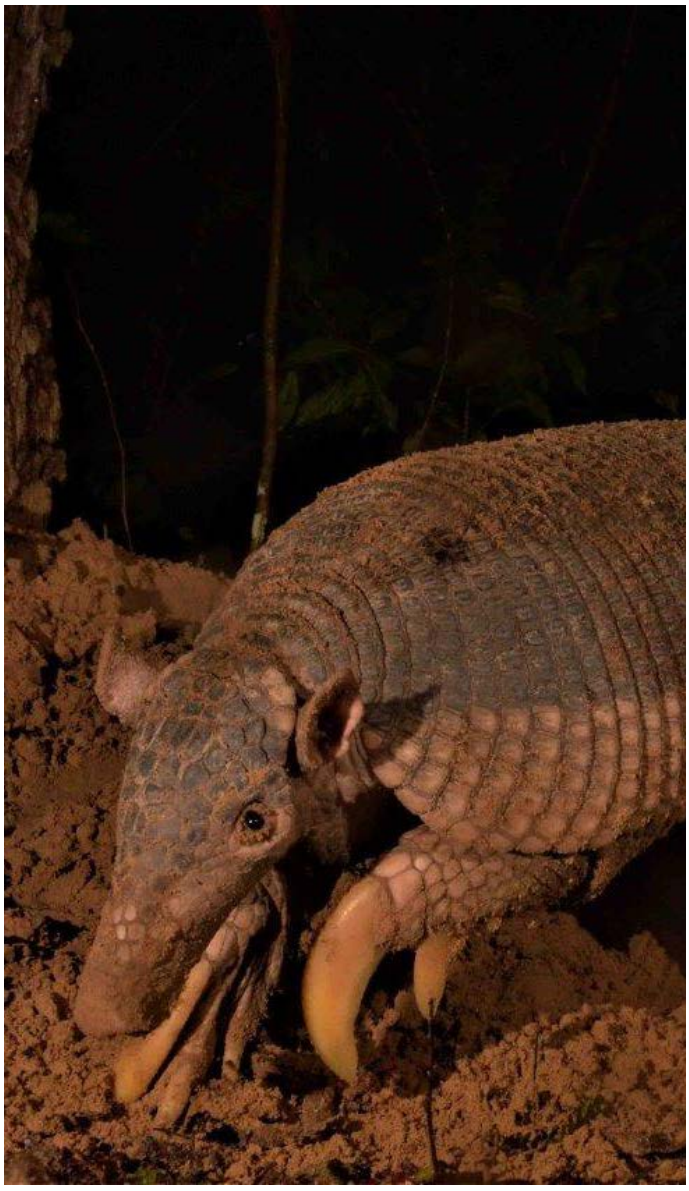
Education and communication are at the core of what we do, but these will be detailed in a separate report.

In March 2023, we conducted a three-year strategic action planning exercise, which is available to download at:

https://cpsg.org/content/icas-institutional-planning-2023-2027-portuguese

https://cpsg.org/content/icas-institutional-planning-2023-2027-english

The Giant Armadillo Conservation Program team now includes: 10 full-time staff, 6 part-time staff (working half of their time with giant armadillos and the other half with giant anteaters), 2 collaborators, 1 undergraduate student working on her final project, 1 MSc student, 3 PhD students, and 1 postdoctoral researcher and over 30 collaborating institutions. Biologist and coordinator of the Giant Armadillo Atlantic Forest Project, Lucas Barreto, has become a ZSL EDGE fellow and will receive capacity training for the next 2 years. In 2023, the project was supported by 9 zoos, 1 foundation, 1 association, 2 government funds and several private individuals. We are incredibly grateful to our partners and donors who have supported us.



2023 Highlights from our Projects

Giant Armadillo Pantanal Project in 2023

A major highlight this year was that, thanks to two generous donations, we built a new field station with two rooms and a bathroom. Finally, we will no longer need to camp and will have a comfortable place to sleep. We captured new animals and are excited to report that Isabelle, who has been monitored by our team for over a decade, was recorded with a new pup.

- 11 expeditions to the Pantanal took place this year at the Baia das Pedras Ranch.
- 4 new giant armadillos were captured (3 females, 1 male), 3 of which were fitted with telemetry devices.
- Continued monitoring through cameras in the permanent grid (N=50).
- Isabelle is over 20 years old and was recorded with a pup using cameras, providing the first estimate of reproductive longevity for giant armadillos.
- Continued extension work in neighboring ranches, sharing information about giant armadillos.
- 7 new ranches were incorporated to the community firefighting brigade. Our brigade now includes 22 ranches that protect 1,600 km^2 of land from wildfires. Six training sessions on equipment use and firefighting practices, as well as a course on identifying poisonous snakes and what to do if bitten were offered to 60 ranch workers.
- No out-of-control wildfires have occurred since we started our community fire brigade three years ago. Gabriel Massocato went to Bolivia to learn about integrated fire management practices.
- Thanks to our close collaboration with Argentinean researchers our team published in the Provincial Action Plan for giant armadillos in the Province of Chaco, Argentina. Arnaud wrote the foreword of the plan. Captures in the Chaco continue and one animal was captured and fitted with a GPS.
- Key capacity building provided to biologists from Colombia and Bolivia and a veterinarian from Argentina. We also continue to provide mentoring for a project in Guyana, as well as for new student projects in Brazil. Five other nationals were also trained. A zookeeper from Edinburgh Zoo visited.

Plans for the Pantanal in 2024

In 2024, we will continue our long-term study of the species in the Pantanal, which is crucial to our research and conservation efforts in all biomes. Captures will continue to focus on adult females for us to monitor and gather more data on reproduction. We will expand camera monitoring to work in Isabelle's home range to follow the progress of her pup. We will continue to monitor our extensive camera trap grid (N=35). The grid will help us to identify individuals using the area, monitor social interactions (animals visiting each other's home range), reproduction events, and the health of the armadillos and key individuals that are not monitored through telemetry. We are committed to run another training session on firefighting to maintain our community fire brigade, while continuing to monitor fires in the region through daily satellite imagery.

Giant Armadillo Health Initiative in 2023

Two new members have joined our team, Mayara Cayaffa and Carolina Lobo. Mayara was hired to work for the Giant Armadillo Conservation Program in the Pantanal. Carolina Lobo is studying for her master's, focusing on basic aspects of female giant armadillo and giant anteater reproduction. Now ICAS's veterinary team has six members each specialized in different fields to conduct research on giant armadillo and giant anteater health.

- One Health initiative: This study, which is part of Danilo's PhD, aims to evaluate the impact of deforestation on zoonotic pathogen transmission between humans, domestic dogs and armadillos from the Pantanal and Cerrado of Mato Grosso do Sul state. In the Pantanal, 60 armadillos (giant, six-banded and southern naked-tailed armadillos) were captured for the collection of biological samples. In the Cerrado, 25 roadkilled armadillos were also sampled. All biological samples collected are being distributed among laboratories in Brazil, the United states (Leprosy) and France

- Matheus Yan finished his study focusing on the presence and identification of insects from giant armadillo burrows in the Pantanal. The results showed several new species of insects, including a new species of soft tick (Argasidae family) never described in giant armadillo burrows. Over 300 species of arthropods benefit from giant armadillo burrows.

- In the Pantanal, a wild crab-eating fox showing neurological clinical signs tested positive for canine distemper virus (CDV) and parvovirus. Giant armadillo samples were analyzed for both diseases, and up to this point, the results for all animals have been negative. That is, apart from one six-banded armadillo (out of 50) who was positive for CDV. This disease is considered a potential risk to animals that share giant armadillo's burrows or ecosystems. Based on this, our vet team developed a task force and began fundraising with the goal of vaccinating all domestic dogs from farms around our study areas.

- Our project entitled "One burrow, one health: The giant armadillo as an epidemiological surveillance agent to develop health initiatives for wild animals, domestic dogs and humans" was one of the fourteen projects selected by FUNBIO (Brazilian Biodiversity Fund).

Plans for the Health Iniatiative in 2024

Our One Health study, as part of Danilo's PhD, will begin by investigating diseases in domestic dogs that live near the study areas in the Pantanal and the Cerrado. At the same time, a vet task force will be created to vaccinate the dogs against diseases that can affect wild animals and humans, such as rabies. The next step will be to take samples from people living alongside armadillos in these two biomes. Our team will focus on new reproduction studies on female armadillos and giant anteaters. Capacity building and training will be provided to the vet team in the field by national and international specialists. Ultrasound, biological samples, and semen collection will be performed to understand patterns and develop reproduction guidelines for our two giants. Finally, all data obtained during these thirteen years studying the health of giant armadillos will be gathered and published in our first Giant Armadillo Veterinary Medicine Guide. We will also continue to focus on capacity building.

Giant Armadillo Cerrado Project in 2023

The main goal of this project is to implement Integrated Management Areas (IMAs) for giant armadillos to help prioritize and protect key areas for giant armadillo conservation in the Cerrado of Mato Grosso do Sul. This year, we have consolidated our long-term field research site in the Parque Natural Municipal do Pombo (PNMP). Protecting 8,032 hectares of native biome, this is the only formally protected fragment of Cerrado in Mato Grosso do Sul where the giant armadillo has been recorded.

- The camera trap grid in the PNMP was expanded and now covers the whole park. The grid is comprised of 85 cameras and 75 km of trails.
- Two new species of tegu lizards that had not been described in the state of Mato Grosso do Sul have now been recorded (see publication).
- Using a morphological and molecular approach, we confirmed the presence of *Dasypus septemcinctus* in the PNMP. This means 8 species of Xenarthra are found in this park. This is the first confirmed observation of this species of armadillo in Mato Grosso do Sul state.
- Recorded new giant armadillo behavior, including scratching trees.
- Strengthening of relationships between our NGO, municipality, and universities through meetings.

Plans for the Cerrado in 2024

Our goal in 2023 was to consolidate our presence in the PMNP and to strengthen our relationship with the municipality that manages the park, as well as with the local community. 2023 was also used to plan future steps and fundraise for this fundamental work. We are excited to announce that we have been granted a Whitley Fund for Nature continuation grant to help us do just that. The project will aim to increase the legal protection, visibility, and value of the PNMP; implement pilot initiatives with the community to improve, restore or protect land, increasing habitat connectivity and permeability; and use giant armadillos as landscape detectives analyzing their movement to identify the best areas to improve, restore or protect land. We are also pleased to report that we will initiate a partnership with Suzano, a multinational for eucalyptus plantations, to explore ways in which they can protect and adapt their management practices to help conserve giant armadillos. In addition, we are planning a variety of new initiatives with local stakeholders. In 2024, this project will be greatly expanded.

Armadillos & Honey Project in 2023

Giant armadillos are being killed by beekeepers because these animals destroy their beehives to consume bee larvae. One giant armadillo can destroy a beekeeper's livelihood in a matter of weeks. This can lead to retaliatory killing. The main goal of this project is to promote the coexistence of beekeepers and giant armadillos to stop these retaliatory killings of giant armadillos. Beekeepers can benefit from the presence of through a wildlife-friendly certification scheme that will open up new markets their products.

- 150 out of an estimated 200 beekeepers have been or are in the process of being certified in Mato Grosso do Sul.
- The project has expanded beyond Mato Grosso do Sul, and 16 beekeepers in 4 other states have been certified (São Paulo, Goiás, Minas Gerais, Pará).
- Team participated in 2 major conferences in Argentina and Brasília.
- Certified honey is being sold at a higher price (10%) and increases sales by 20% according to a case study.
- Three new methods to prevent giant armadillo attacks have been tested.
- A new model apiary of giant armadillo-friendly honey has been built by a cooperative to showcase techniques, and another model apiary is under construction through another association.
- A new project to breed and donate high-quality queen bees to smaller certified beekeepers as additional incentive has provided 140 queens to 10 beekeepers.
- The IUCN SSC Human-Wildlife Conflict & Coexistence Specialist Group, in collaboration with the Food and Agriculture Organization (FAO) of the United Nations, put together a set of case studies to cover projects focused on human-wildlife conflict situations. Armadillos & Honey was selected as one of the 12 case studies worldwide.

Armadillos & Honey Project in 2024

This project is now progressing and expanding throughout Brazil. In the next year, we will continue to certify more beekeepers and engage with the beekeeper community in a meaningful way. We will also partner with extension workers from governmental and nongovernmental organizations. We will never have the capacity to conduct this extension work in all of Brazil but will seek to achieve this through partnerships. We will partner with Suzano to ensure all beekeepers on their land become certified and receive adequate training. Furthermore, we have recently been contacted by an NGO working with Indigenous communities in the Xingu (Amazon) asking for our assistance. Many exciting partnerships are in sight for 2024. The queen bee donations have been very successful and appreciated. Next year, we will additionally focus on increasing the number of certified factories purchasing honey from certified beekeepers. While we have had success expanding certification to outside of our state, we hope to one day export giant armadillo-friendly honey to international markets beyond Brazil.

Giant Armadillo Atlantic Forest Project in 2023

The Giant Armadillo Atlantic Forest Project was started in 2018, in the state of Espírito Santo. This area was critical as it is the most eastern area of the giant armadillo's range, as well as one of the very few fragments of Atlantic Forest where giant armadillos have been documented. The species has been listed as Critically Endangered in the Atlantic Forest. Results were disappointing and showed that we were too late to save this population. Only two individuals, possibly three, have been registered after two years of fieldwork and camera trapping (Fontes et.al., 2021). While we keep in touch with our partners at the Sooretama Biological Reserve, we have not conducted any fieldwork in the complex since 2020. Instead, we started a new project in the Rio Doce State Park (PERD) in Minas Gerais, which is now the last known giant armadillo population of the Atlantic Forest. This initiative aims to assess the viability of this giant armadillo population and engage the local population so that the species does not go extinct and instead becomes a source of pride and a symbol of conservation efforts in the park.

- Lucas Barreto, project coordinator in the Atlantic Forest, has started his PhD and become a ZSL EDGE fellow.
- 60 cameras are being maintained in a permanent grid throughout the park.
- The third action planning workshop, uniting species conservation projects in the Rio Doce State Park, was conducted. We had almost 60 participants in total and made great progress on how to strengthen our collaborations to maintain and expand the park which protects so many unique species.
- All three members of the Atlantic Forest Project visited Mato Grosso do Sul. Cimar went to the Pantanal, while Lucas and Barbara participated in our strategic planning meeting.
- 17 interviews were conducted with beekeepers from the area surrounding the PERD. At least seven beekeepers reported instances of predation that align with the distinctive destruction pattern associated with giant armadillos. In 2024, we will launch certification for giant armadillo-friendly honey in this region.
- The environmental DNA study was unsuccessful at confirming the presence of giant armadillos in an area where we know they occur. However, in 2024, we will run similar tests during the dry season.
- A postdoctoral researcher from the Federal University of São Carlos (UFSCar) has successfully extracted DNA from giant armadillo fecal samples, opening a whole new research avenue for this project.
- A new livelihood project was initiated with the making of giant armadillo eco-bags by local residents.

Plans for the Atlantic Forest Project in 2024

In 2024, we will continue to visit the 70 fragments in the buffer zone around the park to gauge the presence or absence of giant armadillos. We will make a last attempt at evaluating the use of environmental DNA techniques, focusing on the dry season. We will increase our environmental education and awareness initiatives in the surrounding communities as we update our education materials. We will expand our livelihood project and attempt to produce more eco-bags. We will continue to strengthen our group Unidos pelo PERD (a group that brings together species conservation projects) so that together we can better serve and protect the park. This initiative has been highly successful, and we look forward to a fourth annual action planning workshop in 2024. Lucas will participate in a one-month training course for capacity building in conservation with ZSL EDGE. Beekeepers participating in our Armadillos & Honey project will go to the region to work with beekeepers, promoting coexistence with giant armadillos.

Communication, Education and Capacity building in 2023 will be described in a separate report.

GACP Scientific Publications in 2023

1. Calchi, A. C., Yogui, D. R., Alves, M. H., Desbiez, A. L. J., Kluyber, D., Vultão, J. G., Arantes, P. V. C., De Santi, M., Werther, K., Teixeira, M. M. G., Machado, R. Z., & André, M. R. (2023). Molecular detection of piroplasmids in mammals from the Superorder Xenarthra in Brazil. *Parasitology Research*, *122*(12), 3169–3180. https://doi.org/10.1007/s00436-023-08008-w

2. Cullen, J. A., Attias, N., Desbiez, A. L. J., & Valle, D. (2023). Biologging as an important tool to uncover behaviors of cryptic species: An analysis of giant armadillos (Priodontes maximus). *PeerJ*, *11*, e14726. https://doi.org/10.7717/peerj.14726

3. FAO, & IUCN SSC HWCCSG. (2023). *Using a conflict framework to identify the correct problem to manage*. FAO. https://doi.org/10.4060/cc7363en

4. Magioli, M., Attias, N., Massocato, G., Kluyber, D., Moreira, M. Z., Ferraz, K. M. P. M. de B., Chiarello, A. G., & Desbiez, A. L. J. (2023). What a few hairs can tell us about the resource use of giant armadillos. *Integrative Zoology*, *18*(1), 129–142. https://doi.org/10.1111/1749-4877.12644

5. San-José, A., Mayor, P., Carvalho, B., El Bizri, H. R., Antunes, A. P., Antunez Correa, M., Aquino, R., Bodmer, R. E., Boubli, J. P., Carvalho, E. A. R., Campos-Silva, J. V., Constantino, P. A. L., de Paula, M. J., Desbiez, A. L. J., Fang, T., Gómez-Puerta, L. A., Knoop, S. B., Longin, G., Morcatty, T. Q., … Rodó, X. (2023). Climate determines transmission hotspots of Polycystic Echinococcosis, a life-threatening zoonotic disease, across Pan-Amazonia. *Proceedings of the National Academy of Sciences*, *120*(33), e2302661120. https://doi.org/10.1073/pnas.2302661120

6. Santana, D., Attias, N., Massocato, G., Melo-Dias, M., & Desbiez, A. (2023). Interactions of four teiid lizards with giant armadillo burrows and range extension for two endemic Cerrado species. *Revista Latinoamericana de Herpetología*, *6*(3), Article 3. https://doi.org/10.22201/fc.25942158e.2023.3.709

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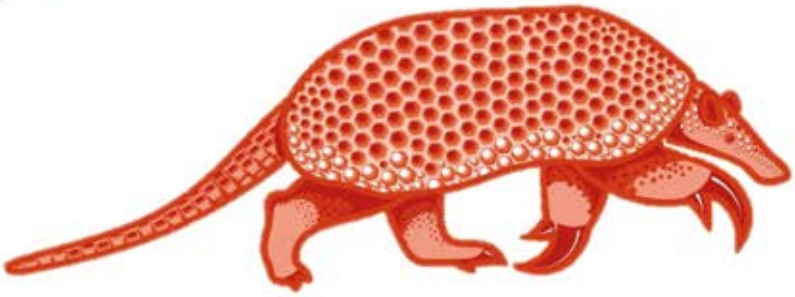

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