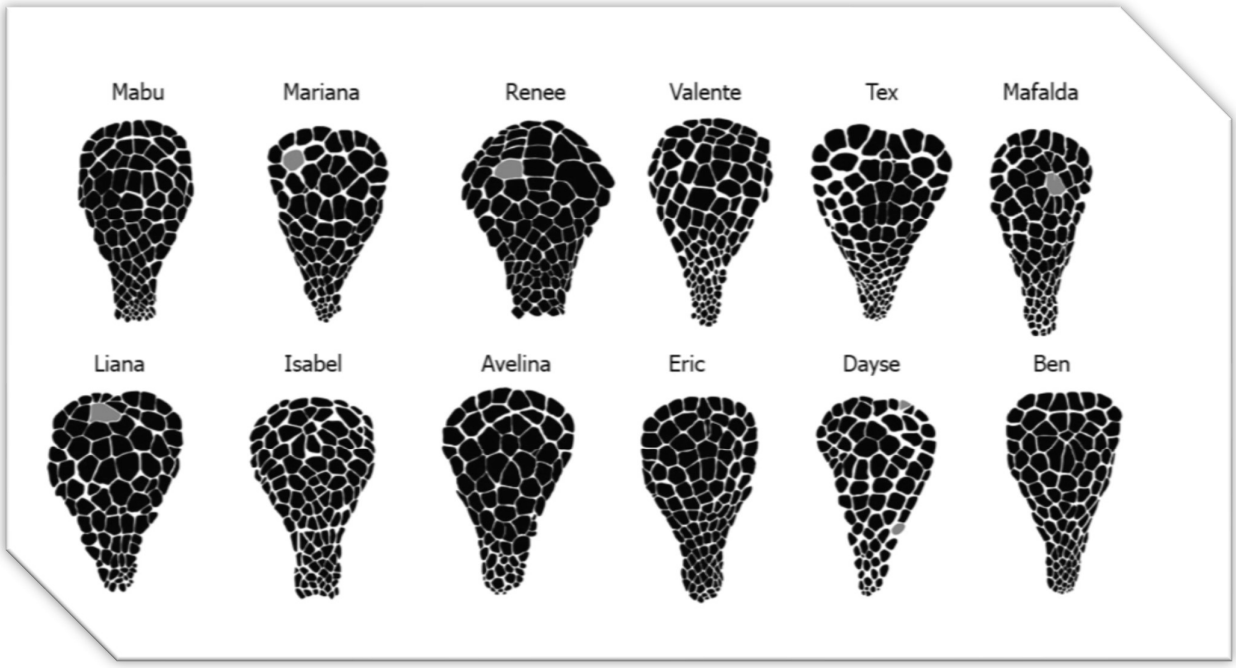
Giant Armadillo Conservation Program

Annual Progress Report



Each armadillo has a unique Cephalic scale pattern

(Massocato & Desbiez, 2020).

January 2020

Executive Summary

The giant armadillo (*Priodontes maximus*) is the largest of the armadillo species and can reach up to 150 cm and weigh 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 the Giant Armadillo Conservation Program (GACP) initiated in 2010. Our project successfully established the first long-term ecological study of giant armadillos in the Brazilian Pantanal and has now expanded to two other biomes using the species as a catalyst for promoting biodiversity conservation.

The main objectives of the GACP are to investigate the natural history and biology of giant armadillos, understand their function in the ecosystem, and utilize field data to inform conservation outreach and planning as well as influence public policies and decision-making. The project's ultimate 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 armadillo ecology and biology, 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 (over 70 Brazilian wildlife biologists and veterinarians trained).

The GACP was initiated in June 2010 at the Baia das Pedras ranch in the Brazilian Pantanal wetland and has obtained many excellent results. These include documenting the important role of giant armadillos as ecosystem engineers, understanding the species spatial ecology and habitat selection, new information on giant armadillo health, diet, reproduction and communication. Four scientific papers presenting this data have been published in 2019. This key data on the species natural history is helping to inform conservation decision making throughout the species range. In 2015, the project expanded to the threatened neighboring Cerrado biome in the State of Mato Grosso do Sul (MS). A detailed new distribution map of giant armadillo to promote habitat conservation measures for the species in MS has been completed in December 2017. We are collaborating with state officials, NGOs and universities to promote habitat conservation and restauration measures based on this data. The program is also addressing conflict between beekeepers and giant armadillos who raid their hives. In 2018 we also expanded to the Atlantic forest of Espirito Santo where we are concluding that giant armadillos are functionally extinct. In 2020 we will expand the Atlantic forest of Minas Gerais where the last population of giant armadillos in this biome survives.

Education and communication are at the core of what we do. A full-time educator was hired in 2018 and a second educator has been hired this year. The GACP has promoted giant armadillos and other species of Xenarthra to the general public, collaborating with state schools and training teachers as well as leading an education and awareness campaign in Brazilian and international zoos. Thanks to our communication and outreach efforts, in 2014 the giant armadillo was designated as one of five key mammal indicator species for habitat conservation in the Brazilian state of Mato Grosso do Sul (MS). A species few people knew about few years ago is now influencing habitat conservation

measures. Best of all a National Action plan for giant armadillos in which our team was instrumental to create has been validated by the Brazilian government in April 2019.

The Giant Armadillo Conservation Program team now includes: 4 full time staff, 4 part time staff, 2 collaborators, 2 Ph.D and 2 M.Sc students and over 25 collaborating institutions. In 2019, the project was supported by 8 Zoos, 1 private company, 2 foundation, 1 government fund and 6 private individuals.

Highlights for 2019 and plans for 2020

This was another incredible year for the GACP. Main highlights include consolidation and continuation of work in the Pantanal, progress in the Cerrado and major changes in our plans in the Atlantic forest. The GACP participated in the national red listing and the creation of a National Action plan for giant armadillos in November 2018, and the plan was endorsed and published officially in April 2019. Our NGO ICAS is responsible or collaborating in 24 actions of the 31 actions. This action plan is a huge and exciting accomplishment for the project. Highlights for 2019 include:

Research: In the Pantanal

- 8 expeditions to the Pantanal took place this year at the Baia das Pedras Ranch.

- Four new female giant armadillos have been captured in 2019. Three are adults and one sub adult between 13-18 months. This young female will help us to complete our understanding of parental care in giant armadillos. We had previously followed in detail parental care of a young male for two years until his death in 2015 (Desbiez et.al, 2019). We are therefore, once again, monitoring a mother and young and hope to understand when exactly dispersal happens.

- This year two of our giant armadillos died of unknown causes. The necropsy of one animal was performed and yielded very interesting results which we are investigating (report available upon demand), no necropsy could be performed on the other as death occurred during the flooded season.

- 10 new GPS devices deployed on recaptured and new giant armadillos.

- Study on Giant armadillo reproduction concluded. Results have been analyzed and a paper is being prepared. Results show that giant armadillo males reach sexual maturity between 7 to 9 years of age. Currently sexual maturity is estimated at 12 months! This means the generation time estimated for giant armadillos should actually be double! This may potentially change the status on the red list for giant armadillos as trends must be evaluated over 42 years instead of 21.

Plans in 2020 for the Pantanal

In 2020, we will continue our long-term study of the species in the Pantanal, which is crucial to our research and conservation efforts. We will continue using a new activity sensor within the GPS device. We will also start to establish a new permanent grid throughout part of our study area so we can monitor potential social interactions (animals visiting each other's home range), potential reproduction events, health of the armadillos and key individuals that are not monitored through telemetry. We will continue improving the scientific tourism experience and implementing actions of our Education and Communication strategy to increase our outreach efforts and conservation impact.

Research: In the Cerrado and Atlantic forest of Mato Grosso do Sul –

- Maps for the Cerrado and Atlantic forest are completed, available and communicated with authorities. We are now lobbying for the creation of protected areas. Habitat management plans for key municipalities will be proposed in 2020. The change in government in January 2019 has not been favorable to our progress.

- Field work to monitor giant armadillo population in the Cisalpina reserve had to be halted as the reserve has been sold. Giant armadillos are still used as the symbol of the reserve. A proposal to created guided trails with signs about local biodiversity has been submitted. We hope to make progress on this in 2020.

- From April to November 2019 we ran seven field campaigns at the BR 267 study area to evaluate giant armadillo densities and occupancy in the Cerrado. We worked on 32 rural properties and sampled a total of 50 landscapes, with 150 unique camera-trap locations and a total effort of approximately 4.480 camera days of sampling. We recorded 22 species of medium to large-sized mammals, which represents ~80% of the mammal richness from the MS-040 study area. Giant armadillos were recorded in 20 (40%) of the 50 landscapes sampled.

Plans in 2020 for the Cerrado

We will work closely with authorities to lobby for the creation of key protected areas using the giant armadillo density and distribution maps for the Cerrado and Atlantic forest of Mato Grosso do Sul. In 2020, we want to continue collaborating with other NGOs and local municipalities to help create specific local habitat management plans for municipalities in priority areas for giant armadillo conservation. Camera trap work has now been finalized and will be analyzed in 2020. We are still in negotiations and discussions regarding the Cisalpina study area.

Armadillos & Honey

Giant armadillos are being killed by beekeepers as they destroy their beehives to consume bee larvae. One giant armadillo can destroy a beekeepers livelihood in a matter of weeks. To prevent this, beekeepers apply lethal poison on the fallen beehive, which will kill the giant armadillo. This will solve the problem. Giant armadillos are solitary and occur at such low densities that the damage is usually done by a single individual. However, the poison will also kill tayra, giant anteaters, southern tamanduas and many other species of wildlife. In some areas where our models predict giant armadillos should be present, we have found no evidence of the species. We know of several areas where the species has gone extinct due to this retaliatory killing. This retaliatory killing is currently the most urgent short-term threat for these last giant armadillos in the Cerrado of MS.

Beekeepers work in the last remnants of native habitat and are key stakeholders and partners to lobby for the preservation of native habitat. We need to join forces with them to preserve and lobby for habitat protection. The main goal of this project is to eradicate the conflict between beekeepers and giant armadillos, so that retaliatory killing of giant armadillos is stopped, and beekeepers actually benefit from the presence of giant armadillos through a wildlife friendly certification scheme that will open new markets for their products. The project made progress in 2019 and highlights include

- Video camera traps were deployed in collaboration with beekeepers to test mitigations strategies. Three mitigations strategies work 100%, four depend on areas and 5 where discarded.
- 135 interviews with beekeepers are being analyzed.
- A logo for the certification has been created and was well received by beekeepers.

Certification criteria still need to be established and more research conducted.

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Certification logo

While this project experienced financial difficulties last year, funding has now been secured for the next two years of this project, thanks to the Whitley Fund for Nature Continuation Award as well as the Stuttgart Zoo in Germany and Fundação Boticario in Brazil.

Plans in 2020 for the Armadillo & Honey Project

This year we need to create and implement the certification program. Through Participatory workshops and discussions in social networks, criteria will be established and standards then set with the Wildlife Friendly Enterprise Network (WFEN) to create the certification standards. Through extension work with beekeepers, association and Eucalyptus plantations mitigation measures and certification will be promoted. An intense and strategic communication plan will help us to create a demand for giant armadillo friendly certified honey.

Atlantic Forest Expansion

The Giant Armadillo Atlantic Forest Project was started in 2018, in the Atlantic forest in the State of Espírito Santo. This area is very important as it is the most eastern area of the giant armadillo range, and 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. We had therefore decided to expand the project to this region. We are working in collaboration with Aureo Banhos from the Universidade Federal do Espírito Santo (UFES). We have a Masters Student (Bruno Fontes trained in the Pantanal) who has conducted the research. Bruno will be defending his thesis in March 2020. Results are disappointing and show that we are too late to save this population. Only two animals, possibly three have been registered after two years of field work and camera trapping.

In 2019 we ran an expedition to the last park (Rio Doce State Park) in the Atlantic forest known to have giant armadillos and confirmed the presence of the species. This year we fundraised and prepared to launch a new project in the Rio Doce State Park. Thanks to funding from the Whitley fund for Nature a new project is being started in February 2020. This initiative aims to assess the viability of the giant armadillo population and engage the local population so that the species does

not go extinct and instead becomes a source of pride and symbol of conservation efforts in the park.

Research plans in 2020 for Atlantic Forest Project
Finalize the work in the two reserves of Espirito Santo and publish findings. Start a new project in the Rio Doce State Park. At the Rio Doce State Park, fieldwork will assess the long-term population and genetic viability of the species in the park and surrounding buffer zone as well as the current and potential threats. Field work will involve setting camera trap grids and visiting almost 70 fragments surrounding the park.

Communication and Education

A strategic plan for education and communication was prepared through a participatory workshop in April 2018. (*This strategy is available upon demand*). An educator was hired to work on both the Giant Armadillo and Giant Anteater projects in September 2018. This year in January 2019 an assistant Educator was hired to support Andrea's growing workload. Activities focused on implementing the plan and highlights include:

- About 50 schools involved in the educational activities in MS, including 7 rural schools;
- In the Pantanal Study area established Scientific Tourism activities, educational materials for the surrounding communities and local rural schools.
- About 2,000 visitors engaged with our exhibition stand at the 71st meeting of the Brazilian Society for the Advancement of Science
- Training of 4 environmental education interns;
- Participation of approximately 2,500 students in various activities;
- Training of 20 educators from the city of Campo Grande Municipal Office of Education;
- Established important new educational partnerships with Brazilian Zoos (3), NGOs (2), Municipal Office of Education Transportation (Campo Grande and Aquidauana), Municipal Office of Environment and Urban Planning; the Mato Grosso do Sul State Council on Transportation; Uberlândia/MG: Water and Sanitation Department and two local animal rehabilitation center;
- Developed many new educational resources including: new activity materials; a transportable education exhibition, educational banners and much more.
- Our work was featured in a PBS film called Animal Espionage and a one hour special documentary for Houston's AKPRC show on Channel 2. It should be aired in April.

Plans for Communication and Education in 2020

We will continue with the implementation of our plan in 2020. New education kits for schools are being prepared. Scientific tourism, and engagement with the communities in the Pantanal will be continued. In June 2020 activities will be started in Rio Doce State Park. After technical visits by our education team, a strategy will be developed to create materials and training opportunities to deliver environmental education activities in and around the park to schools and universities. About 130 schools (schools travel from several states to visit) visit the park and 136 schools are located in the buffer zone.

Capacity building

Capacity building continues to be at the heart of everything we do. The projects have become a reference for students and professionals interested in in-situ Conservation.

- 6 Brazilian professionals have been offered training since January 2018 (5 biologists, 1 veterinarian) as well as our Argentinian partner Yamil DiBlanco who is running a new giant armadillo project in the Chaco of Argentina. Total amount of professionals and students trained by the project in the field since 2010: 80
- Team members participated in 3 national conferences and 4 international conferences and gave a total of 7 presentations.
- Two master's students have finished their thesis this year. We currently have 3 masters students and 2 PhD students involved in the project.
- The team organized a weeklong species conservation course at the local university UFMS for over 20 students from Mato Grosso do Sul as well as other parts of Brazil.
- Organized population viability analysis course in March 2019 for Brazilian conservation professionals with long term data sets.

- Project members gave several talks at universities, student events, national forums and meetings as well as to the state radio.

Capacity building Plans for 2019
We will continue to welcome trainees, particularly in the Pantanal field site. In 2020 we will focus on training of Latin American conservationists interested in working with giant armadillos. We have received sponsorship two bring two Columbian biologists to the field in the Pantanal. We will also create more formal capacity building opportunities.

GACP Scientific Publications:

Scientific papers in peer reviewed Journals

- Desbiez, A.L.J., Massocato, G.F., Kluyber, D. 2019. Insights in Giant Armadillo (*Priodontes maximus* Kerr, 1792) reproduction. Mammalia. In press.
- Massocato, G.F. & Desbiez, A.L.J. 2019. Guidelines to identify individual giant armadillos, Priodontes maximus (Kerr, 1792), through camera traps. Edentata 20:1-16
- Desbiez, A.L.J., Massocato, G.F., Kluyber, D., Oliveira-Santos LGR and Attias, N. 2019. Spatial ecology of the giant armadillo (*Priodontes maximus*) in Midwestern Brazil. Journal of Mammalogy. In press.
- Dalazen, G. T; de souza filho, Antonio F; Sanchez S, A. M; Fuentes C, D; A Gattamorta, M; Kluyber, d; Desbiez, A. L. J; Heinemann, M B; Matushima, E R. Survey of spp. and in Free-ranging Armadillos from Pantanal, Brazil. JOURNAL OF Wildlife Diseases , v. X, p. 2019-01-019-X, 2019.
- Desbiez, A L.J; Massocato, G.F., Kluyber, D. Do Nascimento Luba, C and Attias, N. 2019. How giant are giant armadillos? The morphometry of giant armadillos (*Priodontes maximus* Kerr, 1792) in the Pantanal of Brazil. Mammalian Biology. 95: 9-14.
- Ascensão,F., Yogui,D., Alves, M., Medici, E.P, Desbiez, ALJ. 2019. Predicting spatiotemporal patterns of road mortality for medium-large mammals. Journal of Environmental Management. 248: 109320

Conference Proceedings / Book of Abstracts

- Calchi,A; Alves,M; Vultao,J; Oliveira,B; Luba,C; Massocato,G; Souza,D; Desbiez,A; Teixeira,M; Werther,K; Silva,T; Mendes,N; Santi,M; Machado,R; André,M. Molecular Detection of Anaplasma spp. in Xenarthra in Brazil, 30th meeting of American Society of Rickettsiology. June 2019, Santa Fé, México.
- Calchia, A..C; Alves, M; Yogui; Kluyber, D, Massocato, G; Desbiez A.L.J et al. The first molecular detection of Bartonella spp. In free-ranging mammals from the Xenarthra Superorder in Brazil. 9th International Conference on Bartonella as Emerging Pathogens, 2019, National Veterinary School of Alfort - Paris.
- Dalazen, GT; Yogui, DR; Alves, MH; Souza Filho, AF; Kluyber, D; Desbiez, A; Navas Suárez, PE; Gattamorta, MA, Heinemann, MB; Matushima, ER. Serological survey for leptospirosis in anteaters from Pantanal and Cerrado regions, Brazil. Biennial Conference of the Latin American Section. Jul 2019, San José, Costa Rica.
- Fromme L, Yogui DR, Alves MH, Luba CN, Desbiez ALJ, Santos ALQ, Siebert U, Brehm R. Reproductive morphology of adult male and female giant anteaters (Myrmecophaga tridactyla). In: Proceedings of the Joint Leibniz-IZW/EAZWV/ECZM Zoo and Wildlife Health Conference 2019, Kolmården, Sweden, p. 112.

- Kluyber, Danilo ; Alves, M; Yogui, D.; ..... Desbiez, A.L.J ; ?Estradas Sentinelas?: O que elas nos dizem sobre a saúde dos tamanduás-bandeiras?. In: 10º Congresso Brasileiro de Mastozoologia (CBMz) & 10º Encontro Brasileiro para o Estudo de Quirópteros (EBEQ), 2019, Águas de Lindoia. 10º Congresso Brasileiro de Mastozoologia (CBMz) & 10º Encontro Brasileiro para o Estudo de Quirópteros (EBEQ), 2019.
- Kluyber, Danilo; Massocato, Gabriel Favero ; Labruna, M. B. ; Martins, T. F ; Gennari, S. M. ; Dalazen, G. T. ; Groch, K. R. ; Yague, C. S. ; Matushima, E. R ; Roque, A. L. ; Jansen, A. M. ; Silva, a. k. c. ; lisboa, c. v. ; maldonado, f. r. ; barros, j. h. s. ; garces, h. g. ; bosco, s. m. ; bagagli, e. ; Coutinho, S. Dall Acqua ; Carvalho, V. M. ; Santos, R C. F. ; Ferreira, J. ; Suffys, P. ; Desbiez, A. L. J. . Iniciativa de Saúde para Conservação de Xenartras: ? Tatus como espécies modelo para aplicação do conceito de Medicina da Conservação. In: 10º Congresso Brasileiro de Mastozoologia (CBMz) & 10º Encontro Brasileiro para o Estudo de Quirópteros (EBEQ, 2019, Águas de Lindois. 10º Congresso Brasileiro de Mastozoologia (CBMz) & 10º Encontro Brasileiro para o Estudo de Quirópteros (EBEQ, 2019.
- Navas-Suárez, Pedro Enrique; Sacristan, Carlos; Diaz-Delgado, Josue: Yogui, Debora; Alves, Mario; Ramblas-Zamana, Roberta; Ospina-Pinto, Maria Catalina; Fuentes-Castillo; Danny; Desbiez, Arnaud; Catão Dias, José Luiz. Road-killed armadillos provide insights into pulmonary adiaspiromycosis in Mato Grosso do Sul, Brazil. In. IV Conferencia Bienal WDALA. Costa Rica. 2019.
- Sousa, K.F., Pereira, D.M.C., Neves, J.J.A., Desbiez, A.L.J., Kluyber, D., Alves, M.H., Yogui, D.R., Coutinho, S.D lipodependent malassezia is part of the external ear canal microbiome of free-ranging giant anteaters (Myrmecophaga tridactyla).. Brazilian Micology Conference , Maceió, AL, October 2019.
- PEREIRA, D. M. C. ; SOUZA, K. F. ; NEVES, J. J. A. ; DESBIEZ, ARNAUD L. J. ; KLUYBER, DANILO ; MASSOCATO, GABRIEL FAVERO ; Coutinho, S. Dall Acqua . Presence of Dermatophytes in the soil of Giant Armadillo Burrow (Priodontes maximus) in the Pantanal of Mato Grosso do Sul. In: Congresso Brasileiro de Microbiologia, 2019, Maceió. Congresso Brasileiro de Microbiologia, 2019.

Workshop Reports

- Organized a symposium on Xenarthras with six participants at the Congresso Brasileiro de Mastozoologia (CBMz) & 10º Encontro Brasileiro para o Estudo de Quirópteros (EBEQ)
- Gave a key note talk at the WAZA conference in Buenos Aires entitled: Partnerships between field programs and zoos

Magazines

- DESBIEZ, ARNAUD L. J.; MASSOCATO, GABRIEL FAVERO ; KLUYBER, DANILO ; ATTIAS, N. . JÁ VIU ALGUM TATU-DE-RABO-MOLE?. Ciência Pantanal, 29 set. 2019.
- DESBIEZ, ARNAUD L. J.; KLUYBER, DANILO . Cientistas capturam imagens de tatu-gigante no Pantanal. Folha de São Paulo, 22 set. 2019.
- DESBIEZ, ARNAUD L. J.; MASSOCATO, GABRIEL ; KLUYBER, DANILO . Você conhece os tatus que vivem no Brasil?. Terra da Gente, Campinas e Região, 06 maio 2019.
- DESBIEZ, ARNAUD L. J.; KLUYBER, DANILO ; MASSOCATO, GABRIEL FAVERO ; SANTOS, RENATA CAROLINA FERNANDES . Priodontes maximus darf nicht sterben Das Pantanal- Riesengürteltier-Projekt. Rodentia - Kleinsauger-Fachmagazin, p. 24 - 29, 01 jan. 2019.

Social media in numbers:

Facebook: 23,445

Instagram: 12,800

You Tube: 39,077