

The rich tradition of jaguar research and conservation in Venezuela and its impact on human-jaguar coexistence throughout the species' range

La rica tradición de investigación y conservación del jaguar en Venezuela y su impacto en la coexistencia entre humanos y jaguares en el área de distribución de la especie

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HISTORY

Some of the earliest studies on jaguars and human-jaguar coexistence took place in Venezuela, including by Ambassador (to Kenya) Edgardo Mondolfi, a Cornell graduate (Animal Production and Zoology), professor at the Central University of Venezuela, Director of several Ministries, with links to the Smithsonian Institution, the Species Survival Commission of the IUCN, and the United Nations Environmental Program (UNEP). Mondolfi is considered the “father” of modern Mammalogy in Venezuela (Fig. 1). His mastery of all matters mammalian led to the mentoring of many researchers, amongst them two veterinarians, Rafael Hoogesteijn and Ernesto Boede. The three carved a place for Venezuela as jaguar studies started in the 1980s. Their chapter in the 1986 edited volume *Cats of the World* is testimony to that, one of the earliest serious publications on jaguars in the world (Mondolfi & Hoogesteijn 1986).

Much of the work of the three researchers focused on human-jaguar conflict, a fair amount of that in the state of Cojedes.

By the early 1990s, Venezuela was a leader in the young field of jaguar research and hosted the conference “*Felinos de Venezuela*” in 1991 (FUDECI 1992), with specialists from Switzerland, the United States, Mexico, Brazil, and Venezuela. R. Hoogesteijn, A. Hoogesteijn and E. Mondolfi published the first study on cattle depredation by jaguars (Hoogesteijn *et al.* 1993); this publication was followed by Hoogesteijn and Mondolfi’s very comprehensive and lavishly illustrated book (Hoogesteijn & Mondolfi 1992) summarizing all the knowledge of jaguars at the time, including information on Venezuelan natural history richness. As Venezuelan researchers developed further knowledge, they established fluid contact with colleagues from Brazil and Belize. Venezuela was the first country to experiment with jaguar translocations to solve



Figure 1. Dr Edgardo Mondolfi, considered the “father” of modern mammalogy in Venezuela, holding the largest jaguar skull measured in all the Americas (shot in 1945 by Paul Stempel at Hato La Rubiera in the Guárico State Llanos). Photo: Rafael Hoogesteijn (~1990).

the cat-cattle conflict, although the results were not particularly encouraging (Fig. 2).

In the mid-late 1990s, a team from the University of Florida – Gainesville (UF), consisting of John Eisenberg (globally renowned mammalogist), Melvin Sunquist (a tiger and ocelot expert), Rafael Hoogesteijn (a cattle veterinarian finishing his MSc; Fig. 3) and John Polisar (a PhD candidate with wide-ranging interests and a background that started with carnivores in the northern Rocky Mountains; Fig. 4), initiated a project in Hato Piñero, Cojedes state, an 80,000-ha cattle ranch and nature preserve. The setting was a flooded savanna-forest mosaic, working cattle ranch, with 14,000 heads of cattle and 450 heads of riding stock, along with white-lipped peccaries, tapirs, deer, capybaras, anacondas, caimans, jaguars, and pumas.

The project encountered numerous obstacles and overcame them for success (Fig. 5). One of the main products, led by Polisar (Polisar *et al.* 2003), included a complete (and laborious) accounting of prey distribution and biomass on the ranch and remains one of the most intensive and thorough studies of the origins of and solutions for human-cat conflict- until today. A companion paper led by UF MSc students Daniel Scognamillo and Inez Maxit was also published in 2003 (Scognamillo *et al.* 2003). It presented a detailed examination of ecological coexistence

through resource partitioning of jaguar and puma and has been widely cited by jaguar researchers. The environmental and management setting in the seasonally flooding lowlands of the Orinoco Basin in many ways resembles the Brazilian Pantanal, and a substantial portion of the early stages of jaguar research started there. Hato Piñero was the first place in Latin America where specially designed electrical fences (Fig. 6) were tried in the field as a successful deterrent for jaguar/puma/cattle depredation problems (Scognamillo *et al.* 2003). Two jaguars (one male and one female), one female puma, and two female ocelots were captured and fitted with radio collars for the first time in Venezuela for telemetry studies during the first stage of this project (Hoogesteijn *et al.* 1996). By the time the project concluded, researchers had captured and studied five jaguars (3 females and two males), and six pumas (four female and two males).

Another significant development in the nineties was the export of two Venezuelan jaguars as wild founders for a “Llanos Jaguar Breeding Group” to the Jacksonville Zoo in Florida, USA. Negotiations between the Fundación Nacional de Parques Zoológicos y Afines of Venezuela (FUNPZA), the Jacksonville Zoo in Florida, USA, and the Wildlife Office of the Venezuelan Ministry of the Environment (Profauna) began by inscribing the Venezuelan Jaguars of wild origin in the studbooks held by the American Association of Zoos and Aquariums.

Venezuelan negotiators included Edgardo Mondolfi, Pedro Trebbau, Esmeralda Mujica, Ernesto Boede and Israel Cañizales (all associated to FUNPZA). The Environment Ministry had two representatives that worked for Profauna (the section in charge of wildlife protection); biologists Mirna Quero and Salvador Boher. Rafael Hoogesteijn, acted as the initial liaison between Venezuela and the Jacksonville Zoo Director.

To start a “Jaguar Breeding Group” of jaguars from the Llanos region, a US veterinarian was hosted in Venezuela by Boede and Mujica, to collect genetic samples from captive jaguars of wild origin, kept in different collections. After almost two years of paperwork and sanitary trials, all the needed authorizations and CITES permits were issued for a very popular male (Bruno, kept at the Cattle Ranchers Association of Carabobo State) and a female (from a local zoo). Both animals were deposited in the new facilities of the “Orinoco Floodplain” exhibition at the Jacksonville Zoo. This early model of international cooperation pioneered processes and procedures potentially relevant throughout the jaguar range.

Francisco Bisbal (1953-2020), was the chair of the Museo de la Estación Biológica de Rancho Grande (EBRG) for many years, an institution attached to the



Figure 2. Team that completed one successful Jaguar translocation in Venezuela, left to right: Omar Hernández (Fudeci), Jose Luis Méndez-Arocha (Profaua-MARNR), Edgardo Mondolfi (mammalogist and associate researcher), Ernesto O. Boede (wildlife specialist veterinarian). Entre Ríos region, Caura River, Bolívar State, Venezuela (February 1993). Photo: Ernesto Boede.



Figure 3. Rafael Hoogesteijn working a large herd of cattle in the Porto Jofre region of the Northern Brazilian Pantanal (2013). Photo: Rafael Hoogesteijn.



Figure 4. A recent photograph of John Polisar doing fieldwork in La Mosquitia, Honduras. Photo: John Polisar.

Venezuelan Ministry of Environment. Francisco organized a number of collecting expeditions in many places in Venezuela, being also an extraordinary museologist. In the 1980s he published papers relevant to the Venezuelan carnivores, including the jaguar.

During the 1990s, Almira Hoogesteijn (Venezuelan Veterinarian; Fig. 7) began working in jaguar conservation and research activities; she has since participated in many important publications with her brother Rafael.

By the time large-scale jaguar conservation ignited, with the January 1999 First Range Wide Priority Setting Exercise conducted in Cocoyoc, Mexico; Venezuela was a recognized force in jaguar conservation. Representations at that conference associated with Venezuela included Ernesto Boede, John Polisar, and Daniel Scognamillo. Polisar, Hoogesteijn, and Boede had prepared the maps for the workshop in late November 1998 in Valencia, Venezuela.

Hoogesteijn is currently a Ranch Manager and globally renowned human-jaguar coexistence expert employed by Panthera in the Pantanal of Brazil, advising other Panthera teams and conflict resolution projects, along with numerous colleagues across a diverse range of Latin American countries. Boede is now deceased, as is Mondolfi, and both left a notable written legacy. Hoogesteijn is a prolific author and adviser on human-jaguar conflict across the species' range.

The international educational institutions most tightly involved with this genesis of applied research on jaguars include the University of Florida and Cornell University. From UF, this includes, Rafael Hoogesteijn, Laura Farrell, Inez Maxit (Fig. 8), John Polisar, Daniel Scognamillo

(Fig. 9), John Eisenberg, Melvin Sunkuist, Jim Nichols, and Wayne King. Peter Crawshaw was completing his studies at UF as the Piñero project started. Edgardo Mondolfi and Almira Hoogesteijn received their PhDs from Cornell. John Polisar began his education in natural resources at Cornell. As the new millennium started, Venezuela was a source of academically strong, groundbreaking, and widely recognized contributions to jaguar research and conservation.

VENEZUELA'S IMPORTANCE FOR JAGUAR RESEARCH AND CONSERVATION 2003-2022

Venezuela is a physically beautiful country. It has several biomes essential for jaguars and is of extreme strategic importance for jaguar conservation on a range-wide level (Fig. 10). Post-2003, jaguar research continued in several distinct regions of Venezuela, including the Amazon, the coastal range, the Llanos, and the Lake Maracaibo basin.

Emiliana Isasi-Catalá (who had worked as a volunteer for Polisar in Hato Piñero) conducted her first investigation on jaguars and pumas in Hato El Socorro (Cojedes State), a large cattle ranch neighboring Hato Piñero. As part of the objectives, this study evaluated habitat use and diet of these big cats to determine possible conflicts due to predation on livestock and other domestic animals. As part of her research interests, Emiliana has sought to improve jaguar and puma population assessments using reliable estimation methods. Therefore, she tested the identification of individual jaguars and pumas based on morphometric analysis of footprints, which later became part of her undergraduate thesis. Additionally, she began the study of these species using camera traps in protected areas such as the Aguaro-Guariquito and Guatopo National Parks to determine the effectiveness of this tool in population estimates. Subsequently, she evaluated the presence of jaguars in the Aguaro-Guariquito National Park, evaluating its potential for jaguar conservation (Fig. 11). She published the results of that research, and now works on jaguars and their prey in Peru. Her study area in Venezuela was extremely rugged, which helped protect it since several of Venezuela's larger cities are nearby. Emiliana's doctoral research resulted in the first formal abundance estimate for jaguars in Venezuela. She went on to study, at a larger landscape scale, the threats to connectivity and the tools to maintain that connection, among which were traditional cacao and coffee agroforestry practices, and establishing and maintaining good rapport and working relationships with local communities, which can be effective stewards of the land. Threats include forest conversion for mono-



Figure 5. The Piñero Project encountered numerous obstacles to overcome yet generated considerable pioneering contributions. Here one of the principal researchers Laura Farrell, is inspecting one of the pig-baited jaguars-traps, with contracted professional trapper, Roy McBride (March 1996). Photo: Rafael Hoogesteijn.



Figure 6. First Latin-American field tested electrical fences that successfully controlled jaguar/puma predation problems in a cattle maternity paddock at Hato Piñero. Photo: Daniel Scognamillo.



Figure 7. Almira Hoogesteijn presents predation mitigation methods in a workshop for livestock owners in Autlán de Navarro, Jalisco, México (2014). Photo: Almira Hoogesteijn.



Figure 8. Inez Maxit and assistant Victor Juan Meires, with a tranquilized jaguar of the Piñero Project. Photo: Daniel Scognamillo.



Figure 9. Local assistant together with Daniel Scognamillo in the process of radio-collaring a tranquilized jaguar at hato Piñero. Photo: Daniel Scognamillo.



Figure 10. Prime jaguar habitat in Hato El Socorro, near El Baúl, Cojedes State, a mix of swamps, forested savannas, gallery forests, and rocky hills that offer jaguars, excellent habitat and abundant prey-base. Photo: Rafael Hoogsteijn.



Figure 11. Running/reviewing the camera-trap grid of Emiliana Isasi Catalá in Guatopo National Park, from left to right: Ernesto Boede, Rafael Hoogesteijn, Emiliana Isasi-Catalá, and assistant José Infante (~2010). Photo: Ernesto Boede.

cultures. Emiliana formed a new project in Serranía El Bachiller, an area contiguous with Guatopo National Park, dedicated to community work to conserve this rugged and beautiful region and the jaguars it harbors. Emiliana also assisted Lucy Perera-Romero in her studies in the Upper Caura.

After acquiring a remarkable experience of many years researching on carnivore populations in the forests of the Białowieża region on the Poland-Belarus border, Włodzimierz Jędrzejewski came to Venezuela about a decade ago to work for the Venezuelan Institute for Scientific Research (IVIC– Instituto Venezolano de Investigaciones Científicas) based near Caracas. His extensive research has yielded an important publication record on jaguars, including a range-wide analysis, intensive camera trapping studies principally in the Cojedes State but also almost in the entire country (with the help of Ernesto Boede and several others (Fig. 12)). More recently, Jędrzejewski has published detailed research on jaguar populations range-wide and has generated manuscripts on the status, distribution, and connectivity of jaguar sub-populations throughout South America. Jędrzejewski's 2016 paper on population density and structure in Hato Piñero (a decade after Polisar *et al.* 2003 and Scognamillo *et al.* 2003) revealed high densities (7.67 jaguars/100km²). It represents one of the few before-after assessments with a larger than a 10-year interval of jaguar status on a working cattle ranch. It provides strong evidence that coexistence is possible.

The population of jaguars in and around the large ranches of Cojedes (Fig. 13) comprises their jaguar conservation unit (JCU), and there are also jaguars in the Delta of the Orinoco River, as pointed out by Almira Hoogesteijn *et al.* (2016). Venezuela and Colombia share borders and biomes and have joint populations which do not recognize political boundaries. Whether it is Llanos, Amazonas, Caribbean slope, or lower slopes of the Andes – these two countries share ecological characteristics and management challenges. Venezuelan research relates to Colombian realities. Colombia's adjacency to Venezuela is extremely important for range-wide jaguar connectivity in the northern part of the continent.

To the west, where there are jaguars around the Maracaibo Lake region, Maria Fernanda Puerto-Carrillo, studies them and recently received an international “Future for Nature” prize for her outstanding work; she founded the Sebraba's Project (Sebraba is the jaguar's name in the Bari indigenous language). Her research takes place in the lowlands adjacent to the southern part of the Lake Maracaibo basin, in the hottest and rainiest climate in the country, where approximately 90% of the original forest has been lost. This region shares its fauna more with northeastern Colombia than the remainder of Venezuela. The region is essential for large-scale jaguar connectivity. Threats include habitat fragmentation and loss, reduced natural prey, and direct killing, with consumption, sport, and livestock losses being the drivers. Although these for-



Figure 12. Ernesto Boede (left) and Włodzimierz Jędrzejewski (right) camera-trapping at Hato El Frío in 2012, Apure State, Llanos of Venezuela. Photo: Włodzimierz Jędrzejewski.



Figure 13. Gertrudis Gamarra (†), a great collaborator and field guide in Hato Piñero, Cojedes State. Photo: Włodzimierz Jędrzejewski.

ests are listed as Near Threatened in the Red Book of Terrestrial Ecosystems of Venezuela, there are two protected areas: *Parque Nacional Ciénagas de Juan Manuel* and *Reserva de Fauna Silvestre Ciénagas de Juan Manuel de Aguas Blancas y Aguas Negras*, both totaling 3,400km² of continuous forest, a good size even for the wide-ranging jaguar (Fig. 14). Maria Fernanda studied diet, through scats, and estimated population density, using a 600km² camera trap polygon and spatially explicit models for an estimate of 3.37 jaguars/100km². In 2021, she started two new research projects on jaguars, one in the north of the Amazon state with the Piaroa indigenous community and

another in areas near San Carlos, Cojedes State, where she works with local producers, addressing the feline-human conflict.

Areas of great importance for jaguars include Venezuela's connections to the southwest, south, and southeast, where the country has (in Apure, Amazonas, Delta Amacuro, and Bolivar states) physical and ecological connections with the Colombian, Brazilian, and Guyanese Amazon-Guiana Shield greater Amazon region and comprises one of the nine countries in the largest Jaguar Conservation Unit in the world.

The Wildlife Conservation Society supported Lucy Perera-Romero's research in the Upper Caura area (Guiana Shield) from 2010 to 2015. Perera-Romero's investigation was conducted 200 miles into the remote Guiana Shield, upstream of river rapids and waterfalls, with complete collaboration of the indigenous inhabitants of ethnic Orinoco Basin groups (Fig. 15). These studies comprehensively focused on prey/game species, subsistence hunting patterns, and jaguar abundance and distribution (Fig. 16). Lucy's studies included three separate camera trapping campaigns across various cultural and disturbance gradients (a relative term given the relatively pristine characteristics of this area). The sampling areas ranged from 235km² to 331km². Despite generating abundant data on how subsistence hunting affected the natural prey base for jaguars/game species for humans, only one sample yielded a density estimate (~ 2.3 jaguars/100km²). The indigenous communities noted the effect their hunting had on game and ecological equilibrium and designated "protection zones" related to each community, where no hunting should occur. Despite the documented low-scale threat that small-scale indigenous subsistence hunting can represent, the indigenous are vested in the environment that they inhabit. The threats from deforestation and water contamination due to uncontrolled mining, the cultural erosion that the mining camps bring, and, in particular, the high demands for bush meat to serve hungry miners – represent a more severe and, in some ways, existential threat for these spectacular forests and their inhabitants, in an area that is truly among one of the world's natural wonders.

Lucy is currently a student at Washington State University, finishing up massive camera trapping research conducted in the Maya Biosphere Reserve in Guatemala in the Department of Petén.

Perera-Romero's research in Venezuela's Upper Caura has been partially published, with some papers yet pending. Her abundant and deeply significant data from Venezuela's Upper Caura can be found in the 2022 Amazon Cam Trap data paper. Her study and the studies by María



Figure 14. María Fernanda Puerto (IVIC), Raúl González (LUZ) and Orlando Gómez (INPARQUES) checking data collected from camera traps in Catatumbo River, Ciénagas de Juan Manuel National Park, Zulia State, 2018. Photo: Pedro L. Bermúdez.



Figure 15. Lucy Perera-Romero camera-trapping in the upper Caura river region, a very remote and difficult access area, in which she was widely helped by the local indigenous communities. Photo: Lucy Perera-Romero.



Figure 16. Jaguar in upper Caura, Bolivar State, Venezuela. This area borders the Amazon and is part of the >2,000,000 km² largest Jaguar Conservation Unit worldwide. Photo: Lucy Perera-Romero.

Fernanda Puerto-Carrillo, Emiliana Isasi-Catalá, and Włodzimierz Jędrzejewski, have taken place thirty-plus years after the ground-breaking work of Edgardo Mondolfi, Rafael Hoogesteijn, Ernesto Boede, and twenty years after the outcome of John Polisar, Daniel Scognamillo, and Inez Maxit – and are a solid testimony to Venezuela’s rich history and continued active role in jaguar research.

Last but not least, it is worth mentioning that some paleontological researches in Venezuela have rendered information about the fossil record and paleodistribution of the Jaguar in the region. The reports include *Panthera onca* in the Late Pleistocene sites of Muaco, and possibly in Taima-Taima, both in the Falcon state (Bocquentin 1979, Aguilera 2006, Chávez-Aponte & Carrillo-Briceno 2012, Carrillo-Briceno 2015), and the El Breal de Orocal ORS20, in the Monagas state (Solórzano et al. 2015, Ruiz-Ramoni 2016). Some remains assigned to *P. onca* have been also reported from a cave named “La Cueva del Cañón de Sorotamia”, in the Socuy River basin, Zulia state (Rincón 2006); however, the geological age of the site is not well defined, and this could be Pleistocene and Holocene (see Ruiz-Ramoni 2016).

SUMMARY

Rafael Hoogesteijn, now stationed in Brazil, still publishes prolifically. Polisar took what he learned in the Llanos of Venezuela and applied it range-wide. Inez E. Maxit is the Study Abroad Coordinator at Stephen F. Austin State University in Texas, and Daniel G. Scognamillo is an Associate Professor for Research in the Feline Research Program in the Caesar Kleberg Wildlife Research Institute-Texas A&M University-Kingsville. Isasi-Catalá, Jędrzejewski, Perera-Romero, and Puerto-Carrillo have skillfully carried the tradition forward with significant new contributions in Zulia State, in the Llanos, in the Guiana Shield-Amazon, along with the coastal range, throughout South America and range-wide. Almira Hoogesteijn continues working with ranchers in Mexico.

It is no exaggeration to say that work with Venezuelan origins has played an essential role in jaguar research and human-jaguar coexistence throughout the range of the species. Because Venezuela has a rich history in jaguar research and conservation and has played such an important role in human-jaguar coexistence range-wide, it would occupy a welcome & strategic position as a member of the

2030 Jaguar Conservation Initiative. Venezuela is one of the seventeen most biodiverse countries in the world. The jaguar as an ‘umbrella species’ can indicate that Venezuela, apart from being the cradle of anti-depredation strategies development in cattle ranching, is preserving its globally significant natural heritage and the cradle of anti-depredation strategies development in cattle ranching. The Jaguar 2030 Roadmap coincides with the Sustainable Development Goals, the Convention for Biodiversity’s Global Biodiversity Framework, and the United Nations Decade of Restoration.

Below (see appendix), we list publications focused on Venezuela, of range-wide significance, with the content of Venezuelan origins, or Venezuelan co-authors, organized alphabetically by author-year.

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APPENDIX

Scientific bibliography of the jaguar in Venezuela. The following is a list of articles and books derived from the research activities referred to in this paper. It does not intend to be an exhaustive bibliographic list of the works related to the presence of the Jaguar in Venezuela. It excludes a number of popular articles, historical and travellers’ accounts, ethnographic and etnozoological studies and most references to Jaguar hunting activities in the country.

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