

Ecology and Conservation of the Maned Wolf

Multidisciplinary Perspectives



Edited by
Adriana G. Consorte-McCrea
Eliana Ferraz Santos

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CRC Press
Taylor & Francis Group
Boca Raton London New York

CRC Press is an imprint of the
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CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

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Version Date: 20130624

International Standard Book Number-13: 978-1-4665-1260-3 (eBook - PDF)

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13 The Maned Wolf Conservation Project

Serra da Canastra, Minas Gerais, Brazil

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INTRODUCTION

Conservation programs that focus on a charismatic flagship species have proven particularly successful in promoting the preservation of critical habitats and ecosystems (Leader-Williams and Dublin 2000). Top predators as “umbrella” species serve an additional important role because their survival entails that of a host of other species (Ray 2005). Large carnivores have been the center of conservation programs worldwide for several reasons: they are key species for ecosystem protection and restoration, site-based conservation planning, and the monitoring of biodiversity status (Ray 2005). Among several carnivore species in South America, the maned wolf is one of the most efficient representative species for the success of a conservation program, due to its wide distribution range, particular ecology and behavior, and lack of threat to human life

(despite nominal damage to the local economy). Throughout the world, endangered species have been used as ambassadors to link people to the value of wildlife and the ecosystems they inhabit (Leader-Williams and Dublin 2000). By protecting endangered species, one may well provide an incentive for stakeholders for habitat maintenance or restoration, which in turn results in improvement of their lives (Entwistle and Dunstone 2000). Conservation programs involve several stakeholders in the planning of conservation practices associated to education, scientific research, and public policy application (Reyers et al. 2010). This “transdisciplinary” approach has been presented as one of the solutions for balancing wilderness maintenance, socioeconomics, and culture (Jerusalinsky et al. 2010; Reyers et al. 2010). Following this approach, protecting the maned wolf helps to preserve species’ natural habitat, the cerrado biome in Brazil, which is considered one of the world’s biodiversity hotspots (Myers et al. 2000). The Maned Wolf Conservation Project is an example of how to use a flagship species to raise people’s awareness of wilderness protection, together with utilizing a transdisciplinary approach to promote conservation of a threatened species and improve the relationship of a local community with nature. The project was designed to generate new information on species biology in a way that would serve as a model for developing other research/outreach-based initiatives for conserving species and habitats within the cerrado or other threatened ecosystems throughout the country or the continent.

STUDY SITE

The project took place in the Serra da Canastra region, Minas Gerais State, southeastern Brazil. The region is under the dominium of the cerrado biome. The cerrado is listed as one of 25 biodiversity hotspots (Myers et al. 2000) and is home to 935 species of birds and nearly 200 mammals. During the past 50 years, the cerrado has been extensively developed for agriculture; more than 80% of the ecosystem is directly used by humans. Clearly, ongoing development of this critical ecosystem and intense human occupation (which are unlikely to stop) pose significant threats to wildlife, including the maned wolf.

The project site ranges throughout 400,000 ha of altered and protected areas. The Serra da Canastra National Park (SCNP), created 40 years ago, encompasses a total of 200,000 ha of which 71,525 ha have been regulated and managed since 1978. Mammal diversity is high, with approximately 40 species (excluding small mammals and bats), and carnivores represent nearly half of the terrestrial mammal species. The region, mainly the protected areas, constitutes an important sanctuary for threatened species such as the maned wolf, the giant anteater, and the giant armadillo. Besides the SCNP, the region is made up of small ranches (landholdings of 100 ha or less), in all of which planting of forage grass is evident. The primary economic activity in the region is cattle ranching; agricultural activities are mostly confined to subsistence plantings, except for large areas prepared for coffee and corn plantation (Mota and Paula 2006; Paula and Mota 2010).

Local people have been coexisting with wildlife for hundreds of years in the region. Although everyday encounters are often ignored by both sides, occasionally losses for both human and wildlife can be observed as a consequence of livestock predation and direct persecution to carnivore species, mainly pumas and maned wolves. Despite severe habitat disturbance in the surrounding areas, population growth of several wildlife species, including the maned wolf, has been observed within the SCNP during the past years. This demonstrates the value of the park via its physical (water, soil) and biological (richness in biodiversity) aspects. Due to the high density of the maned wolf in this region and the special relationship between people and nature, the region represents the perfect site for long-term population monitoring and practices for maned wolf conservation. Furthermore, by improving the relationship between local people and wildlife by emphasizing a healthy coexistence, it is possible that success stories generated in Serra da Canastra region can be applied throughout the entire range of the maned wolf.

THE MANED WOLF CONSERVATION PROJECT

The Maned Wolf Conservation Project arose from the personal initiative and dedication of two researchers investigating the maned wolf in different areas. Rogério Cunha de Paula started to work with the species in the Serra da Canastra region while Flávio H. G. Rodrigues initiated his investigations in central Brazil. The project was initiated based on the desire to build a conservation model for the maned wolf. The aim is conservation of the maned wolf through extensive research, public awareness, and applied conservation actions of a specific population, and further throughout its distribution range.

The Maned Wolf Conservation Project was planned to provide long-term population monitoring and constant evaluations of the threats to the species in the Serra da Canastra region while management actions and strategies were being implemented.

We believe that by understanding the biology of this flagship species, assessing the impact of human disturbance on maned wolf health and survivorship, and using our experiences and stories to educate the local community, we would contribute significantly to conserving both the species and the ecosystem, as well as improve the relationships between humans and nature.

To achieve our mission and objectives, the idea has always been to build a team of researchers with different expertise and involve several institutions in network-based research and conservation actions. Although the maned wolf has always been the target element of the project, relationships with other species and especially the role of the local community in conservation issues are some of the important facets of the complex polygon that emerged when building the project.

In summary, the aims of the project have resulted in it becoming transdisciplinary, combining the following elements:

Research: through ecology, behavior, health and epidemiology, genetics, reproduction

Education: through discussion of environmental problems, communication, and cultural approaches

Conservation actions: through management of observed impacts, implemented by the fusion of scientific data generated by the research and the strategies proposed by the educational program

The connection of these interfaces has resulted in a better plan for the species' survival. We thus used these three pillars as the foundation of our project structure.

RESEARCH

With the exception of feeding ecology, little is known about the maned wolf in nature, and there are insufficient data to predict future conservation or sustainability status (Paula et al. 2008). The habitat of this species is undergoing rapid conversion, and it is essential to determine the influence of human development on the species' survival. Field initiatives aiming to improve our fundamental understanding of the maned wolf's biology, ecology, behavior, health, reproduction, and genetics, while determining the risks imposed by habitat alterations and increasing human disturbance, are necessary to achieve our main objectives of evaluating the species' long-term survival.

The research component of this project includes assessing social behaviors and characterizing individual territories, food resources, and habitat integrity. In order to apply management actions, it is necessary to analyze specifically the habitat use and dispersal rates of animals that inhabit areas with close contact with humans or areas under anthropogenic activities (such as farming, ranching, mining, and tourism). Considered as one of the main emerging threats to carnivore populations, the spread of diseases from domestic animals to wildlife can be a serious threat to the wolves. Thus, it is extremely important to investigate epidemiological risks to maned wolves from direct and indirect

contact with domestic animals. Genetics can not only provide a background to understand how gene diversity influences species' survival but also show how resistant wolves can be to natural and artificial adversities. Through hormone analysis, we can also understand and perceive the influence of several variables on the species' physiology. Finally, by verifying the main causes of wolf mortality or reduced reproductive success and attempting to control the unnatural causes, we might make the conservation plan for the species more successful.

A detailed study, involving capturing and monitoring wolves using VHF, GPS/VHF, and satellite transmitters (in different phases of the study), has provided high-quality information. The intensive monitoring of collared animals allows us to build models for improved conservation through complete data collection not only for ecological or behavioral needs, but also for all the thematic areas. By following animal tracks, we can provide a database for answering other questions on health, genetics, and reproduction. The data obtained from monitoring of the wolves throughout the project years, combined with various other information generated, provide plenty of possibilities of use for scientific matters, species and habitat management, and public policies. Thus, this will certainly aid habitat restoration, corridor creation, and local population management. Thereafter it can be used as a model for the conservation of the species in general.

EDUCATION

We strongly believe that the maned wolf is an ambassador for making people aware of the value of wildlife and the preservation of the cerrado. In this context, we have initiated a community outreach program to raise public awareness in the Serra da Canastra region. When educating local communities about the species and its conservation, the long-term survival of this species can be improved. Protecting the maned wolf helps to preserve the cerrado and may well provide an incentive for at least some habitat restoration.

The conservation impact of our project is related to the stories—scientific or based on other matters—that we can generate and our experiences that can be passed on to local communities through our growing outreach and awareness efforts.

Clearly, some of the best ways to preserve local habitats and their biodiversity are (1) to communicate the interesting biology and role of species in local ecosystems and communities, (2) to manage conflicts between local people and wildlife, (3) to make locals perceive and understand the need for coexistence with wild species and for preservation of wild habitats, (4) to increase pride within the community, helping them to recognize the positive values of being inhabitants of that place, and (5) to integrate the community and initiate discussion of topics of major concern, including those related to nature. In this way, we tried to bring people together and initiate discussion and debate on issues important to them and what they think is the best way to become integrated in their natural, rural, and urban environments. Our objectives were to understand the community's needs and to encourage shy local people—from children to elders—to discuss anything, thereby learning how to express themselves. The next step was to debate how to live in harmony with wildlife, especially with the wolves.

CONSERVATION

In general, people in Serra da Canastra have mixed feelings toward the maned wolf. The species has been used as a central figure to explain the complexity and fragility of the local ecosystem. We try to raise awareness through the presentation of the beauty of the region, contrasting with negative impacts that lead to the destruction of nature (fire, hunting, deforestation, etc.). Presenting the two sides, we have been trying to engage locals in several self-sustained actions that improve the environment's status in the region, including adapting harvest practices, applying management actions on livestock depredation by predators, and providing information on the ecological functions of the wild species.

Positive conservation impacts will be related to the stories that we can produce and our experiences that can be told to local communities through our growing outreach and awareness efforts. Clearly, one of the best ways to preserve the cerrado and its biodiversity is to communicate the interesting biology and role of species in local ecosystems and communities. We believe that by involving the local community, the research can be more effectively and widely transmitted to local people, who ultimately will be responsible for preserving this habitat and its wildlife in perpetuity. One of the main tasks is to convince farmers that people and wolves can surely coexist.

Conflicts between maned wolves and local populations have been suggested as one of the main threats to the species' maintenance. Although official records of direct persecution resulting in the death of maned wolves are unusual in the Serra da Canastra region, local farmers tend to always blame the wolves for any livestock losses. This attitude is concerning, since awareness and tolerance of the species is low, sometimes leading to persecution and killings.

As farmers raise their avian livestock in an overexposed environment, simple preventive methods would improve their breeding and, consequently, production. However, on top of their losses, farmers cannot afford to build facilities to raise their chickens in enclosed spaces. One option was to test prototypes of chicken coops to prove to local people how effective they were at protecting from predators and improving production.

Since 2005, we have visited schools in the entire regions (mostly rural schools) to speak to teachers and students about conservation of the cerrado and its flagship species, the maned wolf. This has resulted in an improvement in local people's attitudes toward the wolves. Because human and wolf conflict is one of the critical conservation threats to this species, we have been visiting farmers and helping them to solve problems, as well as educating them about the importance of maned wolves to cerrado habitats.

Besides the direct relationship with humans resulting in conflicts, infectious diseases caused by pathogens spread from domestic animals can represent a serious threat to wildlife, in this case to the maned wolf. Maned wolves living in rural areas have been exposed to several domestic animal diseases. We found several types of pathogens in the wild population but the canine parvovirus (CPV), a disease that causes high mortality rates in young individuals, is of major concern. Our previous study demonstrated that anthropogenic factors (i.e., farming, ranching, and tourism) significantly affect the general health status of maned wolves and the population might be at risk due to infectious diseases. Undoubtedly, not only CPV but also several other diseases from domestic dogs must be contained to avoid drastic reductions in the wildlife population due to this factor. Thus, campaigns to vaccinate domestic dogs and reduce their density were proposed as necessary in the surroundings of SCNP.

The information generated in this project has been shared with governmental agencies at state and federal level, and specifically with CENAP (National Research Center for Carnivore Conservation), the research center within the Environmental Ministry responsible for developing leading research, policies, and conservation actions for carnivores in Brazil. This is a way to ensure the application of all the scientific information collected in the field. By collecting and sharing scientific information and through direct actions involving the local people we have experienced better conservation actions recognized by the local authorities and general public.

HISTORY OF THE PROJECT

The prequel of the project was an investigation of the impact of human activities on mammals in the Serra da Canastra region in 1998. The results showed that farming and ranching had a negative influence on species' diversity and abundance in areas surrounding the national park. However, persistence of the maned wolf in altered areas suggested that this species tolerates human activities (depending on the type of activity and degree of severity), especially when levels of habitat disturbance are low. From this point, we decided to perform a more complex evaluation of several aspects

of maned wolf conservation, including the relationship with the local people. Thus, the specific investigation of the maned wolf was started in 2000.

Phase I (2000–2002): Tourism and Altered Behavior

The Maned Wolf Conservation Project arose from concern about the effects of the constant feeding of wild wolves by park rangers, tourist guides, and visitors around the areas near the park's field base. A short-term survey from 2000 to 2002 was conducted through direct behavioral observations and analysis of fecal samples. Several negative results could be clearly seen, and alterations in the animals' ecology and behavior were found.

At that time, seven adult animals (four females and three males) were identified (by individual marks on the mane, throat, tail, and legs) through visual observations and camera trapping. Despite the maned wolf's solitary habit, sometimes several of them (at most five individuals) were observed no more than 10 m apart, waiting in the middle of the day (against their natural crepuscular/nocturnal activity pattern) for the scheduled food provided by people (leftovers from rangers' meals and snacks from guides and tourists). Trash containers were visited by wolves during the day and night, and food, bottles, and cans were taken by the seven individuals around the field base. Pieces of toilet paper, plastic (from bags and caps), aluminum foil, chicken, and pork bone, among many other things, were found in their scats. We analyzed 93 fecal samples and 69 of them had strange elements. Thus, only 26% of the samples had only natural items defecated (hair, bones, scales, seeds, fruit parts). Considering that 46 samples (almost half of the total scats observed) did not have any natural items, we assumed that the artificial feeding might be harmful for the animals. Differences in behavior, feeding ecology, activity patterns, and perhaps health (although not physiologically evaluated), besides an incredibly high tolerance to humans, motivated us to initiate a campaign not only on the site but also in the entire region to stop feeding the wolves. We observed three wolves with broken teeth, secretion in the eyes, and poor coat condition; many wolves had chronic diarrhea.

The desire to stop the artificial feeding was the first attempt to involve the local community in a positive action toward maned wolf conservation. Posters and flyers were distributed in local shops, restaurants, and hotels, and at the park gates and visitor center, among other places. Additionally, talks to tourist guides and park rangers were made and in 4 months, the feeding practice was greatly reduced. Although the campaign was well assimilated in local towns and among tourists, several park employees continued to feed the animals (suggesting that the individuals were depending on their feeding). The garbage cans were replaced in the entire protected area (not only at the feeding site) to prevent access by the animals. Over a period of 9 months, only three animals were regularly using the specific site. One of them, a female, which was the only one left after 11 months, had made her den to deliver five puppies at the site. The litter (and the high tolerance of mother and puppies to humans) was the strong reason for punishments from the park's administration for employees that persisted in feeding the wolves. In March 2001, the artificial feeding was totally abolished from SCNP and the surroundings. Two young wolves were captured, ear-marked, and observed together with the three brothers and mother for 11 months. After this period, they all dispersed, and we lost visual contact with all of them.

All this experience of observations of altered behavior, ecology, and perhaps health raised several questions to be answered. That was the first step of the Maned Wolf Conservation Project.

Phase II (2004–2008): Research, Education, and Conservation

From these earlier studies, a desire to observe the differences between Serra da Canastra's maned wolf population and that of the late 1970s research (Dietz 1984), and begin a detailed transdisciplinary study on the species, also considering the effects of human activities on its life, attracted the expertise of two researchers. From a compilation of what was available on the species and the gaps in the information, we proposed to conduct a long-term study by comparing several aspects of the maned wolf's life in protected versus disturbed areas.

The early components of this complex project began in December 2003 and the first captures began in early 2004. The activities of this second phase committed eleven researchers, including biologists and veterinarians, from nine different institutions.

In this second phase, the project had three primary elements: (1) ecology and behavior, (2) health and reproduction, and (3) capacity building and education. Addressing all of these components in parallel was essential to successfully achieve our goal of establishing a multi-institutional and trans-disciplinary long-term project. Our specific objectives were to determine (1) territorial differences among individual wolves and their social behavior as well as food availability, genetics, and specific responses to habitat quality and human activities; (2) dispersion rates of animals that inhabit protected areas compared to those in close contact with humans or areas under anthropogenic activities; (3) the health and reproduction of the local wolf population; (4) epidemiological risks of direct and indirect contact with domestic animals; and (5) potential risks of the presence of maned wolves to avian livestock. We also aimed to establish an environmental education program with the local communities focusing on the wolves' conservation.

Capturing and Monitoring: Home Range, Habitat Use, Social Behavior, Genetics

Although the following procedures are presented here as part of the second phase of the project, they are still being used now. Several potential areas inside and outside the protected area have been continually used for the capture of maned wolves. The animals are captured in live traps baited with cooked chicken and sardine. Once captured, the wolves are anesthetized and weighed. Body measurements are taken and biological samples (i.e., blood, urine, feces, semen, tissue, hair, etc.) are collected for epidemiological analysis and further evaluations on reproduction status and genetics (these two last analyses were specific to this phase). Each captured animal is marked with an ear-tag and then fitted with a radio collar (VHF, VHF/GPS) in order to monitor its activity patterns, home range, living areas, habitat preference, dispersal movements, behavioral patterns, and individual discrepancies. Animals were fitted with VHF collars (Wildlife Materials in 2004, Telonics in 2004, and ATS from 2004 through 2009) and since 2007 have been fitted with VHF/GPS collars (Lotek).

The captures from 2004 through 2008 were concentrated in the eastern sector of the national park, borders and surrounding areas, within a maximum of 10 km from the border. Until 2007, the collared animals were monitored on a regular basis. A protocol with at least two scans per day (day and night) of the entire covered area used to be conducted by the field team. In addition, the team spent time searching for collared animals to perform ethograms for behavior analysis. Records were kept of all encounters between individuals or pairs as well as all territorial markings (feces, urine); this information was compiled with data on living areas with the purpose of determining social aspects of territoriality.

The home ranges were calculated and analyzed with the Kernal and minimum convex polygon methods (in order to compare with Dietz's analysis) using the software LOAS and ArcView (using the extension Animal Movement). It was intended to monitor all the young animals captured (mainly animals occupying disturbed areas) more intensively in order to access information on parental behavior and dispersal patterns during the period that the offspring separate from the parents. We tried to intensify the monitoring until a young wolf had established its own home range. The dispersion distance was then measured.

From the captures and blood sampling, we performed a genetic evaluation, with the following goals: (1) We found the individual gene mark, which includes the "family" group compositions from studies on molecular ecology through the findings on microsatellite loci. From the genealogic tree, we could make inferences on social structure, territoriality, tolerance on home range overlapping, and dispersal movements. (2) Furthermore, we analyzed the genetic variability of the population compared with genetic information already known from other populations throughout the country.

Feeding Ecology and Habitat Use

Information on resource availability was collected and analyzed in specific surveys based on diet (through feces analysis). Data on fruit seasonality and small mammal dynamics were also obtained and analyzed together with data on habitat use and living areas. Sampling sites for the assessments were randomly chosen, and each site was sampled during wet and dry seasons. A comparison of all the sites assessed was made based on species' relative abundance from all the data acquired on all the taxonomic groups (vegetable and animal). The precise data on food availability that were assessed were related to the home range extensions, and to the size and exact location of each territory within the home ranges. Using this analysis, it was possible to indicate more suitable areas for maned wolves' conservation, based on food availability.

Health, Reproduction, and Epidemiology

An assessment of biomedical status of individual wolves was constantly performed over the period (with a minimum recapture interval of 2 months) to minimize or eliminate any seasonal effects. Upon capture, individual wolves were anesthetized and assessed for general status and body condition. All the clinical measures, besides notes on body condition (including weight and teeth), were taken as important observations for further comparisons. Besides the clinical monitoring of the entire population, as mentioned before, we aimed to assess the level of threat of domestic animals (mainly dogs) to the wolf population. Thus, for this specific objective, captures outside the park, where the animals live in close contact with domestic animals, were essential.

Biological samples (blood, feces, and urine) of wolves were collected and blood from the animals captured from 2004 through 2007 was analyzed. Both biochemical and epidemiological evaluations were performed. For the epidemiological analysis, we tested maned wolves for canine distemper virus (CDV), CPV, brucellosis, rabies, leptospirosis, toxoplasmosis, neosporosis, dirofilariosis, leishmaniosis, and canine ehrlichiosis. In addition, biological samples were collected from domestic dogs on the farms in the surrounding areas. Urine and feces were collected respectively by direct puncture into the bladder and mechanical extraction from the rectum for parasitological tests. Moreover, genital scrubs on females were made with cotton swabs to check for other parasites. Finally, external parasites (mostly ticks) were collected using specific protocols to investigate infestation in protected versus nonprotected areas and the potential diseases carried by the wolves as hosts.

All captured individuals were evaluated for their "reproductive success." This was defined as adult pairs producing offspring during the 1-year assessment interval. Pup survival to weaning and pattern of pup dispersal were also monitored. All these observations were performed by radiotelemetry information and direct observation. Furthermore, semen samples were collected from males during the breeding season and assessed for seminal characteristics (i.e., volume, motility, and morphology). Comparison of seminal characteristics of wolves living in different areas was performed to determine the impact of human disturbance on male reproductive fitness.

Education

Concerning the environmental education, we worked from 2004 through 2010 based on three approaches. The starting point was the beginning of a close interaction with the community in order to learn their culture and understand their perceptions about nature and feelings toward the national park. In order to gather information, chats and interviews were conducted throughout the region with distinct stakeholders, including all generations. Secondly, we focused on teaching environmental subjects in schools, both in local towns and in rural areas. The main objective was to introduce topics related to the space where the children live, the cerrado, through seminars with teachers and talks to the children. This activity promoted discussion among teachers and even at a political level (in the districts' jurisdictions) on an education plan using environmental themes as one of the priorities in local education. The seminars involved close to 100 teachers from two municipalities in the region.

The final objective was to open up communication regarding the activities and purposes of the Maned Wolf Project and the needs and doubts of the community, especially with the farmers. It was hoped that the local community speaking out would result in changes in the way they manage the land, generating positive changes in natural resource use and even their local economy.

After a 1-year period of observation and interactions with the local community, we identified three major aspects to be considered: (a) the negative attitude of the previous land owners that was caused 35 years before when the national park was established by the federal government; (b) the lack of enthusiasm for the culture and environment of the region; and (c) the shortage of opportunities and meetings where discussion about local issues takes place.

Considering these facts, in order to have a successful environmental education initiative that eventually would evolve into a program, we aimed for the following:

- a. To promote the region's cultural and environmental potential
- b. To improve the setting for meetings and discussion about local issues
- c. To encourage the local community to live in a sustainable way, respecting the natural resources, and in harmony with wildlife

Nevertheless, we did not consider only environmental problems related to this species. We chose methodologies that would increase community participation and discussions on the local problems such as tourism, local economy, and public health, among others. Thus, to achieve our goals, two activities were carried out: a collective production of a book about the region and the creation of rural movie sessions.

- Community book. Over 5 months, a group of 30 members of the community—such as teachers, students, farmers, tourism entrepreneurs, and public employees—worked on discussing several topics that resulted in the writing of a book about cultural, historical, environmental, and economic aspects of the Serra da Canastra region.
- Rural movie sessions. The “Cine Lobo” consisted in the exhibition of a 15-minute film produced by the project team. The project generated three short movies showing information about the research project, local natural qualities, conflicts between farmers and maned wolves, and public health. The short movies were presented at schools, farms, and small villages and were followed by commercial movies of interest to the community and later by a discussion of the issues involved, including social, environmental, economic, and others.

Human–Maned Wolf Conflicts

Livestock depredation is one of the main causes of conflicts that frequently result in the persecution of maned wolves due to economic losses. The information collected from 2006 to 2007 showed that 83% of the farms in the Serra da Canastra region ($n = 120$) had conflicts with carnivore species and the maned wolf was indicated as a species responsible for livestock losses. Considering this, we ran quantitative and qualitative analyses on avian depredation and the real impact of the maned wolf on local economies. Further, we implemented management and preventive methods to reduce the depredation. Twenty farms (of the 120 visited) were chosen (based on depredation rates and willingness of landowners to commit to the project's suggestion of sustainable land use) to systematically evaluate the impact of maned wolves on livestock losses. Much information on these farms has been recorded, including the existing facilities (i.e., chicken coops or similar structures to keep domestic animals) and other factors that might keep predators away (e.g., domestic dogs, scarecrows). We visited them on a weekly basis, recording all the attacks as well as the perceptions of landowners toward related species that caused the conflicts. Additionally, notes on the farmers' attitudes toward isolated attacks and the conflicts in general are registered.

The conflict management was evaluated through intensive monitoring before and after the use of preventive methods (domestic dogs, scarecrows, and chicken coops). The preventive options were

analyzed separately in order to highlight the most effective method. The presence and absence of other species of predators involved in conflicts were recorded separately by the active search of indirect signs and camera trapping. The quantification of the attacks was performed. The cost of animals preyed upon by wolves and other predators was based on the local price of chicken in addition to the raising costs to evaluate the real economic impact to a single farmer and from a general regional point of view.

Phase III (2008–2010): Healthy Wolves, Healthy System

During the previous 5 years of the project, we studied the ecology, health, genetics, and reproduction of wolves living in the Serra da Canastra region. We observed that human activities significantly affect wolf ecology and health and perhaps affect reproductive success. However, how the species perceives and uses the altered landscapes was not observed extensively, resulting in the generation of little information. We also found that there is a potential risk of disease spillover from domestic dogs to maned wolves. Considering this situation, we entered the third phase of our project when we started meeting previous objectives and defining new topics to investigate. Using the information generated, and considering the difficulties in managing the scarce financial resources available for long-term projects, we decided what research and actions to prioritize in order to succeed in conservation of the maned wolf. Thus, for this part of the project, our goals were as follows:

- To evaluate the maned wolf habitat's availability and use
- To investigate the impact of domestic animals' diseases on the maned wolf population
- To expand serological assessment to a larger number of wolves and dogs, especially in areas where there is evidence of disease exposure
- To identify various factors contributing to disease risk, including size and location of domestic and wild canids, type of habitat, and anthropogenic factors
- To evaluate the contact rates between maned wolves and domestic dogs in the surrounding areas of SCNP
- To improve and expand interaction with the local community through the educational methods used in Phase II regarding topics of public health and their interactions on the welfare of domestic animals
- To expand the conflict assessment and management through the implementation of preventive methods in other areas of the region

Animals continued to be captured in this phase, but at lower frequencies than before. Other sites were identified for capturing maned wolves to achieve the above objectives. The objectives were more specific and consequently the sampled area was in nonprotected sites. We concentrated our capture activities outside the park in this period. Captures within the protected area were for the purpose of uncollaring the wolves and monitoring in Phase II. The captured animals in this period were fitted exclusively with GPS/VHF collars (Lotek) in order to monitor activity patterns, home ranges in disturbed landscape, living areas, habitat preferences, dispersal movements, behavioral patterns, and responses to human activities, besides the contact rates with domestic animals and epidemiological analysis. The collars were programmed to register locations at 4-h intervals (dropping to 2-h intervals during the breeding season from May through August).

Natural habitats and disturbed areas were assessed in the entire region, inside and outside the protected area. This assessment was correlated with information collected from the animals monitored in the same areas in order to analyze habitat use based on habitat spatial quality. With the aim of mapping potential areas and paths for dispersion, all the environmental variables related to habitat suitability for maintenance of the species were considered. The analysis followed three processes, in a way of overlapping layers of information: (1) Species–environment relationship analysis: Assessment of species' characteristics such as habitat preference, sensitivity to impacts, and general ecological requirements, among other factors. In this procedure, information that was

already known about the species in general and in the study area was used. (2) The second layer was built from monitoring by radio telemetry, observations, and mapping concerning individual animals. (3) Analysis of maps and satellite images composed the third layer, where all the possible spatial, geomorphologic, and topographic information was correlated to vegetation maps. Together these formed the background information used to define potential areas for dispersion and establishment in order to preserve or recover ecological integrity.

Furthermore, the proposed objectives were designed to systematically determine the spread of several diseases in the maned wolf population. Although we had already obtained serum samples from several individuals in Phase II (maned wolves and domestic dogs), increasing the sample size and obtaining samples in multiple years allowed us to accurately determine the spatial transmission of these infectious diseases. By using remote sensing technology, landscape epidemiology provides a tool for mapping the spatial distribution of conditions favorable to infection, based on parameters relevant to pathogen presence and abundance. Therefore, we used remote sensing technology to identify the spatial dynamic of several diseases and the contact rates to domestic dogs in the Serra da Canastra region. Although there was no direct evidence of dogs interacting with wolves, a survey and mapping of domestic dogs and cats and their serology were performed in order to overlap the information of rural areas to wolves' home range.

During this period, we visited schools and spoke to teachers and students about conservation of the cerrado and its flagship species, the maned wolf. This resulted in an improvement in local people's attitudes toward the wolves. Because human and wolf conflict is one of the critical conservation threats to this species, our field researchers visited farmers and helped them to solve problems of wolves' predation of chickens. For example, they demonstrated an alternative way to raise chickens (by building chicken coops), as well as educating farmers about the importance of maned wolves to cerrado habitats. We also conducted a preliminary study to determine the proportion of chicken predation by maned wolves and have found that the frequency of chicken depredation by maned wolves varies among regions. Using this perspective, we produced and locally distributed a brochure that explains, step by step, why and how to build a chicken coop. Then, to assist the interested farmers, we were simply advising and stopped providing materials and labor to build the preventive units. Ten units were built by the project some years ago, and since then we have observed 16 new units throughout the range, built by the landowners. Thus, in this phase, we continued to assist the farmers in conflict management not only directly but also through the "Cine Lobo." We produced a short narrative movie that discusses the maned wolf–farmer conflict and how people and wildlife can coexist in the region (available at <http://vimeo.com/11825505>).

The education actions were based on not only conflict management but also the needs observed during the previous years of contact with the local population. During this phase, we developed a booklet to raise awareness in the community of public health involving healthy everyday practices for people in towns and rural areas. The domestic animals' health and welfare were important topics to be discussed, not only due to the large consumption of animals and animal products (pigs, chicken, and cattle meat, milk, cheese), but also due to the bad disposal or mistreatment of domestic animals in close contact with the local population and wildlife. Besides the printed material, once more we produced a short video to illustrate the problems and present solutions; this was presented at rural movie sessions, local schools, festivals, and other gatherings (available on <http://vimeo.com/6391391>). Additionally in this phase, the project, in association with Brasilia University, conducted a community communication course aiming to teach environmental education practices. The course was open to the local people, who learned and produced several materials: a radio campaign, a newspaper, and a short video, among others, based on environmental topics.

Phase IV (2010 to Present): Gathering, Informing, Expanding

Most of the data obtained in Phase III are still under analysis, especially those on spatial ecology and ecological epidemiology. However, while evaluating the data from the third phase, especially those on landscape ecology and epidemiology, more questions were generated and the need to

expand not only the scientific database but also the educational actions and the conflict assessments and management to other areas within the region was recognized. To fulfill these needs, the project initiated its fourth phase.

The Maned Wolf Conservation Project has always pursued the spread of information as one of its main principles. Scientific and general information has been disseminated only locally, through educational activities and strategies that we have implemented since 2000. From 2004, the project gained the attention of TV, magazines, newspapers, and radio reports regionally and nationally. In many cases, we engaged the local people in the reports (especially those for TV) in order to raise their self-esteem showing the community that several of their own people were involved in good environmental practices.

Environmental education, outreach, and building capacity within local communities are essential components of our maned wolf conservation initiative. Since the project's onset, we have made progress toward these objectives. Our efforts to visit farms and schools also seem to be improving the attitudes of local people toward not only the maned wolf, but also the value of wildlife in general and the cerrado ecosystem. Some of our early success has been due to the videos shared in movie sessions, the community book (available at http://www.procarnivoros.org.br/pdfs/Um_lugar_chamado_canastra.pdf) that is nowadays being used in local schools, the public health campaign, and the conflict management. In all cases, we had deep involvement of the local community. Drawing on the belief that there is much more to be accomplished in terms of community outreach and building relationships with local people, we structured a new phase of the project based on environmental education and public awareness through several communication practices.

New areas were chosen in order to continue to assist the local community in conflict management. The same approach used in Phases II and III will be used in other areas that have not yet been visited. In the coming years, we intend to replicate the methods that we have used in Serra da Canastra in other regions. Thus, the objectives for this phase, besides continuing to evaluate and manage the conflicts, are to focus on public awareness not only for the Serra da Canastra region but also throughout the country, with the collaboration of several partners.

A massive maned wolf communication campaign was initiated in 2012. The two main steps are as follows: (1) the development of a wolf character to be incorporated in written materials concerning environmental education (flyers and pamphlets that emphasize the importance of maned wolf conservation and cerrado protection) and these materials to be distributed to local people, children in schools, and tourists and in strategic locations in large cities. Additionally, we have started to work with local, regional, and national media (television, newspaper, magazines, and radio) to inform the public about conservation issues critical to the sustainability of the cerrado and wildlife status and importance. Besides reaching landowners and people in conflict with the species, another goal is to (2) reduce the impact of human activities on wildlife, mainly on maned wolves. Furthermore, the maned wolf character will be the center of an educational campaign, "Sou Amigo do Lobo" ("I'm a Friend of the Maned Wolf"), to be started in 2013, where several products and benefits will be arranged with local schools, businesses, hotels, shops, tourist centers, and so forth. In addition to visiting schools, our team will lead field trips for students of local schools and universities to enhance their appreciation of wildlife and cerrado habitats and increase efforts toward protecting them.

As the final products of this phase, we intend to achieve the following:

- To have the maned wolf nationally recognized as the cerrado's ambassador and as the animal symbol for the biome. Consequently, we will try to define the species as the totem of the Serra da Canastra region.
- To engage Serra da Canastra's community in discussions and meetings to define new policies for environmental matters.
- To have the natural attributes of the Serra da Canastra region respected and used in an environmental rational, lowering the negative effects of human activities on wildlife and the landscape in general.

Thus, the actions and results produced by this phase should benefit the local community in two main ways: (1) the valuation of nature and culture; and (2) the improvement of local articulation in order to discuss their problems. As part of this context, we plan to invest more time in and use different approaches to reach out to kids and teenagers, providing favorable conditions for communication within their educational processes. Indirectly, a society that is better prepared to discuss different topics, and that has been protecting the wildlife and preserving their suitable habitats, might increase tourism in the region.

As this has been successful in Serra da Canastra, we aim to disseminate all of our methods and strategies and adapt them in other regions where maned wolf conservation is already compromised.

Participating Institutions

The following institutions participated in the project by coordinating or providing support on data analysis, personnel resources, infrastructure, and so forth: Instituto Pró-Carnívoros; Centro Nacional de Pesquisa e Conservação de Mamíferos Carnívoros, CENAP; Universidade Federal de Minas Gerais, UFMG; Universidade de Brasília, UnB; Centro Universitário de Brasília, UNICEUB; Smithsonian Conservation Biology Institute (formerly National Zoo's Conservation and Research Center); Faculdade de Medicina Veterinária e Zootecnia, FMVZ/USP; Pontifícia Universidade Católica do Rio Grande do Sul, PUCRS; Universidade Federal do Paraná, UFPR; Fundação Oswaldo Cruz, FIOCRUZ; Pontifícia Universidade Católica, PUC/Arcos; and Universidade Estadual Norte Fluminense, UENF.

OVERVIEW OF RESULTS

The impressive amount of data generated by the research over 8 years of investigations, in addition to the feedback from the educational approaches and conservation practices, resulted in great contributions and good examples of how a transdisciplinary and multi-institutional project can grow into a program and succeed in linking science, education, politics, and economics.

Not all the data have been analyzed and processed yet, especially those related to Phases III and IV. New information not only on the species, but also on the methods we are using has already been published in peer-reviewed articles and books (May-Júnior et al. 2009; Rocha and Bizerril 2009; Rocha et al. 2013; Bizerril et al. 2011; Paulino et al. 2008; Spercossi et al. 2012). Most of the information acquired in Phase II is available in academic theses and monographs (Amboni 2007; Corral 2007; Leão 2009; Santos 2007; Azevedo 2008; Spercossi 2007; Rodrigues 2009), abstracts of both national and international conferences, and reports for sponsors. Additionally, educational folders, flyers, and booklets were produced to support educational activities. All the scientific and educational material published from the project can be downloaded in the publications section of the Pró-Carnívoros Institute website (<http://www.procarnivoros.org.br>). The short videos produced in the project are available at <http://vimeo.com/comcomunitaria>.

In Table 13.1 we present some information related to the research activities, and the educational and conservation practices.

From 2004 to 2007, most of the project activities were based on capture and monitoring. Thus, the year 2006 presented the largest number of animals trapped (Figure 13.1).

Following the proposed objectives, the capturing was intense from 2004 through 2007. In Phase III they were lower and in Phase IV they were reduced to two capture expeditions per year. Figure 13.2 illustrates the sequence of capture events on a yearly basis. More information on the capturing events and results are available in Table 13.1.

One major finding in the current study, which differs greatly from that of Dietz, who studied maned wolves within the same area three decades earlier, is that wolf density in this study seems to be much higher than that reported by Dietz (1984). In the current study, several adult wolves occupied an overlapped home range, while Dietz reported that only one male and one female shared the same area. The differences in the management of the area (from the late 1970s compared to this

TABLE 13.1**Project Remarks from 2004 to 2011**

| | |
|--------------------------------|---|
| Captures and monitoring | 303 capture events (7423 trap-nights) 58 maned wolves captured (28 females and 30 males): 6 young (3–12 months old), 22 subadults (1–3 years old), 30 adults (3–10 years old) High recapture rate: 28 animals captured 2–68 times; 30 wolves captured only once 43 animals monitored by VHF telemetry (1.278 locations) 9 animals monitored by GPS/VHF telemetry (23.384 locations) 25 individuals living exclusively within protected areas; 19 wolves on park's border (within 1 km and off limits); 20 animals specifically in farmland |
| Ecology | Home range varying 15–114 km ² (average 51 km ²) Home ranges within the SCNP larger than those outside No differences between males' and females' home ranges Average for females: 63 km ² (usually dropped to half size during breeding season) Average for males: 42 km ² |
| Social behavior | Overlapping of home ranges reached 92% for a defined pair Tolerance among wolves, from higher to lower (observed through overlapping home ranges): male–female > female–female > male–male |
| Demography | Serra da Canastra has been identified as the site with the highest maned wolf population density: 0.08 individuals/km ² |
| Reproduction | First maned wolf sperm collection in the wild Variation of levels of cortisol metabolites in feces; possible to conclude that wolves living in area surrounding the park may have been exposed to events that lead to severe stress processes, opposed to those living within the protected areas |
| Genetics | Development of maned wolf's genetic markers Definition of familiar groups among the captured animals and observation of immigration of individuals in the protected area, adding new genetic material in local gene pool |
| Health and epidemiology | Pathogens detected in maned wolves: canine distemper, CPV, adenovirus, coronavirus, rabies, Chagas' disease, leishmaniosis, leptospirosis, and toxoplasmosis Vaccination of domestic dogs in the surroundings of the SCNP: 2500 vaccines (in 2004, 2005, 2006, 2009, 2010) |
| Training and capacity building | Hosted 3 field courses (Concepts and Methodologies on Carnivore Conservation), with a total of 94 Brazilian and foreign students trained 32 students and professionals trained in internships of a minimum of 1 month 2 PhD theses 7 master's theses 3 graduation monographs 14 presentations at international and national conferences |
| Conflict management | Building of 10 chicken coops in local farms to prevent aviary depredation Significant reduction of maned wolf killings Significant increase of tolerance toward maned wolf (reduction of hunting) Conflict zones for maned wolf depredation defined through ecological modeling to direct efforts on conflict management |
| Education | 86 lectures in local and rural schools about the importance of the cerrado ecosystem and presentation of the project Distribution of the project DVD (containing the short educational movies produced by the project team) to local institutions, schools, and local people Publication of the community book <i>Um Lugar Chamado Canastra (A Place Called Canastra)</i> and distribution of 4000 copies in the region Publication and distribution of 1000 copies of the children's book <i>Lá no Coração (Into the Heart)</i> |
| Funding | Around US\$600,000 from Brazilian and international funding agencies, direct sponsors, and private companies |

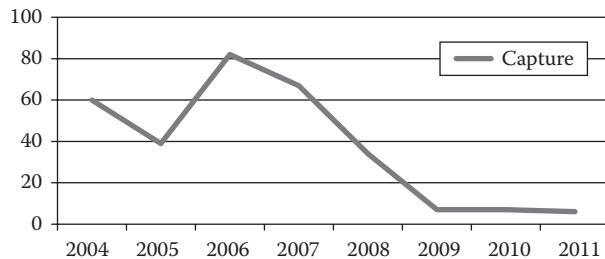


FIGURE 13.1 Maned wolf capture events from 2004 to 2011 in Serra da Canastra region.

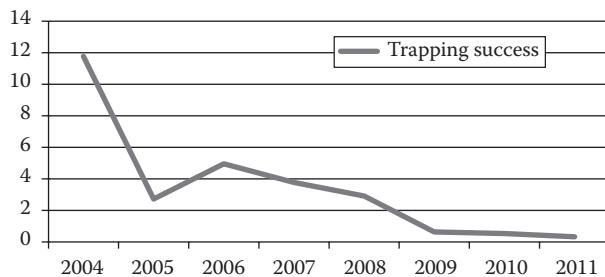


FIGURE 13.2 Maned wolf trapping success from 2004 to 2011 in Serra da Canastra region.

period) surely contributed to the differences noticed in the maned wolf population and the use of Serra da Canastra and its surroundings. The area began to be managed as a fully protected area only in 1979, making a large difference in the quality of habitats within the national park.

Because CENAP/ICMBio (a government research center within the Environmental Ministry) is responsible for developing and implementing environmental policies related to carnivore species, its participation in the project organization ensures that knowledge gained from our investigations has an impact on decision-making processes and on the implementation of the conservation action plan for the maned wolf.

In a general analysis of the achievements of the Maned Wolf Conservation Project in the last 12 years, we are confident that the presence of institutions with activities based in research, education, and public policies, among other topics of conservation, has been important in generating a high quantity and quality of information. This was essential for the use and spread of applied actions both locally and nationally. However, the involvement of the local community, which has been present in almost all the activities, has been crucial to the success of achieving our objectives. With that, we have indications that maned wolf hunting has decreased significantly in the region and local acceptance of the maned wolf has improved greatly, as well as people's awareness of nature in general. This has been possible mainly due to the intense involvement of local institutions and people from different backgrounds in planning and executing several activities in a way that everyone learns and evolves toward a common objective: a better, sustainable life depending on natural resources and the preservation of wildlife.

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