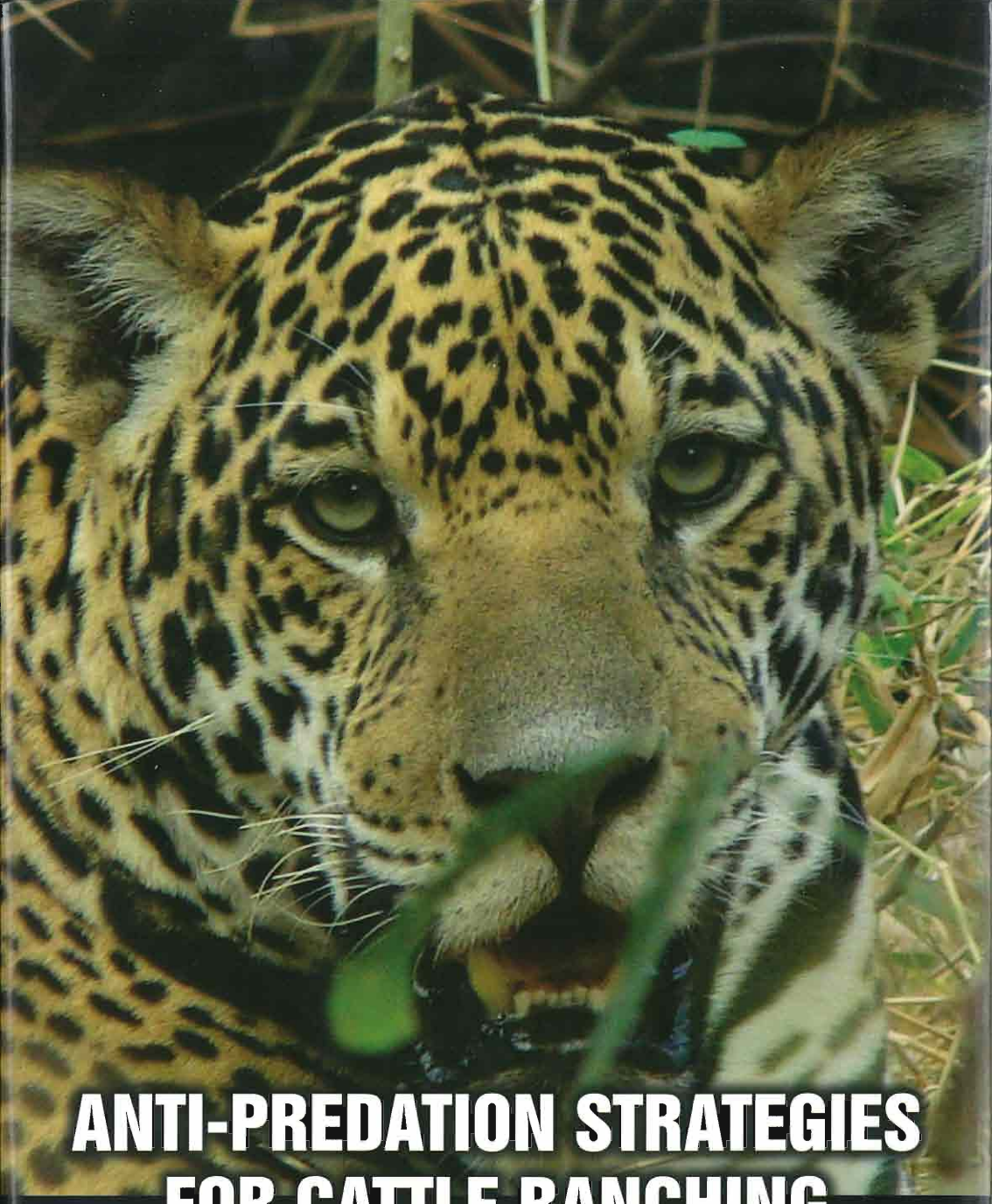

ANTI-PREDATION STRATEGIES FOR CATTLE RANCHING IN LATIN AMERICA: A GUIDE

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PANTHERA
LEADERS IN WILD CAT CONSERVATION

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PANTHERA
LEADERS IN WILD CAT CONSERVATION

Panthera was founded in 2006 with the singular mission of conserving the world's 37 species of wild cats - from the diminutive black-footed cat of southern Africa to the massive Tiger of Asia. Panthera currently focuses its range-wide conservation strategies on the world's largest, most imperiled cats: tigers, lions, jaguars and snow leopards, and we are planning similar global approaches for cheetahs, leopards and pumas. At smaller scales, Panthera also fosters and supports the very best conservation efforts on the world's small cat species. For more information, visit www.panthera.org

ANTI-PREDATION STRATEGIES FOR CATTLE RANCHES IN LATIN AMERICA: A GUIDE

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Cover Photo: a large male Jaguar, the most impressive Latin-American felid, and a key species for Humid Tropical Forests conservation, photographed in the Pantanal environment. Rafael Hoogesteijn. Fazenda São Bento, Northern Pantanal, Brazil.

Back-cover Photo: The jaguar also called "El Tigre" in many Latin American countries and "Onça Pintada" in Brazil, is one of the most spectacular and unjustly feared animals of the American tropics. It is persecuted by farmers, along with the puma, in retaliation to predation episodes (real or not) on domestic animals. It is associated with the mysterious forces of nature of the New World forests. However, in contrast to other big cats (African lion, Asian tiger and leopard) its danger to humans is minimal or nonexistent, unless provoked (Fazenda São Bento, Northern Pantanal, Mato Grosso do Sul, Brazil).

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PREFACE

Carnivores have forever piqued the passions of humans, from their first encounters millions of years ago, to present day. Those first encounters were likely just about competition and simple survival. That is, our ancestors were trying not to be eaten. Today, we have a more comprehensive approach, and we understand the responsibility we have to allow space for all species, even species that might threaten us, and threaten our property. Yet we continue to eliminate wild lands and habitats in which these species live. In the best of cases, when we eliminate these wild lands, we make sure that development is done in a way that wildlife species can still exist in core areas, and that they can pass through human-impacted or even human dominated landscapes. This is what the Jaguar Corridor is all about, making sure that jaguars can move across these modified landscapes. And, it can be just small adjustments in the way we live in these landscapes that can make a difference. When our ancestors successfully domesticated livestock cattle, sheep, and goats it created one of the biggest challenges in the conservation of carnivores: reducing the killing of livestock by carnivores.

Today, around the world, scientists, ranchers, and local communities are trying to find solutions to carnivore-livestock conflict. Rafael Hoogesteijn and his sister Almira Hoogesteijn have been leading the way in the development of methods for carnivore conflict reduction in Latin America. They have worked tirelessly for more than 25 years to advance the conservation of jaguars in ranching landscapes. This book, provides people with help understanding the jaguar-livestock conflict. But, more importantly, Rafael and Almira provide solutions. So often, ranchers and farmers are left to solve their carnivore problems on their own, with government and non-government entities nowhere to be found. And, often the only alternative is for the rancher or farmer to kill the predator. With this book, the Hoogesteijns are reaching out to help, to meet the challenge, to provide solutions and to empower livestock owners with the information they need, to provide alternatives to the killing of jaguars, pumas, and other predators. This also provides government and non-government entities with the tools to assist.

Panthera and other organizations and entities continue to conduct research on jaguar-livestock conflict. And, as the Hoogesteijns note, this edition of Anti-predation Strategies is not only now available in English, but it includes new information from field work in Costa Rica, Belize, and elsewhere. Future editions are going to compile even more of these

results, so that their book becomes a living document, with more and more examples, and more and more solutions to this pressing problem in jaguar conservation. I thank Rafael and Almira for their continued work, and what they have accomplished and will accomplish with the distribution of this latest edition. And, I encourage readers to apply the knowledge herein to their own jaguar conflict situations, and to distribute the book to the people who can use it. Through these efforts, we will move beyond the fear that our ancestors felt, and learn to live with predators like the jaguar.

Howard Quigley
Executive Director, Jaguar Program

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PROLOGUE

Since an early age and being an urban child, I was fascinated by the animal world, in our tours and travels through Venezuela; I began to hear the stories, tales and fables about "El Tigre". In Venezuela when talking about the jaguar, campesinos and field workers do not speak of "un (one) Tigre", Lord no, they speak of "El Tigre", as a mythological and fabulous beast. The jaguar is the prime example of Latin American Fauna, present in the popular cultures of different ethnic groups in all times and territories. Later during my training as a veterinarian in extensive beef cattle production systems and my professional trips to the Venezuelan Llanos, "El Tigre" was still wrapped in an aura of fear and mystery, stirring up simultaneous and diametrically opposite passions: fascination and dedication of biologists and conservationists, hatred and persecution by some ranchers and fear and ignorance by the majority of the rural residents and the public in general. "El Tigre", continues to stir these emotions even today, ranging from total admiration and fascination, to irrational terror and rage. Undoubtedly much of this emotion is caused by jaguar and puma predation (real and attributed) on livestock .

At the beginning of the Seventies, the information available on jaguars, was mostly anecdotal, stories that supported the aura of mystery and fear that surrounded our formidable feline, as an embodiment of the oppressive and mysterious nature of Tropical American Rainforests. Only in the early Eighties, the first studies with scientific rigor were conducted by pioneers like George Schaller, Peter G. Crawshaw, Alan Rabinowitz, and Howard Quigley, in Brazil and Belize. Research slowly revealed the secrets of the biology of our protagonist. From the decade of the Nineties until today, jaguar studies are in full swing, and many young researchers are developing several projects throughout Latin America, vastly expanding our knowledge in a short time.

There are still gaps in the biology knowledge pertaining jaguars, but there is not the slightest doubt of its cultural and ecological importance and the influence this species has on the structure of the American Humid Tropical Forests. To preserve the integrity of these forests (which in turn generate or influence rain patterns on which agricultural crops and commodities depend), we need to conserve large carnivores (including the jaguar and the puma), also the smaller species of felines, and so, we must work with farmers, ranchers and private landowners, since a large part of the jaguar range is located on their properties; they have to live with the jaguars and will strongly influence its fate.

The debate has become more streamlined and less visceral, some ranchers accept the jaguar and predation (to some degree); there are ranches with conservation agendas and tourism operations which depend on the presence of the jaguar, this has contributed to a better understanding and tolerance towards our protagonist.

The conservation paradigm is less dark now, than in the late Seventies, when the fur trade still reined and indiscriminate hunting was in full swing. Habitat destruction was the insignia of progress; and this imposing feline was (and still is) disappearing throughout its extensive range. Even if the demand for fur has diminished considerably, the main causes of this feline's disappearance remain the same: the loss and fragmentation of habitat, wildlife poaching and ranchers persecution due to livestock predation episodes, real and attributed.

The problem of jaguar conservation in cattle country has three fundamental facets: A) the jaguar is protected by law, its hunting is prohibited in all countries where it is present, but the laws are not enforced, B) there are no legal or judicial mechanisms, to prevent illegal hunting of jaguars, pumas and their natural prey species, all of them are under an intense poaching pressure, C) when a rancher has a livestock predation problem, even if he or she does not want to kill the feline and airs the grievance to the competent authorities, there is usually no reaction. This vacuum causes ranchers to seek solutions to the problem on their own, with fatal consequences for all the felines in the area.

Non-governmental organizations (NGO's), like the Wildlife Conservation Society (WCS) and currently PANTHERA, are trying to fill this void. The latter organization through its "Jaguar Corridor Initiative" at a continental level, is developing a collaborative work with farmers, ranchers, local communities, government agencies and other organizations, to ameliorate this conflict. The information contained herein, is part of this effort.

It is an illusion to think that the problem can be completely controlled and that we will eliminate predation and the possibilities of conflict. But it is undeniable that we have a large battery of available strategies and practices hitherto little used, that allow us to greatly reduce the conflict. We can minimize the problems of predation and increase livestock productivity through better management practices and additionally in some cases, by organizing tourism operations.

This publication is based on the "Manual on Predation Problems" (Hoogesteijn & Hoogesteijn, 2005, published by WCS), however, here we extend the information previously presented, based on subsequent experiences, new methods proven by ranchers and biologists with whom we had the privilege to collaborate and an updated literature review which includes the information generated in the last years by colleagues throughout the geographic range of the jaguar. Much progress has been made. It is our sincere hope that this publication helps ranchers and private landowners, biologists and government agents, providing proven tools to help untangle the Gordian knot which exists between food production and the safeguard of our ecological, cultural and aesthetic heritage, through jaguar and forest conservation.

Rafael Hoogesteijn
Director Jaguar / Cattle Conflict Program, Panthera

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DEDICATION

This publication is dedicated *in memoriam* to Edgardo Mondolfi and John F. Eisenberg, fathers of Modern Mastozoology and teachers of young generations of students in their respective countries.

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1 - INITIAL CONSIDERATIONS

The major cause of removal of jaguars (*Panthera onca*) (Fig. 1) and pumas (*Puma concolor*) (Fig. 2) in Latin America, is retaliation for cattle predation episodes. Coupled with habitat loss and opportunistic hunting, it is one of the main causes of large feline disappearance (Nowell & Jackson, 1996). This problem arises through the entire jaguar range from northern Mexico to northern Argentina; it affects National Parks and protected areas, which frequently are illegally used to keep livestock. Of these two species, the jaguar future is more compromised, since its distribution is geographically more restricted (Fig. 3 and 4), with some exceptions (Foster *et al.*, 2010).

Predation problems by felines have increased in Latin America in recent years because of: A) agricultural and livestock expansion leading to habitat reduction, e.g. Llanos of Venezuela and Colombia or the Pantanal of Brazil (Harris *et al.*, 2005); B) Increased wildlife harvest caused by an increasing human population and greater demands for forest products, including wildlife; the demands lead to a decrease in natural prey and of the felines themselves. Globalization, inflation, poverty and disregard towards private property increase poaching activity. The hunting activity also increases the number of wounded jaguars, diminishing their physical ability to catch natural prey, and increasing the inclination to predate on domestic animals (Fig. 5 and 6); C) Some jaguar populations have recovered after the cessation of the fur trade and organized sport hunting. Unquestionably there is more evidence of jaguar activity in several areas such as Los Llanos, than 20 or 30 years ago (Jedrzejewski *et al.*, 2013). In previous years, almost all cowboys employed in cattle ranches hunted jaguars and ocelots (*Leopardus pardalis*), usually at night with flashlights and headlamps. The skins were sold to traffickers who smuggled them to the international markets. The amount of skins traded, increased so much, that the individual size of the skins was progressively getting smaller, meaning that ever younger animals were killed without reaching adulthood (summarized in Hoogesteijn & Mondolfi, 1992). Spotted cat populations declined alarmingly. The cessation of the international trade and the then legal sport hunting, increased the relative abundance of spotted cats, leading to an increased conflict with humans and cattle in these areas.

Undoubtedly livestock production is a cause of habitat loss and a conservation problem for cats in Latin America. However, in flooded savanna areas, livestock production has been demonstrated to be a cost-effective strategy, less destructive to the environment. The use of seasonally flooded natural grasslands is sustainable, if compared to

macro-intensive agricultural production schemes such as soybeans, rice, cotton, corn and sugar cane. These crops imply large-scale deforestation, erosion, land leveling, siltation, intensive water consumption and contamination due to agrochemicals (Hoogesteijn & Chapman, 1997; Hoogesteijn & Hoogesteijn, 2010). Savannas suitable to livestock production are distributed along the Llanos of Venezuela and Colombia, the Beni of Bolivia, the Pantanal extending through the states of Mato Grosso and Mato Grosso do Sul in Brazil, parts of Bolivia and Paraguay and the wooded savannas of Guyana.

In the Llanos of Venezuela, the best-managed extensive livestock ranches were also those that had the most abundant wildlife populations (Hoogesteijn *et al.*, 2005). Several ranches diversified their income sources with tourism. This scheme is expanding in the Pantanal (Hoogesteijn & Hoogesteijn, 2010) in which jaguars play a prominent role. Within the paradigm of conflict resolution, biologists and conservationists have to understand that farmers and ranchers are not the enemy. Many ranchers have taken the responsibility for several generations to maintain and protect wildlife on their properties, despite sustained losses. The biggest threat is constituted by large developers and agricultural mega-projects, which result in irreversible ecological changes (White, 2008).

The jaguar has become a major tourism attraction in several areas of the Pantanal, generating significant income for ranchers and the local population. These revenues more than offset the losses caused by predation (Hoogesteijn & Hoogesteijn, 2010) (Fig. 7 and 8). However, inadequate tourism practices can also increase the risk of attacks by jaguars. Marchini *et al.* (2009), state: "The use of baits to attract jaguars to river mouths or beaches, and other open places where they can be more easily observed by tourists, can habituate jaguars to human presence. That means that they lose their natural fear for humans. And worse, this practice can lead jaguars to associate the presence of people with food. This combination of loss of fear and association of people with food, can provoke an attack on human spectators". The use of baits to attract jaguars (prohibited by law in Brazil) can have disastrous consequences to both sides, and has to be rejected by serious promoters and be prohibited by law in all countries.

Another opportunity to reduce economical losses due to predation is the development of "Organic Meat" production schemes (Domingos, 2005). In the era of mad cow disease (spongiform encephalopathy), antibiotics, and hormones, lean meat without chemical residues, and free of zoonotic diseases, could achieve higher demand and market prices, with the introduction of appropriate marketing strategies. Sales in strong foreign currencies could provide better income for ranchers participating

in these programs, offsetting losses from predation.

In several workshops with ranchers, organized by Government Agencies and NGO's such as Panthera and WCS, in which the authors participated, it became clear that many attendees appreciated and were proud of having jaguars on their properties as part of their natural and cultural heritage, but were compelled to remove them because of continued predation episodes.

In Latin America this problem is threefold: A) the hunting of jaguars is illegal and prohibited by almost all governments; B) there are no legal or judicial deterrent mechanisms to prevent illegal hunting of jaguars, pumas and their natural prey. All of these species are under strong poaching pressure and laws have practically no effect (the few judicial cases we have witnessed in Brazil, were caused by the illegal ownership of firearms, not because of the killing of jaguars); C) when a cattleman has a problem of predation, although he files complaints to official bodies, there is generally no response, he is forced to solve the problem, generally trying to kill all the large felines in the area. The policy pursued by many ranchers today can be sadly summarized in the three "S": "Shoot, Shovel and Shut Up", compounded by the use of toxic agrochemicals. This practice treats the symptoms but does not resolve the causes of the problem.

There is a definition of a "Problem Jaguar" a cat who's favorite prey is domestic animals. Predation rates of domestic animals vary according to local ecological conditions, jaguar population dynamics and age of the predator. Research has identified that predation of domestic animals is usually associated with older and/or injured jaguars, females with young or young dispersing animals in search of new home ranges (Leite *et al.*, 2002). Management efforts should be directed towards "Problem Jaguars" and not to all carnivores in the area (Silveira *et al.*, 2008). Predation rates also vary in relation to local ecological conditions, such as wildlife abundance, distance to near riparian forests, forested areas in or near grazing pastures and farm facilities, and interactions between these factors (Azevedo & Murray, 2007; Michalski *et al.*, 2006, Polisar *et al.*, 2003).

In the Brazilian Pantanal, research done by Cavalcanti (2008), showed that all jaguars in the study area consumed cattle to some extent throughout the year (although some individuals in greater proportion than others). The pattern of predation was a temporary phenomenon, it decreased the following year, when the floods were minor; then, the main predation activity was focused on white-lipped peccaries (locally called "queixadas" - *Tayassu peccari*, see "List of Scientific and Common Names of Natural Prey Species Consumed by Jaguars", at the end of the text). Crawshaw & Quigley (2002), report that particularly in the Pantanal,

healthy jaguars prey on livestock as they would on wild prey, since the cattle herds move freely through the mosaic of open grasslands, woodlands and forests (Fig. 3 and 9). In those specific circumstances, we cannot talk about "Problem Jaguars".

However, Rosas-Rosas & Valdez (2010), in northwestern Mexico, in a very different ecological and livestock setting, clearly demonstrated the existence of "Problem Jaguars", whose removal, in the opinion of the authors, would favor the conservation of the remaining local population of jaguars.

An effective jaguar conservation strategy, to be implemented in any Latin American country must meet the following criteria (Rabinowitz, 1995; Quigley & Crawshaw, 1992; and Hoogesteijn & Hoogesteijn, 2005):

1) The establishment and expansion of protected areas of adequate size according to the needs of the species. The ones currently in existence are insufficient to ensure the survival of carnivores in need of large territories (even in Brazil), with the exception of the Amazon forest (Sollman *et al.*, 2008). Considering that 96% of the distribution of the jaguar in areas of flooded savannas of tropical America is in private property, the land use pressures makes it difficult to create special management areas, that are large enough for the conservation of the species. It is therefore essential to organize private areas, which contain abundant forest and water resources, with an explicit hunting prohibition (jaguars and prey). The program of the Jaguar Corridor Initiative, organized by Panthera, initially for several Central American countries, includes livestock areas. Expanding into South America, this project tries to fill the gap of the protected areas. These multi-use areas allow exchange of genetic material at a continental level, aiding the survival chances of jaguar in particular and wildlife in general, ensuring their existence for future generations (Rabinowitz & Zeller, 2010).

2) To prevent the killing and hunting of large felines and their prey, effective deterrence mechanisms have to be instituted. Currently poachers and illegal hunters act with impunity (in almost all Latin American countries), therefore, monitoring should be strengthened and the law should be enforced.

3) Ranchers should be able to profit from the presence of felines and wildlife in general. Activities between ranchers and conservation organizations could include: a) the promotion of tourism, b) the production of organic meat (Domingos , 2005), c) *"rewards"* to ranchers that maintain wildlife populations in their establishments, and ban indiscriminate

hunting of felines and d) adopt management measures aimed at minimizing livestock predation losses. These efforts should translate in reduced tax payments, or "bonuses for the protection of biodiversity" (now being considered in Costa Rica). The authors are aware that those programs won't have any effect if they are not accompanied by legal mechanisms to deter feline opportunistic hunting, with heavy penalties to offenders. Additionally it is imperative to control poaching and illegal trade of wildlife species. There are innovative programs, as the one developed by Rosas-Rosas & Valdez (2010), who organized a successful white-tailed deer (*Odocoileus virginianus*) sport hunting program. The revenues generated by this program were sufficient to outweigh livestock losses caused by large cats, and convinced ranchers to suspend control efforts of jaguars and pumas, achieving a better conservation outcome in northwestern Mexico.

4) If there are no outreach and education programs available, punitive actions are useless. Government and NGO's assistance is essential to ranchers who have predation problems. Despite all precautions and changes in management practices, there always will be predation cases. Many ranchers (and their employees) ignore how to increase livestock productivity, most still believe that felines have no part in their lives, given that they pose a threat and produce economic losses. There is very little knowledge of the ecological importance of predators in maintaining the integrity of natural ecosystems (Fig. 4). Rural communities are traditionally terrified by the presence of a large number of wild animal species and specifically of jaguar and puma, although their actual degree of danger has been wildly exaggerated (Hoogesteijn & Mondolfi, 1992; Marchini *et al.*, 2009 , Shaw *et al.*, 2007; Hoogesteijn *et al.*, 2011, 2014). These attitudes must change. Outreach programs should include: education and management programs for local ranchers, education related to conservation of the jaguar and their prey, implementation of strategies that reduce predation episodes (diminishing the vulnerability of cattle), especially on those ranches with good productivity and efficient husbandry programs.

2 - STRATEGIES TO REDUCE PREDATION

Although the strategies proposed here, have been available for some years, they are not regularly used; mostly because ranchers are not aware or because the implementation may require additional expenses and work, on top of those that are already carried out in livestock operations. Tradition also plays an important role; we have witnessed the reluctance of ranchers to change husbandry practices implemented by their ancestors, and that they considered worked fine in the past. Unfortunately they do not take into account the environmental changes and economic demands of the globalized world. Most of the strategies here proposed have been used and proven to be effective, others will need further testing. However, we cannot stress enough that each ranch has its own set of conditions and that creativity and innovation is part of the process.

The effective implementation of the strategies is directly related to the intensity with which the cattle is managed, and inversely related to the size of the ranch. It is easier to integrate anti-predator strategies in smaller ranches with intensive husbandry; it is more difficult in large ranches with extensive cattle management. There is no recipe or silver bullet that can be applied to all ranches alike. The common element for success is the positive disposition of the owner (s) to control the problem. The implementation of these strategies is more labor intensive and requires more dedication from employees who work with the cattle. The motivation to make that extra effort can be achieved through economic appreciation, for example, offering cash bonuses to employees involved, if productivity increases or losses decrease. In very small family farms, the donation of construction materials for night enclosures, electrical fences and animal health tests (e.g. Brucellosis) has proved successful (R. Salom-Pérez, pers. comm.).

There is a great opportunity for Government Agencies, NGO's, farmers & ranchers associations to participate in collaborative projects (described ahead).

The following information is a comprehensive summary of the strategies developed by different authors to reduce predation with information condensed from Hoogesteijn *et al.*, 1993; Rabinowitz, 1995; Nowell & Jackson, 1996; Polisar, 2000; Crawshaw & Quigley, 2002; Hoogesteijn *et al.*, 2002; Shiaffino *et al.*, 2002; Polisar *et al.*, 2003; Hoogesteijn & Hoogesteijn, 2005; Michalski *et al.*, 2006; Azevedo & Murray, 2007; Palmeira *et al.*, 2008; Rosas -Rosas *et al.*, 2008; Hoogesteijn & Hoogesteijn, 2009; Cavalcanti *et al.*, 2011; and Hoogesteijn *et al.*, 2011 (literature list at the end of the guide).

2 A) GENERAL CATTLE MANAGEMENT PROCEDURES:

1) STOP THE HUNTING OF JAGUARS AND THEIR PREY:

The indiscriminate and opportunistic hunting of jaguars and pumas, which causes crippled felines, limiting their ability to hunt their natural prey, should be prevented (Fig. 5 and 6). Additionally it is essential to protect populations of wildlife prey species from poaching, through public or private surveillance. In some countries it is necessary to organize vigilance services to reduce livestock rustling (cattle theft) and wildlife poaching (Hoogesteijn & Arenas, 2008). This vigilance can be implemented in each individual property or as a common effort amongst several small and/or medium ranchers, if possible with government support.

In areas of South America in which commercial harvesting of wildlife is customary, it might be necessary to totally prohibit it, or establish harvesting quotas, e.g. spectacled caimans (*Caiman crocodilus*) and capybaras (*Hydrochoerus hydrochaeris*). This measure is especially important in those cases where such exploitation heightens the feline predation problems on domestic stock. This pattern is a clear sign of over-exploitation of the natural prey biomass. Similarly, in Mesoamerica indiscriminate hunting of pacas or tepezcuintles (*Cuniculus paca*), white-tailed deer (*Odocoileus virginianus*) and peccaries (*Tayassu tajacu* and *T. peccary*) amongst others (see "List of Scientific and Common Names of Natural Prey Species Consumed by Jaguars", at the end of the text), causes the same problem.

If populations of prey are depleted, managers may include the reintroduction of species, e.g. capybaras and spectacled caimans, whose reintroduction is relatively simple and the species reproduce well, boosting the natural prey resource, and reducing pressure on livestock.

2) USE OF NIGHT ENCLOSURES OR CORRALS:

A very effective action in areas with intense predation is to enclose domestic animals in corrals, pens or small pastures near human habitations for the night. It is easy to apply on small to medium size properties and in any ecological location. If the night enclosure has lights or is located near human habitation with dogs, it is even more effective. These night enclosures (Fig. 10, 11, 12, 13 and 16) can be provided with electric fencing (Fig. 16 and 30). The animals (be it cattle, pigs, sheep or goats) are easily habituated to get into the corrals. This action reduces predation impacts significantly with a slight increase in farm labor and operating costs.

Certain practices entice the animals to voluntarily enter the corrals: the smoke produced by the burning of dung overnight, deters blood sucking insect pests; the placement of a mineral lick or supplement or a concentrate ration, not only does attract animals to the night pens, but serves as a food supplement to improve production. During the rainy season or in areas of high rainfall, more than one enclosure will be needed to rotate the animals when the ground becomes too muddy.

These night enclosures have been tried out in different sized farms and various ecological settings. For example, in Costa Rica, in the Nairi Awari Indigenous Reservation on the Talamanca Mountains, jaguars and pumas attacked and consumed domestic pigs that freely foraged in the forests. When enclosed at night there was a significant decrease in attacks. Along with the pens, bio-digesters were built, to produced biogas from the feces of the night locked-in animals (Fig. 13). The use of biogas eliminated the need to collect firewood, thus minimizing "wood collection time" in exchange of a "pig collection time". Additionally this practice had the positive side effect of reducing the family's harmful smoke exposure from the wood stoves (Salom-Pérez, 2010; and R. Salom-Pérez, Panthera Costa Rica, unpublished data).

Recently in Costa Rica, a combination of night enclosures and electric fences established for small calf and calving paddocks (Fig. 16), eliminated the feline-caused loss of cattle. This work was performed in twelve small experimental farms located at the Barbilla-Destierro Biological Sub-corridor and the San Juan La Selva Biological Corridor (D. Corrales-Gutiérrez & Panthera Costa Rica Team, unpublished data).

In certain areas of the Venezuelan Llanos (Hoogesteijn & Arenas, 2008), parts of Central America (e.g. Honduras, F. Castañeda, pers. comm.) and Mexico, cattle rustling is prevalent. Night enclosures prevent the losses by cattle rustling, improving and facilitating night surveillance of the herds. Human theft and feline predation were minimized, even with very large herds of up to one thousand animals (Fig. 10 and 11).

3) DISTRIBUTION OF WATER SOURCES:

It can be convenient to build or excavate additional water reservoirs (ponds) for wildlife and livestock, strategically located along the farm/ranch. Cattle should drink in water sources located in paddocks outside the forest; wildlife should stay inside the forested areas, preferably without livestock access. These water sources enhance the spatial distribution of cattle, natural prey and felines, avoiding the concentration of livestock, wildlife and cats in the few watering holes that persist during the dry season, often surrounded by riparian vegetation that facilitates

ambush by predators (Polisar *et al.*, 2003, Rosas-Rosas *et al.*, 2008).

4) FENCING OF FORESTED AREAS:

When possible, it is desirable to fence off forested areas to prevent cattle access in search for forage or water. Cattle herds should be kept away from forested areas, used by jaguars and pumas, reducing the contact interface and therefore conflict (Azevedo & Murray, 2007; Michalski *et al.*, 2006). This recommendation can be implemented in small and medium sized ranches, adjacent to forested areas, and in cattle ranches in flooded savannas, with narrow gallery forests along rivers and seasonal water courses. However, it is not feasible to implement in extensive ranches with large forested areas. Fence raising requires a large investment in building and high annual maintenance costs.

The maintenance of cattle herds away from forested areas recommended by Azevedo & Murray (2007) is applicable to ranches, whose pastures are used at a low grazing pressure (smaller amount of animals in relationship to grazing area). However on farms/ranches that are at full carrying capacity and have to use the paddocks adjacent to forested areas, this measure is more difficult to apply, so other recommendations are called for.

5) USE OF BREEDING SEASONS:

Instead of having bulls reproducing with cows all year long, and therefore having births all year long, it is recommended to establish a breeding season no longer than four months. In addition to efficiently improving the organization of the livestock operation, it allows intensive monitoring of newborn calves during a shorter period of time in the year. This is very important considering that the most vulnerable age of cattle to predation is between birth and six months. Near to parturition pregnant cows should be placed in especially prepared paddocks (Fig. 16), away from forested areas, with little or no incidence of predation and easy to monitor (Hoogesteijn & Hoogesteijn, 2005; Palmeira *et al.*, 2008).

During the calving period, it is convenient to hire additional workers to supervise the newborn calves. The keeping of newborn calves and their dams in calving paddocks for at least three months (Michalski, *et al.*, 2006), reduces the incidence of predation significantly (Fig. 14, 15 and 16).

Additionally Hoogesteijn & Hoogesteijn (2009), demonstrated the potential effect of the introduction of the breeding season, in reducing predation. In a large cattle ranch located in flooded savanna of Cojedes State (Venezuela), management measures were implemented in 2005 to

reduce feline predation losses. A limited breeding season of three months was enforced; births were limited to the months of February to April. This calving intensive period allowed a thorough control and vigilance in the maternity paddocks reducing overall predation losses from 6% to 1.2% the equivalent of 82 additional calves. Also, Water Buffaloes (*Bubalus bubalis*) were used as deterrents in the paddocks with high predation losses (more about the use of Water Buffaloes to control predator activity described in section 2D). The organization of the breeding season is described in detail in Stüwe *et al.*, 2001; and Stüwe & Hoogesteijn, 2006.

6) DESIGN AND LOCATION OF CALVING PADDOCKS:

Herds of calving cows should not be kept in pastures with or adjacent to forested areas. These cows should be placed in clean open areas, without nearby forests and preferably close to human dwellings. This countermeasure is easily applied in small and medium sized ranches, especially those that are well organized and have a 3-4 months breeding season, which limits the calving season to 4-5 months in the year. In the calving paddocks, grass and vegetation has to be kept low to avoid feline ambushes on cattle (Cavalcanti *et al.*, 2011). Another alternative is to surround the calving area with feline repulsion electric fences (explained in section 2C).

7) USE OF EXPERIENCED ANIMALS, GUARD DONKEYS AND BELLS:

Experienced older animals (bulls, steers or older cows with horns) confront predators, therefore, not all these animals should be culled. These animals teach defensive grouping behavior to the younger animals, reducing predation. These animals can be provided with bells, the sound scares predators off, improving protection. Data supporting this action were collected by Tortato (2012) in a Pantanal ranch. The area had surrounding foothills and forests, and a high predation frequency. A larger proportion of older animals in the herds diminished the losses by felines. Between January 2006 and September 2010, 73% of the deaths caused by jaguars and pumas happened when the proportion of adults in the herd was lower than 60%. Predation was also higher during the rainy season, were flooding forced the cattle herds to move to higher forested grounds, increasing the feline / cattle interface.

According to some farmers, the use of guard donkeys (*Equus asinus*), grazing with herds of cattle has been effective. Donkey braying scares felines off and reduces predation (S. Juan, Kerbo Farms, Belize, pers. comm.). This experience is being proven experimentally in Belize with

promising preliminary results (R. Foster & Panthera Belize Team, unpublished data). It could be a good tool for Central-American Jaguars which are smaller in size and weight compared to jaguars from other areas where these equines can be part of their diet.

In Costa Rica, at the experimental farms of the Barbilla-Destierro Biological Sub-corridor and in a farm in the north of the country, the use of large stainless steel bells in larger calves to prevent predation (grazing outside electrical fenced protected areas) is being tested (Fig. 15), and up to now (the first 8 months of the experiment) has proven effective in preventing puma predation (D. Corrales-Gutiérrez & Panthera Costa Rica Team, unpublished data).

8) CHANGE OF LIVESTOCK OPERATION:

Although more difficult to accept, the change of a breeding operation to a rearing / fattening (grass fattened) operation in areas with high incidence of predation might be a significant shift. Calves should not be born or placed in areas with predation problems. These areas should be preferably be grazed by cattle which are over one or two years old.

9) HERD MOVEMENTS:

When herds graze in flooded low-lying pastures, they can get isolated and weakened, becoming more prone to predation. This is a common scenario in the flooded savannas of The Pantanal (Brazil), The Llanos (Colombia and Venezuela), The Beni (Bolivia), and also in certain areas of the Honduran Mosquitia (F. Castañeda, pers. comm.). This situation can be eluded by moving cattle to higher grounds, where the quality of pastures is better and cattle can stay dry at least at night when not grazing. Healthy and strong animals are less prone to predation.

10) DISPOSITION OF CARCASSES:

It is worthwhile to remove dead domestic animals as soon as discovered. The development or inclination of an "acquired taste" to domestic animals by felines should be avoided at all costs. This can be the case if felines have access to domestic animal carcasses that died of natural causes.

11) RECOGNITION OF PREDATOR SPECIES:

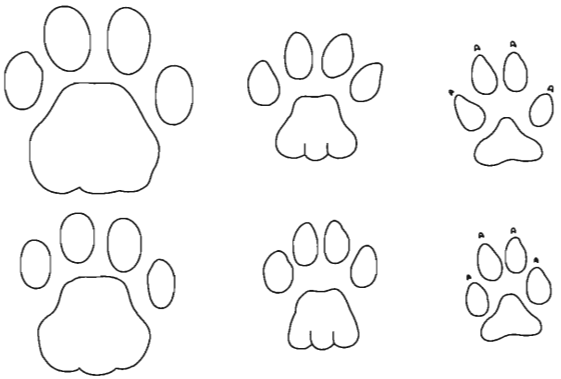
In a cattle operation with predation problems, it is vital to distinguish

the predator at hand. This is possible through the visual aspect of the predated animal and signs left by the predator. Attacks by felines are very different from attacks by coyotes, herds of feral dogs and/or cattle rustlers (Figures 17 - 25).

It is very important to differentiate deaths specifically caused by feline predation, from those in which animals died from other causes (snake bites, calving problems, lightning etc.), and were consequently scavenged by felines or other carnivores.

In several countries of Latin America, rustling is a big problem and accountable for more losses than predation (Hoogesteijn & Arenas, 2008). Disappearances of domestic animals are not synonym of predation by jaguars. Signs of predation have to be available; otherwise the case should be labeled as "unknown".

Many predation deaths are not caused by large felines, coyotes are becoming an alarming cause of loss in Central America. It also has been our experience that packs of domestic dogs (*Canis familiaris*) attack large and small - sized domestic animals of various species. Because these groups of dogs do not necessarily have to be feral, many ranchers do not believe this is possible. Vultures have also been a problem, especially Black Vultures (*Coragyps atratus*), which cause significant losses of newborn calves, while picking at their navels and eyes, if not continually defended by their dams. More information on predator identification is available in Hoogesteijn & Hoogesteijn, 2005.



Here we see a sketch of tracks left by jaguar, puma and dog respectively from left to right. The upper row corresponds to the front feet, the bottom row to the hind feet. The drawings are not to scale and were modified from previous publications (Aranda 1994, Shaw 1993).

12) USE OF CREOLE CATTLE BREEDS WITH DEFENSE DISPOSITION:

The vast majority of cattle in tropical America are Zebu (*Bos indicus*) pure- or cross-bred with varying degrees of European breeds (*Bos taurus*).

Some individual cows have highly defensive reactions against predators and protect their newborns from attacks (e.g. Nelore breed), but most stampede in the presence of the predator, fleeing in different directions, leaving small calves alone, disoriented, lost, and prone to attack.

The Creole cattle (*Bos taurus*) was introduced in America by the Spaniards (mainly from the region of Andalusia) and the Portuguese. This introduced animals adapted to the new world conditions with the local wildlife. This process happened in the Llanos of Colombia and Venezuela approximately 300 to 400 years ago (summarized by Gómez Pernía, 2010). The introduction of cattle in Brazil happened a bit later, with the development of the sugar cane industry and mining, in which cattle were used as draft animals (summarized by Mazza *et al.*, 1994). Cattle and people dispersed in a similar way as in the United States during the settlement of the West. People had wagons pulled by bullocks and called themselves "Bandeirantes", conquering the center and south west of Brazil. Regardless of the timing and reason of the introduction, several hardy breeds adapted to the new harsh conditions of the flooded savannas of the Neotropics. These are the Creole/Criollo Llanero and the Pantaneiro breeds (Fig. 26). There are other remarkable Creole breeds available such as the "San Martinero" and the "Criollo Casanareño" in Colombia; and the Caracú, the Curraleiro and the Pantaneiro in Brazil.

Most of these breeds adapted to Neotropical conditions, have an inherent ability to defend themselves from predator attacks (Calzadilla Valdés, 2007), and demonstrate a gregarious herd behavior similar to the one exhibited by the Asian Water Buffaloes (described in section 2C).

These breeds have a high fertility rate; however, during the adaptation process to a tropical rustic environment and because they were reared in semi-wild conditions, they were not selected for productive traits related to carcass conformation or meat quality. It was not the meat trade, but the leather trade that kept the economy in motion at that time.

Many of these breeds don't have the good carcass conformation demanded by modern markets. Consequently they almost disappeared when absorbed by the more desirable zebu breeds. An experimental action (already field-proven), yet to be scientifically documented, constitutes the rescue, recovery and widespread use of Creole breeds in areas with high predation incidence. The hardy Pantaneiro, in addition to its defensive behavior, developed the ability to forage under water, plunging its head to graze submerged vegetation. Under the supervision of the Brazilian National Agency for Agricultural Research (EMBRAPA for its acronym in Portuguese, Mazza *et al.*, 1994), breeding centers of Pantaneiro cattle are expanding. The carcass and meat producing

characteristics could be bettered through selection, or cross-breeding with native breeds with desirable traits, i.e. the Brazilian Caracú, and/or the Colombian Romo-Sinuano, thus enhancing carcass and meat quality and conserving the defensive traits and vigor.

This strategy besides the night enclosures and the rational use of Asian Water Buffalo (both sometimes not applicable), may be the only viable alternative in very extensive ranches located in flooded savannas to diminish the vulnerability of the cattle herds to feline attacks.

13) EFFICIENT CATTLE-HEALTH PROGRAMS:

Abortive diseases and various maladies normally generate more losses than predation by felines (and predators in general). In a study conducted by Hoogesteijn *et al.*, (1993), in a well managed ranch with abundant wildlife populations, in the Venezuelan Llanos, it was found that losses due to predation by felines averaged 40 calves per year (equivalent to 6% of the overall mortality - or all deaths of all cattle, in the year). However, the losses between a positive gynecological checkup for pregnancy and subsequent calving were as high as 13%. The defective management of pregnant cows caused many abortions mostly by diseases such as Leptospirosis, Brucellosis, possibly IBR (Bovine Viral Rhinotracheitis) and BVD (Bovine Viral Diarrhea). Reducing this loss from 13% to 6%, a goal perfectly feasible with the introduction of a comprehensive vaccination program (Hoogesteijn & Mazzei, 2003), this ranch would have gained about 220 additional calves per year; about five times the number of calves predated by jaguars and pumas. The birth of weak calves, more prone to predation, could also be diminished. Therefore, the establishment of an efficient health program is a great ally, helping offset losses from predation and improving the overall productivity of the ranch.

14) THE "PIZZA" OR "WAGON WHEEL" SYSTEM:

The "Wagon Wheel" or "Pizza" paddock disposition is an intensive grazing system in which a group of pastures are organized with the same arrangement of the spokes of a wagon wheel with a central axis. The divisions can be made with electric (more common) or conventional fencing, all paddocks converge towards a "square" or central area where drinking water and mineral troughs are provided. The grazing system is intensive, animals remain in the pasture during the day and only for a short number of days (i.e. a system of 16 paddocks will have two days of grazing and at least 30 days of rest) depending on the number and size of

Continue on Page 41

Figure 1 - The jaguar also called "El Tigre" in many Latin American countries and "Onça-Pintada" in Brazil, is one of the most spectacular and unjustly feared animals of the American tropics. It is persecuted by farmers, along with the puma, in retaliation to predation episodes (real or not) on domestic animals. It is associated with the mysterious forces of nature of the New World forests. However, in contrast to other big cats (African lion, Asian tiger and leopard) its danger to humans is minimal or nonexistent, unless provoked (Fazenda São Bento, Northern Pantanal, Mato Grosso do Sul, Brazil).

Figure 2 - Studies have shown that many predation episodes attributed to jaguars were in fact made by pumas. Puma predation is centered most frequently on young animals like calves and foals. Photo: Henrique Villas Boas Concone, Camera Trap, Gadonça Project, Fazenda San Francisco, Mato Grosso do Sul, Brazil.

Figure 3 - Habitat Mosaic of flooded savannas, gallery forests, swamps, lakes, rocky hills and caves, used by jaguars (Hato El Socorro, Cojedes State, Venezuela).

Figure 4 - Jaguars and pumas constitute top predators in the Neotropical forest food chain. By controlling the herbivore and meso-predator populations, they exert a profound influence on vegetation, which in turn can affect rain patterns and temperature. (Deciduous Forests at Hato La Teja, Guárico State, Venezuela).

Figure 5 - A high percentage of cattle-predating jaguars, present previous shot injuries. These injuries leave these animals unfit for the hunt of natural prey. This figure shows a female jaguar head with missing teeth produced by a shotgun blast. This animal preyed upon cattle (Hato La Candelaria, Barinas State, Venezuela).

Figure 6 - This figure shows the clean skull of the same female of Figure 5. The lead of the shot is embedded in the bone of the skull, there is extensive tooth loss, and no canines on one side. It is incredible how jaguars survive such terrible wounds.

Figure 7 - Important income sources are being generated by using jaguars as a "Flagship" species for tourism. This income also benefits local people living with the species, as is happening in the Northern Pantanal of Brazil. (Photo: Steve Winter, Fazenda Jofre Velho, Northern Pantanal, Mato Grosso, Brazil) .

Figure 8 - Jaguars are not only an ecological valuable resort, they are also part of the cultural heritage of the Americas. Many aspects of its ecology are still unknown and its value as a tourism asset has not been completely harnessed. Nevertheless, it is necessary to work with ranchers to reduce predation problems and with the government authorities to reduce poaching, to achieve effective conservation goals. (Encontro das Águas State Park, Northern Pantanal, Mato Grosso, Brazil).

Figure 9 - Predation problems on domestic animals are correlated with wildlife prey availability. The less wildlife there is available, the larger the predation problems on domestic animals. In the forest pasture ecosystem, free-ranging cattle behaves like wild animals do, therefore felines consider it prey. Several studies reveal that higher losses are a consequence of deficient husbandry practices (absence of health and/or reproductive programs) or cattle rustling, compared to predation losses (Hato La Vergareña, Bolívar State, Venezuela).

Figure 10 - Night enclosures constitute an excellent strategy to control both cattle rustling and feline predation. It is relatively easy to apply in herds of varying size, even very large ones as this one (Hato Merecure, Llanos of Apure State, Venezuela).

Figure 11 - Group of cows and their calves, being driven to a night enclosure in a nearby corral, located very close to an occupied out-post station house (Fazenda San Francisco, Mato Grosso do Sul, Brazil).

Figure 12 - Puma predation losses in a Colombian family farm (La Esperanza, Middle Magdalena River), were prevented, by building this night enclosure corral next to the family main house.

Figure 13 - Night enclosure corral, in the Nairi Awari Indian Reservation at the Talamanca mountains of Costa Rica. This corral was provided with a bio-digester which produces biogas from feces of pigs locked-in at night. Feline attacks and losses have decreased. The biogas eliminates the need to collect firewood, thus compensating the effort to collect and feed the animals; additionally, there is a decrease in harmful wood smoke exposure when using the stove. (Photo: R. Salom-Perez, Panthera Costa Rica Program).

Figure 14 - Predation can be reduced fencing-off forested areas, maintaining pasture and vegetation low in the calving paddocks, and placing those paddocks near human dwellings. Specially designed electric fences (see Figure 30) have been proven to be effective. The care of newborn calves solves a great part of the problem.

Figure 15 - The use of large stainless steel bells in calves, combined with night enclosures and/or electrified calving paddock fences, is having good preliminary results to control puma predation losses in Costa Rica.

Figure 16 - In this farm in Costa Rica, a calving paddock, used for late pregnant cows and small calves (in the background), was provided with a feline-repellent electrical fence. It has 5 strands of the original barbed wire and 2-3 adapted strands of electrical wire. It has had excellent preliminary results to control feline predation losses.

Figure 17 - This calf was killed by a jaguar attack; two of the four holes of the canines over the nape are visible. The neck bite fractured the base of the skull and the first vertebrae. (Hato El Socorro, Cojedes State, Venezuela).

Figure 18 - This two-year-old zebu bull was killed and partially consumed by a jaguar. Jaguars often devour the flesh of the chest, ribs, shoulder blades and neck first. Usually cattle carcasses are found in this characteristic position, that favors consumption of the most desired parts (Hato La Vergareña, Bolívar State, Venezuela).

Figure 19 - An adult male jaguar footprint, with a dog's foot for comparison. Identification aspects to be noted are the larger width than length, the roundness of the finger pads and the shape of the footpad. (Hato San Ignacio, Cojedes State, Venezuela).

Figure 20 - An adult female jaguar track. The footprint is smaller in size than the male track, and the finger pads are slightly more elongated (Hato Samancito, Cojedes State, Venezuela).

Figure 21 - An adult puma track. Identification aspects to be noted are that the footprint has a longer length than width, the fingers are more elongated, and the foot pad has three characteristic lobes. Generally puma tracks tend to be smaller than jaguar tracks. (Hato El Socorro, Cojedes State, Venezuela).

Figure 22 - Pumas have a tendency to cover their prey with vegetal material, Jaguars do not display such a behavior. When the vegetal debris is retired (next figure), it is possible to examine the prey, in this case a foal. (Hato Paraima, Cojedes State, Venezuela).

Figure 23 - Pumas usually consume first the muscles of the ribs, and some of the viscera such as the heart, liver and lungs in the thoracic cavity. Stomach and intestines are removed cleanly, without spilling contents. After consuming those parts they generally begin to devour the haunches.

Figure 24 - Pumas usually kill by biting its prey in the throat (as shown in this foal), leading to death from asphyxiation and/or limited blood supply to the brain.

Figure 25 - When a domestic animal dies due to predation, losses can be higher than only the slaughter price. In this case a pregnant cow was predated, and so the future calf was also lost (lying behind her). The loss can increase if the animal has high genetic value (seed bull or a selected cow). Some ranchers cull the cows that do not wean a calf each year. If the cow lost her calf to predation, the herd can lose a valuable cow which was erroneously eliminated for low productivity (Fazenda São Bento, Mato Grosso do Sul State, Brazil).

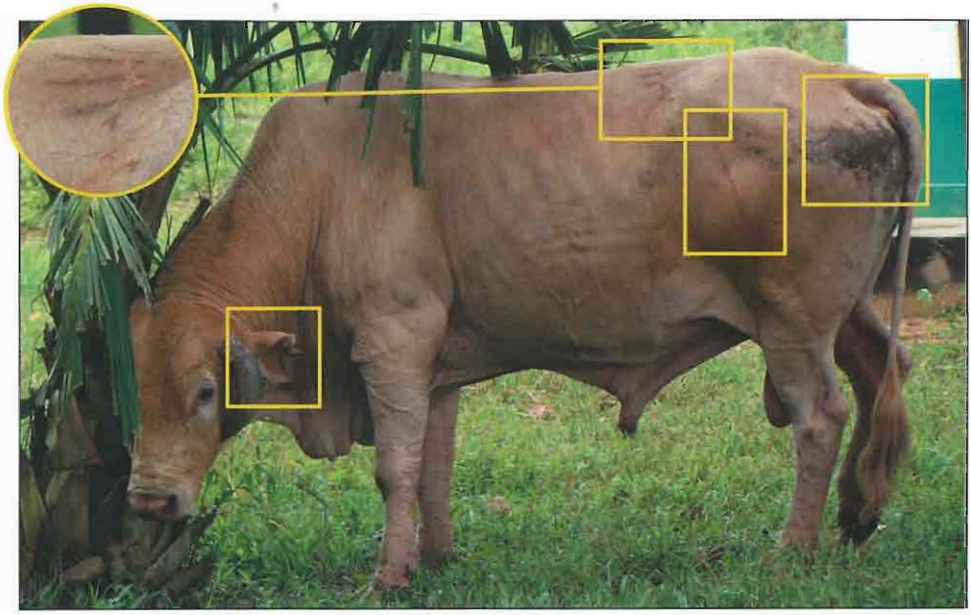


Figure 26 - European cattle were brought from Europe by the Spaniards and Portuguese. These animals adapted to Neotropical conditions and learnt to coexist with felines, developing gregarious defense habits and adapting to the local flooded savannas conditions. This presents a novel opportunity in which Creole-breed bulls can be used in extensive ranching conditions. In the picture, a Creole Pantaneiro Bull that defended his milking cows herd many times, shows his battle scars (Fazenda São Bento, Mato Grosso do Sul State, Brazil).

Figure 27 - Individual animal identification, the keeping of regular cattle inventories and the collection of mortality data quantified by date, cause, and place; allow the identification of the areas of the property more affected by higher loss, the causes of death and their yearly comparison. When these records are analyzed, it is possible to establish which areas of the ranch are most affected and the most common causes of death; and with this information, a workable plan can be designed to decrease mortality. (Hato Merecure, Llanos of Apure State, Venezuela).

Figure 28 - Native grasses can be associated with more productive introduced grasses such as Needle Grass (*Brachiaria humidicola*) using minimum tillage (MT) technologies (see text). Not only does this system respect forested areas, but it increases productivity, decreases erosion and soil compaction and protects biodiversity, therefore minimizing predation problems. Photo: Marcela Lemos Monteiro (Fazenda São João, Mato Grosso do Sul State, Brazil).

Figura 29 - This aerial photograph compares MT (upper corner left) and the traditional pasture introduction method. The environmental impact of the second method is very clear, establishment expenses are higher and productivity is not necessarily better. Photo: Marcela Lemos Monteiro (Fazenda São João, Mato Grosso do Sul State, Brazil).

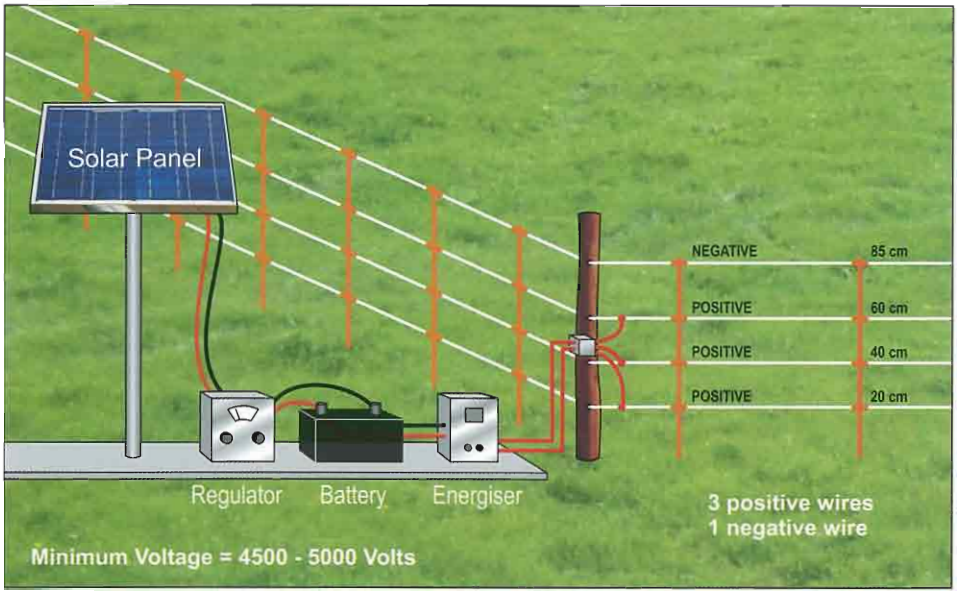


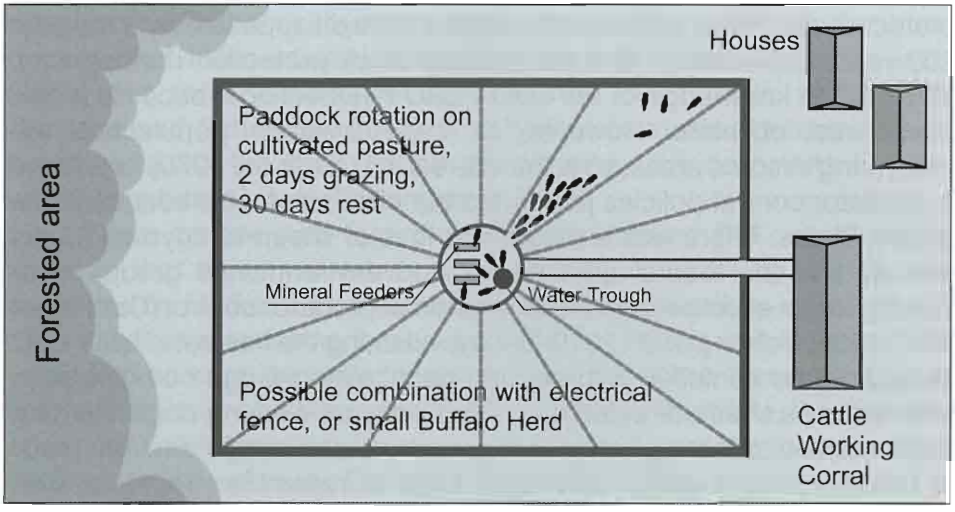
Figure 30 - Simplified diagram of an electric fence designed to repel feline attacks, it can be placed on the outside of the paddocks or corrals (Diagram: Luciano Porto, modified from Scognamillo *et al.*, 2002).

Figure 31 - Herds of beef producing water buffaloes, managed under extensive conditions in conjunction with commercial Brahman cattle breeding herds, with excellent results in productivity and without predation losses (Hato Los Viejitos, Apure State, Venezuela).

Figure 32 - In the flooded savannas of the Venezuelan Llanos there is an increasing number of ranches that are keeping cattle and buffalo herds together. The income increases with the beef and milk (cheese) production, and predation is kept to a minimum. (Hato Merecure, Apure State, Venezuela).

Figure 33 - Buffalos don't suffer predation losses. When confronted by a predator or any other danger, they display a gregarious defensive behavior. The keeping of crossbred dairy buffalo females of the Murrah breed, in small, tame, well controlled groups, in conjunction with cattle herds, deters predators and decreases predation problems. Photo: Roberto F. Coelho, Fazenda San Francisco, Mato Grosso do Sul State, Brazil.

paddocks available. During the day the animals graze high quality forage (only eating the grasses leaf ends) and have access to water and minerals in the central square, where they sleep locked-in at night. Although this is a more technical and intensive system with cultivated pastures, it uses a smaller area for livestock which could mean that a larger section would be available as a natural protected area. It requires a high initial investment: The establishment of the cultivated pasture paddocks, the building of fences, electric or conventional, the organization of the water source, the arrangement of corridors, and a proactive management. It may be built with conventional fences as paddock divisions, and could be enhanced by a special feline repellent electrical fence in the "Plaza" area where the cattle sleeps at night. Another alternative could be to place a small herd of water buffaloes with cattle during the night. In the long term, this system yields big savings in machinery use, fuel consumption and pasture maintenance, maximizing productivity and being highly effective in controlling predation. Pasture carrying capacity needs to be respected; and overgrazing has to be strictly avoided, since it could adversely affect cattle productivity and system maintenance.



"Pizza" or "Wagon Wheel" Fencing System, provides for an efficient increase of management intensity, herd productivity and predation control.

15) CATTLE IDENTIFICATION AND MORTALITY DATA:

Good livestock management practices include the individual identification of each animal in the herd, and the detailed collection of data, the recording of mortality and its causes is especially important (Fig. 27). It is necessary to update livestock inventories (at least one overall count of

heads per herd and/or paddock, per week or month).

This information should be summarized for each year in terms of mortality rates by cause and location on the ranch, allowing the rancher to know the real causes of the losses, the real impact of the predation problem in relation to other causes of mortality, and the identification of the areas in his property with higher occurrences of predation (or, other causes of mortality or rustling). Data then can be used to define and organize actions to improve the management and thus, enhance productivity. Owners and managers are usually surprised when after one or two years of correct data collection, they discover that predation is a minor cause of loss in comparison to other causes previously not taken into account, such as bites by poisonous snakes, losses caused by vultures, plant intoxication, lightning, uncommon diseases and cattle work accidents (Hoogesteijn *et al.*, 1993).

16) THE USE OF GUARD DOGS IN CARNIVORE CONSERVATION:

Livestock guard dogs (LGD) have been used for centuries to protect livestock from predators. LGD originated in Europe and Asia mainly to protect sheep. Many species of predators have disappeared over the past 200 years especially in Europe, making stock protection unnecessary. Much of the knowledge of the use of LGD has been lost because it was considered obsolete. However, as large predator populations are recovering in some areas, so is the interest in LGD. In the 1970s, a change in predator control policies prohibited the elimination of predators in the United States. There was a staggering loss of sheep to coyotes (*Canis latrans*) and the federal government and environmental groups were looking for an effective, non-lethal method of predator control (Coppinger *et al.*, 1988; Gehring *et al.*, 2010), thus awakening the interest in LGD. LGD should not be confused with herding dogs, even though both are often referred to as sheep or cattle dogs, and both are working dogs. Herding dogs work by gathering livestock in groups, and moving them from place to place. Herding dogs have been bred to resemble predators, with stalking behavior and pointed ears; they are highly trainable and obedient.

LGD protect livestock, but do not herd, they have been bred to look inoffensive to stock, with floppy ears, and some of them even have long white hair that resembles wool. They avoid direct confrontation with livestock, do not display stalking behavior, and generally are very calm around livestock. These traits allow LGD to integrate themselves with groups of livestock, be accepted by them and live amongst them. LGD are not as highly trainable as herding dogs, they make their own decisions, they are independent of humans, and they were bred to live and work with

livestock unsupervised, protecting herds. Traditionally, dogs place themselves between the stock and the threat and they bark loudly. If provoked, the dog will attack, but often their presence alone deters predators (Marker *et al.*, 2005). They are usually very large dogs (70 cm high and > 45 kg); the most common breeds are Great Pyrenees (France), Komondor (Hungary), Akbash dog and Anatolia Shepherd (Turkey), and Maremma (Italy).

Although LGD are more commonly used to protect sheep, they have successfully been used to protect goats, poultry, cattle, horses, pigs, rabbits, deer, ostriches, and even wildlife such as penguins in Australia. These dogs can be imprinted with any stock, which they will regard as their social companions, protecting them from anything that they see as a threat, including birds of prey.

Predators for which LGD have been reported useful are caracal (*Caracal caracal*), cheetahs (*Acinonyx jubatus*), jackals (*Canis mesomelas*), leopards (*Panthera pardus*) baboons (*Papio spp.*), brown bears (*Ursus arctos*), black bear (*Ursus americanus*), wolves (*Canis lupus*), domestic and feral dogs (*Canis lupus familiaris*) and thieves (*Homo sapiens*) (Gehring *et al.*, 2010). Although they have mostly been used to protect sheep from coyotes; encounters with wolves have been documented. In the western United States wolves killed LGD (Bangs *et al.*, 2005); the same experience was reported in Romania and France (Mertens and Schneider, 2005). In a typical encounter between black-bears and LGD, the bear usually retreats when the dog starts to bark, without physical contact (Gehring *et al.*, 2010).

There are few data regarding LGD and felines. The only study we know of that examined how LGD reduced predation by felines was published by Marker and collaborators (2005), in Namibia, in which LGD were effective in reducing losses caused by cheetahs and leopards. We could find no such examples involving jaguars. In the Americas, pumas and jaguars have been reported to prey on dogs. Therefore, the question arises, do LGD have the fierceness and size necessary to antagonize these large felines? In the Chilean Patagonia, LGD have been reported to control not only foxes and birds of prey, but also pumas (Tapia and Elizade, 2012; and Saucedo, C. Pers. Comm.). Shaw *et al.* (2007) concluded that although the use of LGD reduced mountain lion (puma) predation on sheep in the U.S., it was not effective in reducing losses in cattle herds maintained in free-range conditions.

LGD have also been found to successfully exclude meso-predators (e.g. foxes, skunks, raccoons) from pastures. This exclusion had a positive effect on ground nesting birds. Presence of LGD also decreased the number of small mammals (e.g. deer mice, voles, marmots) (Gehring *et*

al., 2010).

Hansen and Smith (1999), reported that 85% of the encounters between LGD and wildlife resulted in LGD either chasing or following "intruders" including moose (*Alces alces*) and roe deer (*Capreolus capreolus*). Depending on the ranch this trait may be considered positive or negative.

In its positive form, authors have suggested that the presence of LGD may decrease presence of infected ungulates from livestock areas (VerCauteren *et al.*, 2008). For example, LGD could be used to deter elk (*Cervus elaphus*), bison (*Bison bison*), badgers (*Meles meles*) or brushtail opossums (*Trichosurus vulpecula*) from interacting with cattle and thus decreasing incidence of brucellosis or tuberculosis.

In its negative form, while chasing wildlife away from livestock is part of the expected activities, this could be a problem in ecotourism facilities or producers that earn revenue from wildlife. Harassing of wildlife was reported in 40% of the working dogs (Gehring *et al.*, 2010). This was especially disadvantageous when dogs drove away deer from the range where producers earned part of the income from hunting leases (Hamsen and Bakken, 1999; Hansen and Smith, 1999; Gingold *et al.*, 2009). This was a common scenario in Namibia where there is a high density of wildlife. Herders were able to recognize such a behavior at an early age and teach the LGD that game and other stock animals were not threats, food or fun (Marker 2005).

Coppinger and collaborators (1988) found that in the places where dogs were not effective, sheep where scattered widely over a large area and never flocked, or producers did not spend more than minimal time with the flocks. Tightly flocked herds can be more effectively defended from predators (Hansen *et al.*, 2002). Problems also arise on farms with mixed stock, where experienced dogs that were socially bonded to one species displayed predatory behavior against the other livestock species.

Although LGD can be highly effective in protecting livestock, the purchase of a LGD will not immediately solve predation problems and these dogs require long-term commitment. They are live animals that require investment, time, and patience; they can become ill, be injured, or die prematurely. But, with these commitments, the reward can be substantial. One of the first steps is to imprint the LGD to the livestock they will protect.

The dogs need to be reared with the livestock they are going to protect. The dogs choose to remain with livestock because they have been reared from puppyhood with them. The goal with a new puppy is to channel its instinct by early and continuous association with livestock, so that a bond is produced. If this bond is not developed, the dog will not stay

with the animals they are supposed to protect. Body contact between dog and livestock enhances the formation of a strong bond. It is important that the dog is not allowed to be in the house or with the family, or any area without livestock. A LGD is a working animal and should be treated as such. It is not a pet, and making this distinction is important.

Training instructions can be found in:
The Ins and Outs of Livestock Guardians, www.asdrl.org; Livestock Guarding Dogs Protecting Sheep from predators, www.nal.usda.gov/awic/companimals/guarddogs/guarddogs.htm; Guardian Dogs, Best practice Manual for the use of Livestock Guardian Dogs, www.invasiveanimals.com/wpcontent/uploads/2010/09/Guardian-Dogs-web.pdf; Livestock Guard Dog Basics for working dogs, www.c-c-farms.com/lgd_basics.html).

These training manuals provide some essential guidelines for raising an effective LGD. However, a few of these are worth mentioning here. For instance, puppies should not be placed where losses to predators are high. For those areas, the LGD will need to attain a certain level of physical maturity. The dog should at least be large enough to defend itself if confronted by a predator. The dog should be visited daily in the pasture. If food is not provided in a self-feeder, it can be given to the dog each day. The daily visit provides with an opportunity to observe how the dog is. To little contact may cause the dog to be shy of people, making these dogs difficult to handle for physical examination and control. In this situation, for instance, they cannot be moved to other pastures or to a kennel. It is essential to be able to handle the dog; at the very least, the dog should be able to obey the commands "no" and "come".

Livestock must be trained to accept the presence of the dog inside and outside an enclosed area. Here, the training capabilities of a herder play an important role in the process, not only training the dog, but also in training the stock to the presence of the dog.

Owners of LGD have additional responsibilities. These breeds are large, powerful, and protective of their territory and livestock. In a survey of 763 LGD keepers, 7% of the dogs had bitten people. It becomes the owners responsibility to protect people. To avoid accidents, the dog should be trained to stay in its designated area, the owner should alert neighbors that the dog may wander to their property, enlisting their aid in reporting and preventing this roaming. It also helps for LGD owners to post their property as to the presence of the dog, keep the dog off roads, and to be alert to the presence of poison baits, rodenticides, traps and snares. (Green *et al.*, 2010). Guarding dogs may weigh up to 50 kg, and will need proper nutrition. Generally, high-quality dry dog food will meet their requirements. Each dog will require from 800 g up to 2 kg of food / day

when fully grown. It is important that animals are well fed to avoid dogs chasing wildlife and hunting for "food".

Overall, LGD reduce predation, reduce labor (lessen the need of night corralling), increase utilization of pasture land where predators made grazing impossible, alert owners to disturbances in the herd or flock, increase self-reliance in managing predator problems, protect the property and members of the family, and provide peace of mind to the ranch or farm owner (Green, *et al.*, 2010). LGD have the great advantage that they are a proactive predation control measure. The predation event is avoided rather than the scenario, in which the problem eventually gets solved after it has occurred. The use of a guarding dog does not exclude the use of other predation-control methods. As with every predation control tool, the use of LGD could have specific uses within the herd management program that they are more or less effective with. These would need to be analyzed with the rancher as the application of LGD progresses.

Many questions would need to be answered for tropical conditions, i.e. will LGD be large, strong and brave enough to deter jaguars and pumas? The wolf experience with LGD indicates there may be some issues here. More aggressive LGD might be able to deter large predators, but more aggressive LGD also are more prone to kill smaller predators and other wildlife, potentially injure livestock, and negatively interact with people.

Livestock guarding dogs are being used successfully to control predation losses on sheep in some southern countries like Chile and Argentina (Photo: Cristián Saucedo).

Some livestock producers would be concerned with costs. Green and collaborators (1984, 1999), calculated that a LGD would need to save enough stock to defray a first year cost of approximately US$ 834, subsequent annual maintenance cost would be approximately US$ 286. Costs would be greater if there were more than one dog. To some producers, the peace of mind of knowing that the dog protects the flock is a significant benefit worth the investment.

How many dogs would be necessary in the large areas used in some countries / ranches? The number of LGD in the Latin American settings also needs to be determined. Local stockowners would need detailed training in to the use these dogs. Although all these challenges in the use and training to use LGD can be solved with time, experience and education programs, guarding dogs may not work everywhere for everyone, as is the case with most anti-predator measures. The use of LGD needs to be approached with caution in those settings where wildlife is an important asset to producers. However, it seems that LGD can be an excellent aid to control predation for sheep producers in a wide variety of conditions. LGD may not be a solution for everybody, but they can be part of the solution to many, especially where coyotes or domestic dogs cause the main predation problem.

17) PHYSICAL REPELLENTS AND CHEMICAL REPELLENTS:

The use of propane explosives and pyrotechnic devices has been successfully used to scare off and reduce predation by felines; it has the disadvantage that the predator might move to the neighboring ranch/farm. These explosive cannons may force predators to move their occupation areas or devise new approaches to the herd. Visual and acoustic stimuli, such as electronic shepherds, motion detectors, non-lethal shots and sonic collars have been tried. Among these, the RAG (or Radio Activated Guard) was successfully used to repel wolf attacks on livestock (Breck *et al.*, 2002). The sensor on the collar is activated when a tagged predator attacks, the inconvenience is that the offending animal must be fitted with the radio collar or "electronic tag".

There is the possibility of testing other innovative methods to repel predator felines. One is the toxic collar, which is placed around the neck of domestic animals in areas with predation problems. The necklace has a capsule that may contain irritating substances, or terrible taste deterrents (e.g. capsicum, lithium chloride). The capsules burst when the cat bites the prey in the neck, spilling its contents into his mouth. This method was used on coyotes and wolves (Nowell and Jackson, 1996); originally a potent toxin was used. The method selectively condemned the offending

canine to a painful death.

An important aspect to keep in mind is that predating felines have a great capacity to adapt to new situations and can get used to some of the strategies previously mentioned. There is no technique that is totally effective; the best option is always to use a rotation or combination of methods in an additive or substitutive approach, which varies according to the individual conditions and possibilities of each farm.

2B) PASTURE INTRODUCTION TROUGH " MINIMUM TILLAGE" :

Most natural pastures in the Neotropics have a low nutritional value, significantly reducing the carrying capacity for domestic animals. Many ranchers decide therefore to introduce higher quality grasses. We are not discussing whether this introduction is convenient or not (for more information on the subject see Hoogesteijn *et al.*, 2010), but the traditional dynamic of introducing pastures, generally translates into total deforestation of the area, subsequent burning of the forest remains after deforestation, and pasture seeding aided by heavy use of agrochemicals, herbicides included. The area in question is transformed into a monoculture of the introduced grass species. As any other agricultural activity in Neotropical soils, in time there is a nutrient impoverishment, with the loss of the ecological integrity and its wildlife. We propose an alternative system called "Minimal Tillage" (MT), developed by a Brazilian rancher; who's land lies in moderately flooded savannas in the state of Mato Grosso do Sul (Brazil). This system allows the use of MT for grass introduction, respecting the forested areas. Between these "clumps" or islands of woody vegetation, the superficially tilled area is sown with introduced grasses seeds, and an association of native and cultivated grasses is established. This system is fairly easy to apply in areas with a medium level of flooding, and is more economical and effective than the traditional pasture foundation system. MT practices ensure a highly diverse agro-forestry system in which soil, plants, domestic animals and wildlife can coexist harmoniously. This system supplies the rancher with several benefits summarized as follows:

A) Introduction costs: The introduction of cultivated grasses is cheaper and easier; total introduction costs per hectare are approximately US$ 157/ha, in contrast to the traditional system with an average expenditure of US$ 471/ha. The MT costs average US$ 314 less per hectare. Deforestation, piling, burning, and subsequent dispersal of burnt material costs are saved. In addition MT increases soil nutrients, decreases soil erosion, diminishes soil compaction due to the use of

tractors and increases carbon sequestration. This system does not require the use of chemicals such as lime, fertilizers or herbicides, during the introduction or maintenance of the pastures. However, as with all grazing systems the important aspect to pay attention is overgrazing. With constant monitoring to prevent overgrazing, the system is sustainable; some paddocks have had not needed weed control for over 15 years. One of the reasons why environmentalists rightly criticize the expansion of livestock is the extensive deforestation it leaves in its wake. Using MT this impact can be considerably diminished.

B) Increased productivity: A comparative study on the ranch, before and after the introduction of the MT, showed that by associating native grasses with *Brachiaria humidicola* - Needle Grass, the carrying capacity increased from 0.58 to 0.75 cattle heads/hectare; almost doubling the amount of heads. Herd fertility improved remarkably from a mere 50% to a 75% in average. Productivity increased triple fold. The improvement of pasture quality and quantity permitted the introduction of the Brangus breed, more demanding, but more precocious, with higher fertility and better carcass and meat characteristics. In the Pantanal, the traditional practices are to breed calves to be reared and fattened elsewhere. This rancher has a complete operation; he not only breeds the calves, but rears and fattens them in one single property. Animals are taken to slaughter at an average age and weight of 30 months and 470 kg respectively.

C) Shade: For optimal productivity cattle needs to be maintained in a relative comfort zone. Even tropical adapted breeds when kept under the direct sun loose appetite, weight and energy. When trees are felled down to plant grass, shade is lost. Contrary to total deforestation, with MT trees are not felled providing between 20 and 30% more shadow.

D) Food sources diversity: The diversity of grasses, legumes, shrubs and bushes growing in the vicinity of trees, offer browsing possibilities to complement the grass diet. This is an important food source especially in extreme weather conditions during the peaks of the dry and rainy seasons in the Pantanal and the Llanos floodplains. Legumes represent an especially important part of the diet and nutrition thanks to their high protein content and indirect effects on soil nitrification. Soil nitrification, necessary for all plant species, especially grasses, is an additional benefit. The vegetation cover prevents erosion and enhances the intake of carbon dioxide, contributing to the reduction of greenhouse gases.

E) Biodiversity: By preserving the original flora, native fauna has access to shelter and food resources. The conservation of forested areas, coupled with a complete ban on hunting, has increased the local wildlife populations in this ranch, when compared to neighboring cattle ranches that employ the traditional method of pasture introduction. The wildlife abundance, allowed the development of a small and successful ecotourism facility.

F) Decreased predation problems: The high density of wildlife, explained in the previous section, reduced livestock mortality caused by feline predation. This ranch has practically no jaguar predation episodes. It has eventual losses caused by puma, which is a common problem in neighboring cattle herds. This ranch has a particular situation, in which the population of feral hogs is very large. Owners declare that the feral hog population is large because there is no hunting in the ranch and the pigs profit from the mineral surplus administered to cattle. All predated carcasses found during this study were of feral pigs. This ranch has also a well established breeding season, final-stage pregnant cows and newborn calves are well supervised and managed, thus eliminating feline predation.

The incorporation and establishment of introduced grasses has commonly and justly been classified as a predisposing cause of biodiversity loss in savanna ecosystems. It is necessary to discard polarized attitudes and accept ranchers and farmers as allies in the battle to protect biodiversity. Grasses that evolved to thrive in soils of the American savannas are not conductive to keep profitable levels of livestock productivity. Until research facilities produce native grasses with better yields, ranchers will use introduced grasses adapted to grow in low fertility soils with better yields.

We need to face the conservation and food production challenges together with landowners and achieve benefits for both parties, especially considering the existing land tenure schemes in Latin America. The MT simplifies and reduces operational costs and at the same time guarantees a highly diversified agro-forestry system, conductive to the harmonious and sustainable coexistence of soils, plants, wildlife and domestic animals (Fig. 28 and 29).

2C) USE OF ELECTRIC FENCES

One of the most important and effective tools available to prevent predation by felines on cattle, sheep, goats and even fowl, is the use of electric fencing, specifically designed to repel predator attacks. Until now

its use has not been widespread, mostly because it has been used to keep domestic animals "in" instead of wild animals "out". It is very important to note that electric fences for regular use in livestock, with one or two strands of electrified wire, prevents cattle to move from one paddock to another, but are useless in preventing a predator attack. Fences must be specifically designed to prevent or repel the entry of a feline on the grounds where cattle or smaller domestic species are kept. Therefore they are exceptionally useful when used in reduced areas, such as corrals used as night enclosures or smaller pastures, used mostly for late stage pregnant cows or newborn calves and their dams. Electric fences have also been used to surround all the pastures of a farm, especially when small, or around critical areas with high predation events.

In the Venezuelan Llanos, Scognamillo *et al.* (2002) initially tested at Hato Piñero, a design with 3 strands of electric wire. An 18 hectare calving paddock with a 1,697 m perimeter was surrounded with strands respectively arranged at 30, 60 and 90 cm from the ground. Strands were charged with 2,500 to 3,000 Volts. Felines were not deterred by this design; there were eight attacks by jaguars and two by pumas. Subsequently, an additional negative strand was added at 85 cm from the ground, and voltage was increased to 4,500 - 5,000 volts. With these modifications the attacks ceased, showing this design as effective (Fig. 30).

Schiaffino *et al.* (2002) tested an electric fence to prevent pig predation by jaguars in northeastern Argentina. The original design presented one wire hair with a maximum voltage of 4,000 V, around a corral. The design was insufficient to prevent predation, but cameras placed around the corral showed the flight response of the jaguar when touching the electrified strand, and suggested changes in the design (more strands of wire at different heights) and an increase in voltage (such as in the previous design) to make it effective. Again, these studies emphasize the importance of night corrals, since all attacks occurred at night.

Another trial was conducted in the Brazilian Pantanal (Cavalcanti *et al.*, 2011). The fence consisted of two electrified wires at 25 and 50 cm in height with a 5,000 to 7,000 Volts charge. The perimeter was approximately 14 km long, enclosing various grazing paddocks. The fence was regularly checked to prevent leakages of energy or faulty wiring. Additionally, the fence and the sleeping areas of the herds were monitored during the night by an employee on a tractor equipped with a powerful spotlight and explosive fireworks, which were used when visual assessment, or restless behavior of the cattle herds, indicated real or potential presence of a nearby feline. This system was shown to be

relatively effective and decreased predation losses from one year to another. It would have been more effective if the electrified area, would have been smaller, and the patrol activity more consistent. The original design suggested by the researchers proposed to electrify smaller paddocks to be used as sleeping areas, or areas of night enclosures. The owners decided to electrify the complete grazing area. This study showed increased losses due to predation, when the perimeter to be fenced increases. A special factor to be concerned with, is the longitude of the fence and its performance.

Night enclosures combined with electric fences require a certain investment and technical knowledge. The fence and electric system needs regular service and maintenance; there is a need of people trained in the knowhow of the trade. It is an option in areas of high predation incidence and where owners are willing to invest. These are initiatives in which Government Agencies and NGO's could assist ranchers, and actively provide support in the conservation of big cats, as is being performed now by the Panthera teams of Belize and Costa Rica (explained further ahead in the text).

2D) USE OF ASIAN WATER BUFFALO (summarized from Hoogesteijn & Hoogesteijn, 2008, 2009)

Asian Water Buffaloes (*Bubalus bubalis*) are originally from South East Asia and were domesticated around 5,000 years ago. Having evolved in the presence of a very large predator as the Tiger (*Panthera tigris*), they have an extremely gregarious behavior. When under a perceived threat, buffalo females form a circle around their calves, whilst the bulls walk around this circle, looking actively and aggressively for predators or any danger, unlike cattle. Both *Bos taurus* (European cattle) as *Bos indicus* (humped cattle) breeds, were domesticated and reared by man approximately 7,000 years ago (Bradley, 2003) in almost total absence of predators.

Buffaloes tend to graze in closed groups never straying far away from each other and aiding any member of the herd that calls in distress.

We conducted a study in four Venezuelan ranches which held cattle and buffaloes together. The objective was to compare predation mortality between the two species which were held in equal conditions. We found that the odds ratio that cattle had to be predated by jaguars or pumas, was 25 times higher than for buffaloes (Fig. 31 and 32). Buffaloes had the same reaction to predators, regardless of circumstances or management systems in which the herds were kept.

The use of water buffalo is expanding in the Llanos of Colombia and

Venezuela. It is a more efficient and profitable species than cattle in flooded savannas, or very humid environments. Buffaloes are highly appreciated for their gentleness when properly managed, their productivity, disease resistance, longevity and defensive behavior. Differences in productivity between cattle and water buffalo are attributed to their ability to digest and transform low quality forages. Buffalo's don't need quality, but quantity. This species has a greater resistance to infectious diseases, endo-and ecto-parasites than cattle. Their growth curve, fertility and longevity are larger than those of cattle under similar conditions.

However, over-grazing and trampling are serious problems to the environment when the species is improperly managed, buffaloes can have a larger impact than cattle. The carrying capacity has to be strictly observed, maintaining the proper number of animals in relation to the available grazing areas. Buffaloes can be mixed with cattle in less flooded areas, especially when the areas are prone to chronic predation episodes. They can also be used alone in the extremely flooded areas, i.e. areas where survival and production of beef cattle are compromised by extreme environmental conditions and intensive predation (Fig. 31, 32 and 33). Further studies are required to define how many buffaloes per area, or the proper ratio regarding buffalo/cattle numbers, are necessary to prevent predation by jaguars or pumas.

Several researchers (Harris *et al.*, 2005; Tiepolo & Thomas, 2006) have expressed concern about the introduction of buffalo in areas of flooded savannahs (e.g. Pantanal), calling it "controversial", and rightly so, because despite their potential benefits, there are prerequisites and limitations for the use of buffaloes for economic, agricultural and/or conservation means. Buffaloes in comparison to cattle require intensive management and supervision. Under a traditional extensive cattle management system (e.g. two round-ups a year), the buffalo can revert to its wild state and turn feral, becoming a nightmare from the ecological and husbandry perspective. However, this is not a limitation of the species, but a human management problem. There are several very successful and well managed introductions of buffaloes in the Llanos and the Pantanal (Fig. 33).

A case that exemplifies a successful and well organized introduction of the water buffalo, is being developed at Fazenda San Francisco, located in the Pantanal of Miranda, Mato Grosso do Sul state, in west-central Brazil. This farm produces rice, beef cattle, and runs a tourism operation. In 2003 at the suggestion of the first author, a small herd of tame buffaloes, of the milking Murrah breed, where bought at a nearby dairy farm and introduced in the ranch. These animals had no previous experience with

predators. The herd was introduced in an area of pastures whit the biggest cattle predation losses in the ranch (Azevedo & Murray, 2007). The losses in this ranch were smaller than in neighboring ranches given the abundant wildlife available; however, this particular area had a problem.

The buffalo herd provides employees and tourists with milk, milk products (as cheese, cream, butter and a creamy milk dessert) and meat on a regular basis. Young buffalo and surplus females that are not consumed are sold as breeding stock to other ranchers. The staff has been trained to work with these animals, biweekly round ups and constant supervision has maintained animals tame. The introduction of these animals was considered a success and the herd has not suffered predation losses. Predation in nearby cattle herds has diminished, employees and tourists have plenty meat, milk and sub products, and surplus animals have a good market (Fig. 33).

Curiously, a feline predation case on buffaloes was reported, in another Pantanal ranch, were a 3 months old female calf was lost to puma. Since the calf had a severe leg injury, it was separated from the rest of the herd, which did not defend it, and could not escape (Azevedo *et al.*, 2010).

This strategy carried out in the Fazenda San Francisco, shows the way to follow. San Francisco combines several anti-predation techniques such as the use of a strict breeding season, control of newborn calves in clean maternity paddocks and the use of well-managed water buffaloes. Losses of cattle to predation have decreased to be nearly zero.

Cattle mortality data, meticulously kept by the livestock department of the ranch showed that for 14 years the ranch managed a total population of 68.000 heads, of which 751 died or were lost (only 1.1%). Approximately 11% of all deaths (84 deaths 11.18%) were caused by felines, equivalent to 0.12% of the total cattle population for this period (R. Coelho, pers. comm.). Research data of the same ranch analyzed by Azevedo & Murray (2007), for years 2003 and 2004 showed that predation was responsible for 19% of all losses; predation deaths were lower than other causes of loss such as poisonous snake bites and diseases. Jaguars and pumas were responsible for only 0.2 and 0.3% of the deaths of all cattle in those two years, a similar relation as the one calculated above for 14 years. Even when in this ranch the feline population is high, predation episodes can be maintained to a minimum using management strategies.

In Brazil contrary to other countries, the use of buffaloes has one limitation; some local markets do not accept buffalo meat; even if buffalo meat could be considered superior because it has many desirable characteristics, i.e. it is leaner, lower in fat and cholesterol and has higher protein content. The carcass characteristics of young males with the same age and management arrangements as cattle are practically identical.

This situation is ameliorated by the fact that buffalo productivity tends to be higher than cattle for the following items: precociousness, meat production, fertility and longevity, and lower natural mortality. Even when consumers are culturally unenthusiastic to consume buffalo meat, as long as there is a market, buffaloes are still profitable. Additionally buffaloes produce milk. This milk tends to have a higher protein content which makes it ideal to manufacture various types of cheese of excellent quality e.g. mozzarella and cottage.

Breeding and rearing water buffaloes to protect cattle herds, is a convenient strategy, provided the ranchers are willing to manage it according to the requirements of the species.

We recommend the introduction of dairy breeds such as Murrah, Nili-Rahvi or Mediterranean, in small groups of 10 to 20 cows with one or two breeding bulls. These animals can be maintained in pastures with the highest incidence of predation, alone or mixed with herds of cattle. It is possible to hold the entire group or part of it under milk production, independently of the use of the milk; this keeps animals tame and manageable.

When owners and the ranch-hands in charge of these buffaloes get used to handling and managing them, more animals can be introduced, or the herd expanded. We have worked in ranches in the Venezuelan Llanos, that handle large herds of buffalo females with up to 500 breeding cows, in extensive conditions (with 1/3 of the herd being milked). Animals are kept in large paddocks with conventional fences (Atencio *et al.*, 2008). As we have mentioned before, herds are submitted to a 4 month breeding season. Animals with bad temperament or low docility (breaking of fences, abandoning the herd etc.), are culled. With the milking routine, the rounding-up and the constant management, the animals keep very tame, the possibility of becoming feral is completely avoided and large areas of flooded savannas can be used for the production of protein, without the problems of feline predation (Fig. 31).

The buffalo provides an effective and revenue producing way to control the problem of predation, the rational use of buffalo and cattle decreases predation to an extent in which ranchers can develop a greater tolerance to felines, especially in very remote areas where other control methods are ineffective or unreasonable.

2E) TOURISM

This activity makes the most of available resources. It is not the subject of this publication to explain how to develop a tourism facility. However, in our experience, much can be gained, by developing little

tourism operations within ranches. The enjoyment of scenic beauties, adventure tourism, the experience of a way of life (the rancher's and/or cowboys way of life) or wildlife observation (including jaguars); can be of interest to an ever hungrier public in search of authentic experiences. As demonstrated in several publications (Hoogesteijn *et al.*, 2005; Hoogesteijn & Hoogesteijn, 2010), the presence of jaguars in ranches functions as a tourism magnet which compensates for predations losses, even if jaguars are elusive and difficult to observe. In our experience it is possible to spot cats in areas where there is no persecution. Spotting depends on the relative density of the cats and the existence of healthy ecosystems. Boat rides and truck nocturnal spotlighting are huge attractions, independently that jaguars are observed or not. This activity also educates and creates awareness of the existing wildlife which is not conspicuous during the day, but that coexists with humans and cattle; this usually being the biggest surprise of all to visitors.

2F) JOINT GOVERNMENT / PANTHERA / FARMERS ANTI-PREDATION INITIATIVES IN BELIZE AND COSTA RICA

Sustainability dialogs have increased governments awareness related to the human wildlife conflict. Recently some governments have acknowledged that the problem is not only of concern to ranchers and actively participate in anti-predation goal oriented programs; here we present two examples.

In September 2013, the Panthera Costa Rica Team together with the Ministry of Environment and Energy, helped to create the Wildcat Conflict Response Unit (Wild Cat CRU or UACFel in Spanish) within the National Conservation Area System. The goal of this team is to respond to predation cases nationwide and assist in the implementation of anti-predatory measures proven successful by Panthera teams throughout America, with assistance from the authors. The Wild Cat CRU is composed of 19 wildlife officials from nine Conservation Areas, which have been trained in two comprehensive workshops.

In twelve small experimental farms located at the Barbilla-Destierro Biological Sub-corridor and the San Juan La Selva Biological Corridor, recommendations consisted in a combination of night enclosures with fenced barbed wired and cat repelling electric fences designed to protect small calf and calving paddocks (following the guidelines of this Guide), and predation events where completely prevented (Fig. 16). Also at some of those farms and in another one located in the north of the country, testing is under way with the use of large stainless steel bells in larger calves to prevent puma predation, grazing outside electrical fenced

protected areas (D. Corrales-Gutiérrez & Panthera Costa Rica Team, unpublished data) (Fig. 15).

The UACFel and the Panthera Costa Rica Team have witnessed a true change in many of the farmers' attitudes toward wild cats. Previously, farmers were quick to shoot raiding pumas or jaguars, but now an increasing number of calls are made to the response team seeking advice and guidance on how to deal with predation events. The group is confident that with continued education, the creation of this formalized entity, and the hands-on policy of implementing practical anti-predation strategies directly with the farmers, the challenges will lessen over time, and this work to reduce cat-cattle conflict in Costa Rica will continue to produce positive results.

In Belize, the Panthera-Belize team is working with the Environmental Research Institute (ERI) at the University of Belize and the Wildlife Program of the Belize Forest Department (BFD) within the Ministry of Forestry, Fisheries and Sustainable Development. Through these partnerships, the team is trying to understand the causes of predation and find cost-effective solutions. The approach focuses on the management of wild prey and livestock.

A designated BFD-Panthera jaguar officer responds to reports of livestock predation nationally, but focusing especially on two corridors within the country that are of particular importance for jaguar connectivity. On receiving a report of a possible jaguar attack or threat of an attack, the officer makes a site investigation, collects data on the nature of the attack and the management of animals on the farm or at the residence. The officer then gives advice on how the person may prevent future attacks. All data are maintained in a national database. As the database grows, the team will be able to answer questions about where, why and when attacks happen.

The Belize team has also conducted surveys on farms in and around the Central Belize Corridor, compiling information on animal management, history of depredation and lethal control. It is directly assisting some of these farms in implementing management changes and better monitoring attacks and attack prevention, including the provision of donkeys as guard animals, lumber for corral construction, solar lights, grass cuttings for the development of protein banks, and barbed wired for improving fence lines.

Ranchers/Farm owners in Belize get aware of this program through several methods. The team works with a number of conservation organizations in the country and has conducted training workshops about jaguar/puma ecology and livestock predation for two large NGO's. The team gives out brochures about protecting livestock (and contact details) opportunistically, and at local and national events. Through the farm

surveys that the team has conducted (70 farms in the Central Belize Corridor) all farm owners in the corridor were given brochures and informed about the program. Often, people will call the NGO responsible for the nearest protected area when they have jaguar problems, and the NGO's pass the report to the Jaguar Officer. There is a free Wildlife Hotline set up and run by the Belize Wildlife Conservation Network. The hotline is advertised nationally. People can call this number about any wildlife-related issues. Volunteers man the phone and respond to reports, however, any depredation reports are forwarded to the Jaguar Officer. The Jaguar Officer gives presentations about livestock predation in communities, schools, and at farm owners meetings with the Ministry of Agriculture.

The team is collecting baseline data on wild prey exploitation in order to inform authorities about sustainable hunting quotas. The consumption of meat from wild animals, is common and widespread throughout Belize. The team is currently conducting surveys of people who hunt in the Central Belize Corridor and elsewhere in the country, to assess the intensity of wild prey harvest in space and time so that it can investigate links between levels of hunting and livestock predation, and identify options for sustainable hunting practices.

These are two examples of the collaboration that can be developed between Governments, NGO's and stock owners, in which separate interests are merged and solutions are implemented, satisfying societal demands.

3 - FINAL COMMENT

The need to involve private landowners in conservation programs of big cats in the Americas constitutes an inescapable reality. For this reason, conservationists and biologists must work in partnership with farmers/ranchers and landowners. Fortunately, to reduce predation problems, we have an ample battery of strategies available, which, if implemented correctly, can translate into a greater tolerance for the species. A positive aspect in this scenario is the importance of the jaguar in the Central and South American cultures. Therefore, this factor can help the initiative of several ranchers, to cooperate in this effort. We cannot overemphasize the importance of appreciating the particular conditions of each farm/ranch, from an ecological point of view, the herd management system used, the political and legal environment around them, the meat industry in each country, and the government's wildlife management agency.

All these factors must be taken into account in implementing the agenda of reducing predation losses to achieve our goals. However, in our experience, the most important factor in success is the development of a partnership approach with the ranching community, without criticism, collaborating with a sector of society that lives primarily of, and works for, the production of livestock; and through this commitment (apart from the one that every human being has to the other inhabitants of the planet), they assume a responsibility that should be assumed by society as a whole.

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LIST OF SCIENTIFIC AND COMMON NAMES OF NATURAL PREY SPECIES CONSUMED BY JAGUARS

Scientific name	Common name (including names used in Belize and Guyana)
 *Agouti paca*	Paca, Gibnut, Labba, Urana
Bradypus sp.	Three Toed Sloth,Sloth
 *Caiman sp.*[1]	Spectacled Caiman, Alligator
Choloepus sp.	Two Toed Sloth, Sloth, Kuwaran
 *Dasyprocta sp.*	Agouti, Akuri
Dasypus sp.[2]	Nine Banded Armadillo, Dilly, Ta-too, Yaci, Kaikan, Kapaci
 *Didelphis sp.*	Opossum
Hydrochoerus hydrochaeris	Capybara, Watras, Paranwi
 *Mazama americana*	Brocket Deer, Antelope, Bush Deer, Usari
Myrmecophaga tridactyla	Giant Anteater, Ants Eater, Tumanuwa
 *Sus scrofa*	Feral Hog
Tamandua tetradactyla	Lesser Anteater, Ant-Bear, Tamandua, Waiwo
 *Tapirus sp.*	Tapir, Mountain Cow, Bush Cow, Waira
Tayassu pecari[3]	White-Lipped Peccary, Bush Hog, Wild Hog, Wari, Pïinkî, Karauta
 *Tayassu tajacu*[4]	Collared Peccary, Bush Hog, Wild hog, Praka, Paraka
Nasua sp.	Coati, Coatimundi, Quash, Kuwasi

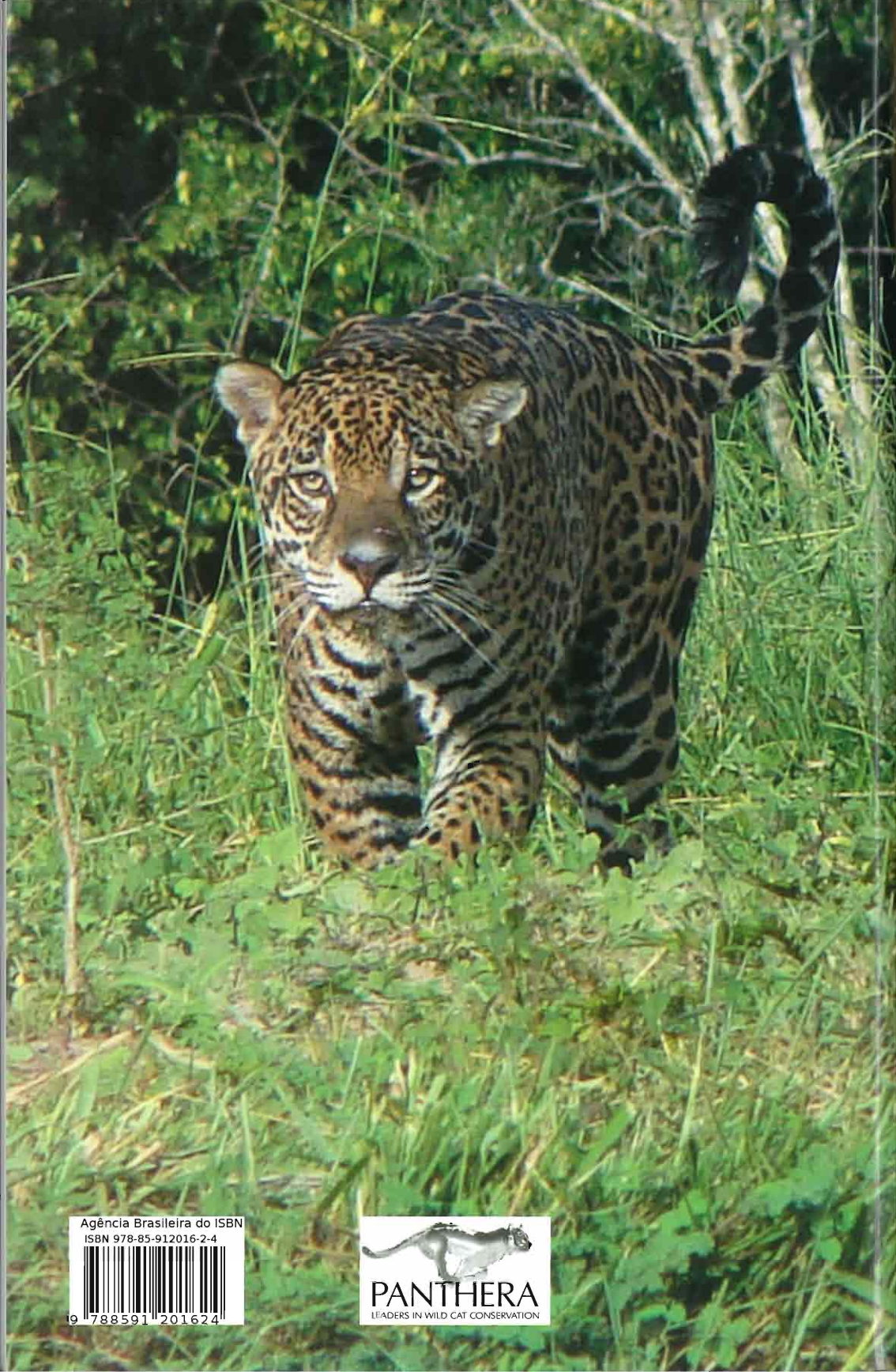







1 - Most common natural prey consumed in the Pantanal, Brazil.
2 - Most common natural prey consumed in the Cockscomb Basin, Belize.
3 - Most common natural prey consumed in the Pantanal, Brazil, and in the Corcovado National Park, Costa Rica.
4 - Most common natural prey consumed in Hato Piñero, Llanos of Venezuela.

(Source: Marchini, Luciano & Hoogesteijn, 2009)



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