MANUAL ON THE PROBLEM OF DEPREDATION CAUSED BY JAGUARS AND PUMAS ON CATTLE RANCHES

By Rafael Hoogesteijn
Supervisor, Apure Ranches, Prohesa; Jaguar Advisory, Wildlife Conservation Society; and Cat Specialist Group, *IUCN*[1]
Translated by Beth Kuperman, Wildlife Conservation Society

INDEX:

1) INTRODUCTION

The scale of human population growth on a global level in general, and in Latin America in particular, with its ever-increasing demand on natural resources, has led to the designation of areas (though relatively small), in which we are trying to conserve the rich biodiversity of our continent. The small fraction of land devoted to the conservation of natural ecosystems, along with their inadequate defense and protection, obligates farmers and ranchers not only to contribute to the necessary production of food, but also to become guardians of both the life systems that support the planet and of its threatened and endangered species (Bowland et al. 1992).

The great majority of cases of depredation of domestic animals by wild carnivores reflect some type of imbalance in the local ecosystem. Felines are not naturally in the habit of attacking domestic animals. If the environment in which they live consists of areas large enough to support them, with sufficient food resources and little or no human influence, these animals tend to avoid man and the animals in his care. For this

[1] Translator's note: The English equivalents of acronyms such as IUCN are not readily apparent, as often times the letters will be arranged in a different order. Such entries have therefore been left in their original Spanish, but italicized.

reason, the absence or depletion of natural prey animals due to furtive hunting or disease transmission from domestic animals can provoke the onset of attacks by large felines on domestic animals where conservation areas and rural properties border each other.

In Latin America, the problem of depredation of domestic animals, especially cattle, is caused by the two large American cats: the jaguar (*Panthera onca)*, and the puma (*Felis concolor)*, and, as a consequence, there is an intense persecution of these animals on the part of ranchers and breeders. This factor is the one that, along with the loss of habitat, most directly affects their survival. Human persecution of the big cats as a result of their depredation of livestock, or because of the potential danger that these animals represent to human life, is the final step in the process of their disappearance outside of protected areas—a process that begins with the loss and fragmentation of habitat (Nowell and Jackson, 1996). This persecution is occurring even within protected natural areas, so that currently in Latin America jaguars and pumas exist in largely inaccessible areas where they are difficult to hunt. Of these two species, the jaguar has a more compromised future given that it has a more restricted distribution, as much in terms of geography as in diversity of habitats utilized; the puma being a much wider-ranging and adaptable species.

Until the 1970's, jaguar populations saw themselves greatly affected by the international fur trade. Today, human expansion (with its resulting pressures on land use, loss of habitat, and opportunistic hunting) has restricted the jaguar to a fraction of its former range. The jaguar has already reached extinction in the US, El Salvador, Uruguay, and in most of Panama, Nicaragua, and Argentina, occupying by 1989, 33% of its original range in Central America, and 62% in South America (Swank and Teer, 1989). Part of the problem is due to the perception that the mere presence of these felines necessarily brings along with it the consequence of depredation, resulting in the convenience of their extermination, since depredatory animals cannot be tolerated, even in the absence of cases of depredation in the area (Hoogesteijn and Mondolfi, 1992).

Even though the expansion of cattle ranching in Latin America has been one of the factors behind deforestation, cattle production has demonstrated itself to be a viable

and relatively less destructive use of the neo-tropical savanna, (with seasonably floodable natural pasture lands) in comparison with large-scale agricultural production of crops such as rice and sugar cane (with massive use of deforestation practices, leveling, herbicides, insecticides, and fertilizers). These savannas are distributed throughout the Llanos (Plains) of Venezuela and Colombia, the Beni of Bolivia, the Pantanal of Mato-Grosso in Brazil, part of Paraguay, and the forested savannas of Guyana. The most well managed ranches, from the point of view of cattle farming in the Venezuelan Llanos, are those that also maintain the largest faunal populations-- which are used for eco-tourism-- or through the rational and sustainable use of the capybara (*Hydrochoerus hydrochaeris*) or spectacled caiman (*Caiman crocodilus*) (Hoogesteijn and Chapman, 1997). In three cases analyzed by these authors in Venezuela, wildlife can produce from 25 to 52% of total income, and has the potential to increase income per hectare from $12 US/hectare only cattle ranching, to $18 US/hectare with both cattle ranching and the utilization of wildlife. Nevertheless, with the exception of eco-tourism or sport hunting, economic incentives for the conservation specifically of felines are non-existent, given that they generally cost more than they are worth (Nowell and Jackson, 1996).

Already in 1914, Roosevelt signaled that in the Brazilian Mato-Grosso, ranches that were poor in wildlife would also suffered greater levels of depredation; a statement which, 80 years later, still needed to be confirmed with data (Polisar, 2000). Shaw (1977), hypothesized that the number of head of cattle depredated by pumas in Arizona was inversely proportional to the size of deer herds in the region. Almeida (1980), reported that on one ranch located in the Brazilian Mato-Grosso, previously rare depredation by jaguars grew to one third of the annual yield of calves (some 400 calves per year, in addition to numerous attacks on adult cattle), after the ranch owners carried out a massive killing of spectacled caiman for the commercial sale of their skins.

The aim of this publication is to provide ranchers with a publication that, in an accessible language, allows them to understand that the problem of depredation does not constitute an isolated phenomenon, but rather is a consequence of various factors that are important to understand; how to identify the animal responsible for the depredation; what steps to take in the management of their herds to diminish its

occurrence; to provide possible solutions to the management of problem cats, and achieve a better coexistence between cats and the fauna that, together with them, live on Latin American cattle ranch property.

2) REASONS FOR THE CONSERVATION OF THESE LARGE CARNIVORES:

Many will ask, why save these animals that cause problems and could, in addition, potentially represent a threat to human life? Although we still don't have all the answers to respond to that question, both species regulate the populations of all the species which constitute their prey; preventing their overpopulation and maintaining the vigor of the species, eliminating defective, old and sickly individuals, thus playing a role in the diminution of the spread of disease that affect these species, the cattle and even man himself. Also, carnivorous predators are linked to the control of herbivorous mammals, who in turn are responsible for the consumption of vegetation (being predators themselves of plants and their seeds). In turn, the plant communities influence the distribution of pollinizers, birds and insect. Thus, when the community of predators is affected, the ecosystem as a whole is affected, and any disturbance in the ecosystem is filtered towards the species at the top of the chain—making carnivores more vulnerable than other species (Terborgh, 1998; Miller and Rabinowitz, in press). It is no coincidence that many of the carnivorous species worldwide are threatened or endangered. In the case of the jaguar and the puma, this has important consequences for the structure and maintenance of Latin American tropical rainforests, which in turn influence climate patterns, water resources and precipitation, on both a local and global level.

In the specific case of the jaguar, this species can play an important role in the process of planning and monitoring conservation activities, impacting at the same time the ecological health of the system through its influence over it at all levels. Being a wide-ranging species of great size, and being ecologically sensitive, it needs large areas of protected habitat, and its conservation can help to preserve these habitats in their natural state. Since it is improbable that any one protected area will be large enough by itself, in order to maintain a viable population of jaguars in the long run, their boundaries should be extended through the use of corridors or other forms of land

management. Thus, the protection of the jaguar must be formal (in the form of legal processes of designation of parks, sanctuaries, and/or reserves) and informal (with the acceptance of the jaguar on the part of private landowners). The jaguar's need for huge interconnected areas makes the informal protection of large areas, with the participation of their owners and users, the most critical factor within their conservation plan (Miller and Rabinowitz, in press).

3) LEVELS OF MORTALITY AND PRODUCTIVITY OF CATTLE ON FLOODED SAVANNA:

It is undeniable that jaguars and pumas that prey on cattle exist, which can cause the ruin of a small or medium sized rancher, but much more ruinous is the lack of the application of sanitary plans and technical means to elevate the extremely low rates of production at which tropical cattle herds are maintained (around 40-50% pregnancy and 30-40% weaning). Diseases such as Foot and Moth Disease, Brucellosis and Leptospirosis; the lack of selection and herd management; and the effect of floods, are all factors of much greater magnitude. On the majority of wide-ranging cattle ranches in the neo-tropical savannas, herd management is rudimentary, and the cattle population finds itself exposed to the risks of droughts, floods, epidemics, parasites, and malnutrition. On many ranches the cattle become semi-wild; conditions which favor depredation and rustling, which is practiced with a great deal of impunity on ranches with absent owners, or with ones who do not tightly control the activities of their managers, workers and neighbors who point to felines as the guilty party.

Plasse et al. (1993), carried out a broad study on the mortality and loss of beef cattle on ranches situated largely in conditions of flooded savanna in Venezuela, with a basic archive of 22 herds and 276, 484 diagnoses of pregnancy. These herds for the most part formed part of research projects and had genetic, sanitary, and management programs designed and supervised by professionals with experience. In 13 of these herds with seven years in the study, with 51,126 palpations and one complete evaluation between the time of palpation and the time when the calves reached 18 months of age, a pregnancy rate of 70%, a loss rate before birth of 8.6%, by weaning of 13.6%, and by 18 months of age of 16.8% were determined. 51% of the total losses

from pregnancy to 18 months of age correspond to the pre-natal phase. These figures come from organized or "well managed" and supervised herds. The pregnancy rates for "non-organized" ranches (the majority in the jaguar's distribution range in the area of the Llanos), is around 40-50%. If from these pregnancies at least 20% of potential calves are lost by 18 months of age, the low productivity rates of these herds are alarming. As the majority of these herds do not have a breeding season, and they do not follow sanitary plans, nor keep registries of palpations, births or mortality, they do not even realize the magnitude of this problem, and it is there that the perception of felines as great depredators enters into play. A loss between pregnancy and birth of 12% for example, constitutes an abstract figure and can pass unnoticed on a "non-organized" ranch, since the cows are not palpated and more than 80% of abortions are not even detected. But a cow attacked and or dead and consumed by a jaguar or puma constitutes a real loss, easily located and identifiable by the activity of carrion birds, feline tracks, and the way in which the animal is consumed (Hoogesteijn et al., 1992). In this case the guilty party is easily pointed out and he, along with all other examples of his species that inhabit the area, are sentenced to death.

4) CAUSES THAT PREDISPOSE (CATTLE) TO DEPREDATION BY THESE FELINES:

The predation of cattle by jaguars and pumas can be influenced by: 1) innate and learned behavior, 2) the health and condition of individual cats, 3) divisions of area (space) and resources among jaguars and pumas, 4) cattle management practices, 5) abundance and distribution of natural prey (Polisar, 2000).

One of the factors that most greatly influences the five previously mentioned is deforestation, which causes a direct loss of habitat for carnivores and their prey, who are either pushed out or flee to other, frequently marginal forested areas where they are more easily hunted. Several of the species that constitute the cat's most important prey are also the most commonly consumed by rural populations (Ojasti, 1984). Deforestation is followed by the establishment of human populations and subsistence agriculture, using wildlife species for the supply of necessary protein. Timber companies also employ hunters who are in direct competition with the cats for the

hunted species, resulting finally in the disappearance of fauna around populated areas (Ojasti, 1984; 1986). In this sense deforestation, in addition to being a factor in extinction, predisposes livestock to predation, since, upon finding a smaller number of natural prey animals due to the direct effects of deforestation and human hunting, and upon being pushed towards marginal areas where they have greater contact with pastures and cattle herds, the cats begin to consider these as a possible prey source. Once they realize how easy it is to hunt calves or young cows, they dedicate themselves to this activity.

This problem of deforestation and furtive hunting is aggravated by the opportunistic hunting of felines. Peasants and indigenous people go armed, and any feline seen is shot at with the intent to kill, even when that animal is not causing any problems of predation in the area, and even though there is no demand for its skin. As a consequence, many cats are unnecessarily and uselessly slaughtered, and others are left wounded; made useless and diminished in their abilities to hunt their natural prey, so that they increase their depredatory action on the more abundant and more easily hunted prey of young cattle. 75% (10 of 13) of the skulls of cattle-hunting jaguars examined by Rabinowitz (1986b) had old injuries to the head or to the body caused by gunshot. The thorough examination of 17 other normal (that is to say, not depredatory) jaguars do not show any previous injuries. In 65 jaguar skulls examined in Venezuela, 19 belonged to cattle-lifters, and of these 10 (that is to say, some 53%) showed old shotgun or rifle wounds to the head and/or body, with lead fragments embedded in the bones, causing injuries to sight, dentition and/or locomotion system (Hoogesteijn et al., 1993). From this it can be concluded that problem cats are in part the result of the activities of some cattle ranchers and their employees who injure the felines, leaving them impeded in hunting their normal prey, in addition to allowing their animals to graze and pasture in forested zones where the cats begin to consider them as an alternative food source.

It is necessary to differentiate the pattern of depredations that occur in forested areas that were cleared to be transformed into grazing land for cattle (with the establishment of introduced pastures), or agricultural ventures, having a pattern of depredation on all available species of domestic animals (including dogs); with the

pattern of depredation that occurs in floodplain areas, in which cattle establishments are generally larger in size, habitat for the felines is more limited to riparian zones or forest corridors, deforestation pressure is not as intense, and depredation is centered principally on cattle. Nevertheless, problems of cattle depredation arise even on ranches that have healthy faunal populations and maintain ample areas of forest intact. One very serious and difficult problem to control on the floodplain areas is excessive flooding, which in some years can affect cattle herds as much as it does various fauna, causing high mortality and leading to a high rate of depredation of the few remaining cattle due to the absence of natural prey, and to an intense persecution on the part of ranchers (Hoogesteijn et al., in press). This same problem is mentioned by Schaller (1983), for the district of Pocone in the Brazilian Pantanal, with a reduction of actual cattle from 700,000 to 180,000 head after the flood of 1974. This problem is aggravated by furtive hunting, resulting in the diminution of the feline's natural prey, which has an inverse effect on the level of depredation of cattle, as mentioned earlier. That is to say, while there is greater hunting activity by humans, and fauna is, as a consequence, less abundant, there is a greater intensity of depredation of domestic animals by felines. On the majority of cattle ranches, wild species (capybara and spectacled caiman) are decimated, and cattle constitute the most abundant prey.

In the specific case of the jaguar, they prefer areas of closed forest to areas of open forest and ranch lands cleared for pasture. When there is an abundance of wild prey, jaguars will normally remain within forested areas. In many cases, depredation of calves by pumas is also attributed to the jaguar. In the study conducted by Rabinowitz and Nottingham (1986), in the Cockscomb Basin Jungle in Belize, resident jaguars in the area were not inclined to hunt cattle or other domestic species, and they avoided the vicinity of ranches or open areas, consuming the meat of only natural prey, particularly of small mammals. This is indicative of the stability and abundance of prey in the area, which will persist so long as the forest is not exposed to drastic changes, and if the natural species, including the jaguar, are allowed to continue their natural existence. It is only certain individuals that hunt cattle, and when these are killed the losses do not continue to occur, even though other jaguar live in the area. Another interesting result

of this study is that once a jaguar learns to hunt cattle, he will continue to do so as a principal component of his diet.

5) RESEARCH AND ANALYSIS ON DEPREDATIONS CAUSED BY JAGUARS AND PUMAS

Although jaguars and pumas demonstrate an enormous adaptability in their dietary habits, taking advantage of almost the entire spectrum of natural prey available (85 species have been identified in the jaguar's diet; Seymour, 1989), it is undeniable that domestic animals, especially cattle, constitute and important part of the jaguar's and puma's diet, especially in their floodplain areas distribution (Almeida, 1984; Crawshaw and Quigley, 1984; Hoogesteijn and Mondolfi, 1992). Publications summarized by Oliveira (1992), and Hoogesteijn and Mondolfi (1996), compare the diets of jaguars in rainforest zones with that of jaguars in areas of flooded savanna. These show, using an index of mean weight of vertebrate prey, that domestic animals, especially cattle, constitute an important item in the jaguar's diet in floodplain areas; where we also find the largest individuals of the species.

In 49 stomachs of jaguars hunted in Brazil and examined by Almeida (1984), 20 of them (41%) were empty. Of the 29 stomachs with contents, 10 (35%) contained remains of cattle, following, in order of importance, the capybara, the two species of peccaries (*Tayassu tajacu* and *T. pecari)*, spectacled caiman, and feral hog (*Sus scrofa*).

In 102 jaguar and puma prey examined by Crawshaw and Quigley (1984), on the Miranda Ranch in the Brazilian Pantanal, cattle constituted the principal food item, making up 47% of the 59 jaguar kills, and 42% of the 31 puma kills. The two species of peccary and the spectacled caiman were other important prey animals for the jaguar; and for the puma, the spectacled caiman and the two species of brocket deer were important. Nevertheless, these authors indicate that these data should be considered with caution, as there is an excess of domestic animals in the sample that were found by ranch hands in the course of performing their normal work duties, and small prey (wild animals) hunted in not easily accessible areas, or dragged to areas of very dense vegetation, are more difficult to come across and they are quickly devoured, so that

their discovery is a matter of chance. In a sample of 17 prey animals killed by jaguars who were followed by radio telemetry, only 29% consisted of livestock, while 41% consisted of white-lipped peccaries (Crawshaw and Quigley, in press). In this study, the pumas mainly killed calves and some sheep, while the jaguar's domestic prey were 33% calves, 57% cows, and 10% young bulls. Nonetheless, on the scale on individual livestock operations, the impact of depredation is highly variable. These authors assert that in the Pantanal, healthy jaguars attack cattle just the same as they would wild prey, since the cattle roam freely (as do the wildlife) in the mosaic of open grasslands, bush patches and forests. In floodplain areas, cattle are moved to the lowlands during the dry season, and, when it ends, an attempt is made to drive them back to the less flooded highlands. When the rains come early, labor is scarce, or the cattle drive begins too late, remnants of the herds are left isolated on little banks or islands that crop up above the water level. These are left deprived of vegetation in a short time, the mortality rate of calves is high, and adult cattle suffer from malnutrition since the grass is left largely inaccessible under water. These weakened and isolated cattle are easy prey for the felines, especially for jaguars, who swim from one island to another in search of prey during the flood.

The study by González-Fernández (1995), of 37 cattle ranches in an areas of 2,433 km^2 in the Central Venezuelan Llanos, found cases of depredation on 73% of the ranches interviewed, although in only 11% was the loss greater than 1% of the total herd. Jaguars caused losses in 41% of the implicated ranches, pumas in 54%, and both species in 22%, respectively, although the losses added up to less than .4% of the herd, annually. The losses caused by pumas duplicated the losses caused by jaguars, concentrated mainly on 2-3 month old calves. Although the economic impact caused by depredation on large-scale cattle ranches is not of great concern, it can mean economic ruin for a small rancher, for whom the depredation of a few animals a year represents a considerable loss, difficult to replace. Some farms lose from 2.5 to 5% of all calves born to depredation by felines.

In Costa Rica, Saenz and Carillo (in press), report significant losses caused by jaguar depredations on small cattle ranches (a total of $60,000 US dollars between 1991-1998) with losses of some $1,125 US dollars per rancher. The authors noted a

rising tendency in the number of attacks, caused mainly by sub-adult jaguars in the process of dispersion from wild protected areas with a good density of natural prey, toward nearby areas surrounded by cattle farms with easy to kill domestic prey.

Hoogesteijn et al. (1993), determined the causes of death on three cattle ranches on the Venezuelan Llanos and found that on the first ranch, Hato Piñero (HP), deaths caused by felines were considerably fewer than those occasioned by other causes, reaching only 6% of total deaths or losses. The ranch was well managed in terms of livestock, and healthy faunal populations were maintained. Nevertheless, upon totally prohibiting the hunting of cats on the ranch, the proportion of deaths attributed to felines rose to 15% (of the total number of dead or lost calves), reaching some 40 calves per year. If, for this ranch, we take an average of the data from 1986 to 1990, we can deduce that of the 4,400 cows exposed to bulls each year, an average of 68% become pregnant; that is to say, some 3,000 pregnant cows. Of these 3,000 potential calves, some 400 are lost during the process of gestation and birth (13%), the majority due to illness in the reproductive sphere (Leptospirosis, Brucellosis, *IBR* and *BVD*), some 80 die from known causes (principally illness and accidents), some 130 die from unknown causes, and 40 are depredated with certainty by felines. To summarize, of the total 3,000 potential calves, some 650 are lost. Even attributing part of the unknown causes of death to depredation, this number, although not insignificant, represents barely 6% of the total of 650 potential calves lost or dead. Lowering the pregnancy/birth losses to a reasonable 6%, which is perfectly feasible with the implementation of available technology, some 220 additional calves would be obtained; a full 5 times more than the number of calves depredated with certainty by jaguars and pumas. On another ranch of smaller size and located in an area of greater agricultural pressure, depredation by felines (non-resident) reached 31% of total deaths and losses (of 1-6 calves/year).

Similarly, Farrell (1999), reports for HP that jaguars were responsible for less than 1% of the total losses of cattle over the course of 10 years, while pumas were responsible for 7.5% of the total mortality, preying on small calves. This evidence was confirmed by genetic identification data from puma feces, which revealed prey of no greater size than calves. Farrell (1999) and Polisar (2000), indicate that on this ranch the greatest problems of depredation were caused by pumas on small and newborn

calves in areas relatively poor in fauna (due to natural causes or because of increased pressure from furtive hunting), which included birthing pastures, areas around forested hills, and water sources, principally during the rainy season. To summarize, the loss of calves caused specifically by felines as a percentage of total mortality of all the calves that die annually, the average annual figures for HP are the following: 9% in the period from 1981-1990, 15% from 1986 to 1990 (Hoogesteijn et al., 1993), and 13.3% from 1991-1997 (Sunquist et al., 1999).

Polisar (2000), points out that on HP adult cows (but not calves) can graze in moderately flooded areas, but they need a dry place to sleep. On this ranch, herd management is not as extensive as described on the ranches of the Brazilian Pantanal, where in certain areas it is practically semi-wild. There, the concentrations of cattle on patches of forest that crop up as islands within a matrix of flooded savannas practically invite jaguar attacks. At HP the calves cannot graze in the water, and for greater survival (not specifically to avoid jaguar attacks), they must be removed from the flooded areas, so pregnant cows are taken to higher maternity pastures outside the flood zone. Paradoxically, the areas most rich in fauna, due to the floods, cannot support the birthing and rearing of the herd of small calves during the rainy season, while the drier areas with less fauna can. This responsible movement of the cows to higher pastures introduced the possibility of furnishing the pumas with easy prey in the form of tender young calves. The number of puma estimated on this ranch doubled the number of jaguars. The puma ranged in a greater diversity of habitats than the jaguar, including drier areas generally associated with drier habitats.

The study by González-Fernández (1995), determined that the level of depredation caused by jaguars was related to the size of the herd (with a greater percentage of attacks on larger herds), with more forest covering, and with higher flood levels. Polisar (2000), proposes that the jaguar establishes his rights over the more productive areas, even when the puma coexists furtively in/or adjacent to these areas. For a puma accustomed to attacking peccaries weighing 23 kg in areas poor in fauna, the possibility of preying on a vulnerable calf weighing 50 kg is highly advantageous (excluding, naturally, the response of an exasperated rancher).

Polisar (2000), reported that the distribution of wild prey on HP is influenced by the composition of the forest (mosaics of savanna/forest), topographic character, and soil characteristics, which interact to define the variation of primary productivity, which in turn sets the guidelines for both the distribution of faunal species (with very irregular distribution), and the utilization of areas available in turn to felines. On the Llanos, the ecotones are abrupt, much of the faunal production occurs at ground level, and oscillating aquatic habitats (expanding and contracting in accordance with the seasons), facilitate an impressive aquatic and semi-aquatic prey base (capybara, spectacled caiman, and fresh-water turtles). Productive ecotones appear to be key in defining desirable areas of occupation for the jaguar. In this way, the situation is similar to the one presented in the case of the Asiatic tiger, whose prey are more abundant where grasslands and forests form a mosaic, and the intermingling of various different types of vegetation maintains a rich community of ungulates (Sunquist, 1981). The few preferred prey species were as large in size as they were productive (principally mammals). Large reptiles present in the area of study were less utilized than their high biomass would suggest, probably as a result of their more difficult access and greater risk. The biomass of natural prey was adequate to support the resident feline population without requiring the contribution or subsidy of domestic cattle. The occurrence of selective (directed only towards certain prey species), before opportunistic hunting by cats reinforces this conclusion, above all when their diet is compared with that of felines in entirely forested zones. The capybara was shown to be a prey source of great importance to both feline species in the area, they selectively preyed upon it in comparison to the variety and abundance of available prey, even though it is much less abundant than deer and the two species of peccary. The connectivity factors of gallery forests have allowed jaguars, tapirs, and white-lipped peccaries to persist within the agricultural matrix in the Llanos Altos Occidentales (Western High Plains). The author of this study demonstrates that the frequency of cattle depredation was inversely related to the availability and the vulnerability of natural prey, and directly related to the availability and vulnerability of cattle, with certain coincidences, since the cattle, and especially the calves, did not graze in areas of low elevation with a high density of wild prey, abundant water resources, and mosaics of

savanna/forest. Cattle were virtually absent from the majority of semi-deciduous forest areas rich in fauna, due to the lack of forage in these areas.

6) IDENTIFICATION OF THE FELINE DEPREDATOR:

6.1) EXAMINATION OF PREY:

Correct identification of the problem feline is an important step in the determination of the adequate method (or methods) of control, which will depend on the characteristics of the species in question. Cats have very hidden habits, but they leave certain characteristic traces behind: tracks, feces and fur which can provide information about the animal. The type and size of prey also gives us an idea of the predator; larger sized animals such as horses, donkeys, and adult cattle are depredated exclusively by jaguars. The smaller sized puma preys on younger or smaller animals, usually calves or foals (generally newborn to 1 ½ years of age), while jaguars prey on adult individuals weighing up to 500kg. Animals of medium size, like goats and sheep, are also preyed upon by these felines, as well as by dogs, who can cause considerable damage. If various depredatory species coexist in an area, more than one can utilize the same carcass. From the publications of Shaw (1990), Bowland et al. (1992), Childs (1998), Hoogesteijn et al. (in press), and Hoogesteijn and Crawshaw (2000), we present the following methodology:

1) The prey must be examined promptly, before the action of carrion birds impedes the establishment of the causes and/or the agent of the animal's death. First, one should determine if the animal died from depredation, or if, in case it has died from other causes, the depredator took advantage of the carcass to feed itself. The sides of the prey animals' neck should be skinned; inspecting throat, nape, and base of the cranium, in search of bite marks or lacerations (with perforations cause by the insertion of the canines), which have caused the death. Verify the location of the bite mark and the distances between the perforations of the canines, preferably on the underside of the skin. The distance between the perforations of the canines caused by just one bite by an adult puma are between 4.5 and 5cm for the upper canines, and 3 on 4cm for the lower canines. For the jaguar, the distances are generally greater, except in the case of a sub-adult.

2) The prey should be meticulously examined in sections. Head and neck: determine if the cranium is fractured or not, with the head turned around facing backwards or not. Body: which parts and what amount was eaten, stomach and intestines removed, intact or not, with the innards consumed or not. The prey should be examined as soon as possible; the fresher it is, the easier it is to determine the cause of death. Blood stains on the ground at the scene of death are evidence that the animal was killed by a depredator.

3) The larynx and trachea should be opened to search for evidence of foam, which indicates that the animal was alive and breathing. Also, check the inside on the mouth for regurgitated ruminal contents. In the case of newborn calves (and lambs), it is necessary to check the hooves to determine whether the animals utilized them to walk, and to check if the stomach contained any food, with the aim of clarifying whether is was born alive was depredated, or if it was stillborn and consumed. If these clues are present, they indicate to the rancher that the animal was depredated and not simply consumed. It is also important to examine the size, age and physical condition of the prey; the amount of fat around the mesentery (membrane covering the intestines) and the meat, as well as the color and consistency of the bone marrow, indicate the condition of the animal (if the marrow is reddish and of low viscosity, the prey was in poor condition). It is also advisable to examine the skeleton to determine if the prey had fractures, and the color of the lungs, which are rosy in healthy animals and darker in sick ones.

4) Observe the size of the prey, and determine if it was seriously injured or not; the greater the damage, the smaller the size of the depredator in relation to the prey. Examine thoroughly the site where the animal was killed, the location to which it was dragged to be consumed, the distance between the two sites, and if the prey was found uncovered or covered by leaves and vegetation.

5) Verify the tracks left by the depredator at the attack site and the drag site. The tracks can be modified by specific variations such as age, sex, speed of locomotion, and physical deformations that can influence the appearance of the tracks, in addition to external factors such as the age of the tracks themselves, atmospheric conditions (wind, rain, and sun), and the texture of the ground where the tracks were made. Examine any

other signs that can help in the identification of the depredator, such as fur, feces or marks.

Jaguar, puma and domestic dog tracks can be observed in the accompanying graphics.

6.2) CHARACTERISTICS OF THE PREY AND TRACKS OF THE JAGUAR:

The jaguar generally attacks and consumes large prey: horses, donkeys and adult cattle. The prey may present a bite mark at the base of the neck, behind the ears, and/or at the nape or base of the skull, with a fractured neck and/or vertebrae at the nape. Frequently death occurs in adult animals by fracturing the neck, with the impact of the fall of the animal, leaving the head turned around facing backwards. On rare occasions, the prey presents the bite in the throat with death by asphyxiation. The jaguar generally begins to consume its prey from the front, preferring the meat of the throat, the lower part of the neck, the chest, and the meat covering the ribs and the shoulder blades, or scapulas, making it possible for the rear of the animal (beyond the ribs) to be left intact. The stomach and intestines may or may not be ably extracted without spilling their contents. On the other hand, small calves can be totally consumed, including the head and feet. Occasionally the jaguar consumes the nose, ears, tongue, testicles or udder (depending on the sex of the prey). These parts are not generally consumed by the puma. The jaguar can drag its prey long distances, at times up to more than a kilometer, over rough and forested terrain, and he does not cover his prey with leaves or loose vegetal material. When one encounters an animal that is suspected to have been depredated by a jaguar, one should proceed with caution in the nearby area. Frequently the jaguar stays near its prey to consume it since the tropical heat rapidly decomposes it, and this way he also avoids its consumption by carrion birds. If one approaches a site where a prey animal was killed, and buzzards (vultures or turkey vultures), remain in the nearby trees, it's fairly certain that the jaguar is close by. The jaguar is more associated with forest zones with abundant water sources, and it tends to avoid areas altered by human activity. The characteristics previously

expressed are not absolutes, rather they represent general rules, and can vary between different jaguars.

Jaguar tracks are large and round in shape, the total width being slightly greater than the length, with round toes and large, delineated, rounded pads. Occasionally when the animal walks, one track lands on top of the one before it. The front paws make a larger print than the rear ones in both feline species; a factor to be taken into account when examining the tracks so as not to be fooled into thinking that they are two different cats. In both the jaguar and the puma, the toes of the front and back paws are oval in form, but in the puma the toes tend to be pointed at the very top. Also, the pads show some differences: in the jaguar the upper border tends to be straight, and the lower one can be straight with two lobes, one on each extreme. In the puma, the upper border is generally concave, and the lower border shoes three well-defined lobes, all level with each other (Aranda, 1994).

6.3) CHARACTERISTICS OF THE PREY AND TRACKS OF THE PUMA:

In the case of the puma, he generally attacks and consumes small and medium-sized sheep, goats, and newborn calves up to a year old. His bite is not as strong as the jaguar's (the jaguar presents notably greater development of the cranium and masticatory apparatus than the puma in relation to its size and weight). The puma's prey is smaller in size. The bite generally occurs to throat, and death is by asphyxiation. Infrequently, he bites the nape (generally in small prey). The prey frequently present extensive hemorrhages in the neck and nape, with claw marks on the shoulders and sides. He generally consumes the areas from the ribs back. The stomach and intestines are ably extracted without spilling their contents, permitting access to the liver, heart and lungs. Next he proceeds with the consumption of the meat of the hind legs, from the inner portion of the thighs. A determining characteristic of the puma's prey is that they are hidden and covered with leaves and loose vegetal material to protect them from other predators. However, the fact that an animal is not covered does not necessarily exclude the possibility that it is the puma's prey. If the puma has consumed a large-sized prey animal over the course of several days, there can be various sites in which it was consumed, dragged and covered successively, with drag

marks evident between the sites. Generally, rumen and intestines are buried at the site where puma first ate. The puma, unlike the jaguar, has the ability to utilize drier and more open areas, and he adapts and survives in areas modified by human activities. The tracks around the prey are different (*see diagrams*), and they seem more like a dog print (though without the nail marks). Generally, the puma track is smaller than that of the jaguar, and it is longer than it is wide. The toes are thinner and pointed, and the pad in the heel area shows recesses in the three characteristic lobes previously mentioned. More detailed information about puma tracks can be found in Shaw (1990), and about the difference between jaguar and puma tracks in Aranda (1994). With respect to the examination of tracks, it is worthwhile to mention Shaw's (1990) assertion that teaching someone to examine tracks is like teaching someone to play the piano; the only way is to demonstrate how it's done and to practice with an experienced person.

It is not possible to distinguish puma feces from jaguar feces by their dimensions; the diameter of each not being significantly different, though it is possible to differentiate between them with great exactitude using biochemical analysis of the bile acids (Taber et al., 1977; Farrell, 1999).

It is important to differentiate feline kills from those deaths caused by dogs (domestic or wild), which can unite in groups and cause great damages in cattle ranching areas, with cases of packs that live on the killing and consumption of calves (and also young capybara). The dogs can kill their prey individually or in packs. The prey present wounds to the hind limbs, with evidence of bites and attacks before death. As they are a domestic species, dogs generally are not as efficient and they injure their prey considerably and unnecessarily. At times the prey are not eaten, and they have characteristic tracks around them. There is a great amount of variation in the size and conformation of paw prints of dogs of different breeds. The canine track is more elongated that that of a feline, with the two middle toes extending out in front, the point of the toes ending in a "^", due to the presence of non-retractable claws. Finally, the tracks of the ocelot can be differentiated from other felines by their size and form, which are similar to that of a jaguar in miniature.

7) SOLUTIONS AND MANAGEMENT PRACTICES TENDING TO MINIMIZE PROBLEMS OF DEPREDATION:

Management practices to diminish the effect of depredation and the resulting persecution are based on three principal aspects: 1) the attempt to eliminate specific problem cats responsible for depredations, 2) modifications in cattle management to reduce depredation, and 3) mechanisms for compensation in order to allow ranchers to recoup the losses caused by depredation (Nowell and Jackson, 1996; Hoogesteijn et al., in press; Hoogesteijn and Crawshaw, 2000). The elimination of cats is the treatment for the symptoms, but it does not resolve the causes of the problem, which were explained in the points previously presented.

For most felines, the system of tenancy in areas of occupation or territories constitutes a social adaptation whose purpose is the maximization of the production and dispersion of offspring through the maintenance of a territorial population matrix. Various studies on pumas in the US (summarized by Evans, 1983), show that even in cases of drastic elimination of populations in an area, there were no annual changes in their density. Non-selective programs of elimination did not help to diminish problems of depredation, since populations adjacent to the area of conflict acted quickly to restore the situation, first with an influx of neighboring residents and transients (young non-resident animals searching for an unoccupied area where they can take up residence), followed by an increase in reproductive rates.

The traditional response from ranchers in cases of depredation by felines has been to try to eradicate all the depredators that subsist in the area, whether or not they are responsible for the depredation. Consequently, the problem of depredation can worsen, since on any ranch resident adult felines exist that undoubtedly do not attack the cattle (with their system of tenancy or area of occupation, they prevent the residence or entrance of other feline). If these non-depredatory residents are killed, their territories are left open to colonization by one or several new immigrants, the community of predators is disturbed, and hungry and nomadic individuals, frequently cattle-hunters, can take up residence (and in greater numbers). The result is an increase in losses due to depredation, as a direct consequence of a program of non-specific elimination of predators. Therefore, the first and most fundamental step in a control program is the

choosing of methods that selectively and exclusively eliminate the individual animal guilty of the depredation (Bowland et al., 1992). Furthermore, the attempt to exterminate all the felines in an area does not resolve the problem, rather it can aggravate it, since it is more likely that cats who walk away wounded will become cattle hunters, as was previously explained. At the same time, cats become accustomed to continuous persecution and they alter their habits, making them more difficult to hunt (Nowell and Jackson, 1996).

Contrary to what various cattle ranchers believe, total deforestation of a cattle ranch will not resolve the problem of depredation attributed to the jaguar and the puma either (González-Fernández, 1995), and in fact it can simply replace one depredator for another (jaguar for puma). According to this author, it can even increase the problem of depredation, as pumas generally cause more losses than jaguars, since they concentrate more on newborn and small calves of 2-3 months of age, and they adapt better than the jaguar to marginal habitats with human activity. Ackerman (1984), found very few problems of depredation in Utah (USA), when calves were kept out of areas of puma distribution until they reached several months of age. Nevertheless, in northwest Arizona, when calves were born within these areas, they constituted 87% of depredated cattle (Shaw, 1977). This author mentions in a later publication that 93% of the depredated cattle were less than a year old, and that the losses were greater when the calves were born in areas with a low density of natural prey animals, such as deer, located in the puma's natural habitat.

At the same time, deforestation diminishes populations of available wild prey, thus increasing depredation of cattle in the absence of natural prey. The impact of cattle depredation tends to be aggravated in areas of strong human intervention. Evidence exists which indicates that when a prey animal is killed in remote areas, the jaguar as much as the puma tend to remain at the site and feed on the prey for up to four days. If bothered by human activity, they will quickly abandon their kill, moving around in search of new prey, which can increase the level of depredation (Crawshaw and Quigley, in press).

7.1) CONTROL OF PROBLEM CATS AND TRANSLOCATION:

The control of predators is only effective in reducing or minimizing depredation when only the problem cat responsible for the depredation is eliminated. On the other hand, this fact is completely useless if the illegal and opportunistic hunting of felines, leaving in the balance a great number of injured cats that very likely will become cattle hunters, is not controlled. In several Latin American countries this problem has various facets; on the one hand, dissuasive legal or judicial mechanisms that impede the illegal hunting of jaguars and pumas do not exist, and legal charges brought have had practically no effect. On the other hand, when a rancher has a depredation problem, he generally has to resolve the problem himself.

One of the most widely used methods in the control of offending felines is the tracking of the animal from the site of a recently depredated domestic animal, using specially trained dogs. These dogs follow the cat and they either stop it or tree it, giving the hunter the opportunity to shoot it with firearms or with darts specially equipped with tranquilizing drugs to immobilize it. One of its inconveniences is that the maintenance of the dog pack is costly, and if the dogs are undisciplined or not well trained, they will try to kill any carnivore or other animal that crosses their path or leaves its trace there, killing or scaring away these species from the area- an undesirable situation, and one which is even problematic on ranches with eco-tourism schemes. Another method consists of guarding over the prey and, when the cat returns to eat a second time the next night, spotlighting it with a lantern or flashlight and shooting it, generally from a platform constructed in a tree near the prey (Hoogesteijn and Mondolfi, 1992). Snare-traps near the prey, or baited cage-traps have also been used (Hoogesteijn et al., 1996).

Currently, more innovative methods exist for controlling just the problem cats. One of them is the toxic collar, which is placed around the neck of domestic animals in areas with depredation problems. The collar is outfitted with a capsule filled with a potent toxin. When the feline bites its domestic prey on the neck it is poisoned, allowing the cattle owner to eliminate just the cat responsible for the depredation (Burns et al., 1996). These collars have been used successfully in France, the US, and South Africa (Nowell and Jackson, 1996). Another possible method is the injection of recently killed

prey with lithium chloride, a nausea-inducing substance tested in Kenya on leopard prey by F. Mizutani (Nowell and Jackson, 1996).

In several African countries, sport hunting of big cats is practiced (among them the lion, cheetah, and leopard) using a system of quotas approved by CITES (Convention on the International Trade in Endangered Species). The trophy hunters bring in much greater sums of money to the countries they are visiting than do tourists ($35,000 US dollars for a 21 day lion hunt). In 1990, state income from the issuance of hunting licenses in Tanzania reached $4,500,000 US; more than twice the amount produced by national parks. Well-organized sport hunting constitutes a key factor in the sustainable use of wild places in these countries (Nowell and Jackson, 1996).

Similarly, Shaw (1990), recommends that the better means of management for state agents in Arizona (US) is sport hunting through a close relationship with sport hunting guides in a district, which serves to maintain data on the movement of pumas in an area, and to help direct sport hunting efforts in areas with greater problems of depredation.

Sport hunting of depredatory jaguars as a generator of funds for their conservation has been proposed by some researchers (Swank and Teer, 1992), and rejected by others. Among them, Rabinowitz (1995) asserts that it creates more problems than it solves, as it is simply a system to kill jaguars for profit. It does not protect the jaguar, not does it resolve the problem of cattle depredation. It is highly unlikely that such a system could be appropriately regulated when the majority of Latin American countries have demonstrated neither the inclination, nor the organization to make people comply with instituted hunting laws. Furthermore, it only protects jaguars so long as they are producing economic earnings for man. Similarly, Hoogesteijn et al. (1993), conclude that, taking into account the results of utilization programs of two more easily managed species (such as the spectacled caiman and the capybara in Venezuela), the proposition of sport hunting of the jaguar proposed in that country can have the opposite effect, and thus its implementation in the current state of organization of wildlife services is not advisable. In addition, a tradition of well-organized sport hunting does not exist in Latin America as it does in African countries, even though this is a management problem. Some Latin American countries issued, or even continue to

issue, special permits for the control of feline depredators; in Venezuela these were issued until 1976 upon combined petition by a cattle owner and a sport hunter (Medina et al., 1993). Currently, in the majority of Latin American countries, no specific legal structure exists for the protection of the jaguar, nor any truly deterring legal mechanism to impede furtive hunting.

Despite the fact that neither previous experiences with jaguar translocation (Rabinowitz, 1986a), nor various leopard translocation efforts carried out in diverse African countries (Hamilton, 1981; Norton, 1986), have been successful, Profauna (Autonomous Governmental Wildlife Service of Venezuela) initiated a problem-jaguar translocation program in February, 1993. From that time until 1998, a total of 11 jaguars were captured and translocated with the help of a sport hunter with trained dogs, rifles with tranquilizing darts, the participation of Profauna personnel, and North American hunters from the Safari Club (Florida chapter), who paid a sum of $6,000 US dollars to participate in the capture and shooting of darts. Of this amount, a portion went to the rancher to compensate for part of the damages caused by the captured jaguar, and the other portion went to Profauna (Hoogesteijn et al., in press). With this program an attempt was made to solve the problem of certain cattle-depredating jaguars, avoiding its hunting or euthanasia, and the problems of jaguar conservation and their depredation of livestock on cattle ranches was brought to public light through stories in the press and a televised documentary. It also succeeded in getting some funds to the ranchers who suffered depredations of their herds, with the participation of North American hunters, even though this was an isolated effort. In the majority of cases, the destiny of the translocated jaguars was unknown in the long term, and coverage of the program at the national level was limited to the small area of just one state (Cojedes). No measures were taken to address the fairly common and more intense depredation of calves by pumas (probably because the North American hunters were not interested in hunting pumas). Furthermore, neither educational campaigns on the national level, nor awareness campaigns aimed at ranchers to modify herd management practices tending to minimize depredation by felines were carried out.

In terms of the translocation of other felid species such as the puma, Ruth et al. (1998), in the state of New Mexico (USA), translocated a total of 14 radio-monitored

pumas of different ages, (5 males and 8 females), to an average distance of 477km. 9 of the 14 translocated pumas died during the study, and the relocation was successful only with pumas from 12 to 27 months of age. Linnell et al. (1997), review the translocation experiences of various species of carnivores on a worldwide level, and the general conclusion is that, in addition to the insufficient monitoring of translocated individuals, large carnivores show a constant ability to return to the place of capture to distances of up to 400km or more. Very few individuals remain in the area where they were released, and their survival rate is very poor. Management efforts are therefore better concentrated on the direct reduction of conflict or, where that is not practical, the application of lethal control, taking into account the high cost of translocation.

7.2) MEASURES TO REDUCE DEPREDATION:

In addition to the elimination of the feline that is specifically causing the depredation, Crawshaw and Quigley (1984), Hoogesteijn et al. (1993), Rabinowitz (1995), Nowell and Jackson (1996), Polisar (2000), and Hoogesteijn et al. (in press), propose the following measures and changes in the management of cattle to reduce depredation of domestic animals by jaguars and pumas:

- Protect wildlife populations that constitute the feline's principal prey from furtive hunting through effective vigilance, and do not carry out commercial hunting of these animals (especially in the case of spectacled caiman and capybara), unless they are well controlled and affect a small percentage of the censused populations. Thus, it is necessary to organize patrolling services on the cattle ranches to reduce losses from rustling and furtive hunting, either individually on each ranch, or as a cooperative effort between several small or medium-sized breeders.
- Reintroduce species that the cats can utilize as natural prey (spectacled caiman, capybara, peccaries, etc.), and protect them from furtive hunting once they are reintroduced.
- Construct or dig out water reservoirs (small lakes or pits) specifically for wildlife. This elevates the number of prey animals, focusing their spatial distribution and helping to direct the use of different areas by the felines.

- Prevent indiscriminate and opportunistic hunting of jaguars and pumas, which gives rise to crippled felines unable to hunt natural prey.
- In so far as it is possible, fence off areas of forest corridors to prevent the access of cattle. This measure can be implemented on savanna ranches with narrow forest corridors along rivers and drainages, but it is not easy to implement on ranches with extensive forested areas, as the cost of construction of cattle fences is approximately one thousand US dollars per kilometer, and annual maintenance can reach a third of that amount.
- Do not keep herds of cows that are near term or birthing in pastures next to forested areas. They should be placed in open areas without forest nearby, and preferably situated near human dwellings.
- Establish short breeding seasons of 3-4 months in duration, instead of allowing breeding all year long. This, in addition to allowing for the efficient organization of the cattle operation, allows for closer supervision of newborn calves, which can be born in areas without incidence of depredation over a short time span. During this shortened calving season, it is worthwhile to contract one additional worker, allowing for good supervision of the births and of the newborn calves.
- With respect to the previous proposition, it is important to note that the use of electric fencing around pastures utilized especially for calving has been shown to be an effective technique for the control of depredation by pumas and jaguars (Scognamillo et al., in press). Nevertheless, the utilization of fences is more effective in the protection of smaller herds in relatively small paddocks than in the case of extensive cattle ranching where their use would remain more limited to calving paddocks. Electric fences require periodic and thorough maintenance to avoid neutralization of the electric current, and to guarantee its proper functioning.
- Instead of selling them, maintain a few experienced animals from the herd (steers or old cows with horns), that teach appropriate group behavior to younger animals in the herd, to diminish depredation. In addition, one can place bells or cowbells on some of these individuals, which also constitutes a useful measure.

- In areas of extensive forest with a high incidence of depredation, enclose the animals at night in adequate corrals, near human habitation, and/or in nearby areas with electric fencing. Despite a slight increase in operating costs, this simple measure is very efficient in reducing the negative impact of depredation, and the animals are easily habituated to it. The installation of lights in the corrals also constitutes a useful measure.
- Exchange breeding operations for rearing or growing operations (with animals 1-2 years old) in areas with a high incidence of depredation. That is to say, one should not place young calves in areas with a high incidence of depredation, but rather use those areas for older cattle.
- Utilize water buffalo in areas of flooded savanna with serious problems of depredation. Although the buffalo is a species that can exercise a greater environmental impact than cattle through over-grazing and trampling when it isn't adequately managed and in excessive numbers, various ranchers have had the experience that because of their social and defensive behavior (buffalo form a circle around their calves and aggressively confront predators in addition to having the ancient experience of depredation by the Asiatic tiger), depredation of buffalo calves is less or non-existent in comparison to bovine calves (H. Scannone, N. Zuloaga, P. Moser; personal communication). Additionally, the buffalo is a species of much more efficient and profitable productive behavior than cattle in conditions of highly floodable savanna, and it is undeniable that they are going to experience a great expansion in their utilization as a productive species in this area. At the same time, Farrell (1999), mentions mortality reports on the Piñero Ranch (in flooded savanna on the Venezuelan plains), where it was demonstrated that the high levels of depredation that occurred in an area of maternity pastures with cattle, drastically decreased after cattle where replaced by water buffalo.
- Move the herds that pasture in floodable lowland zones to higher areas so that they are not left isolated and weakened by the floods, and therefore more likely to be preyed upon.

- Dispose suitably of the cadavers of domestic animals dead form other causes (bitten by snakes, cows dead from birthing problems, etc.) to prevent them from being eaten by felines who might then acquire an inclination towards their consumption.
- Be familiar with the appearance and signs of domestic animals depredated by felines, and know how to differentiate these from those losses caused by packs of wild or feral dogs, and by rustlers or cattle thieves. Keep detailed records on mortality and its causes in the ranch's cattle registries, as well as regularly bringing up to date accounts of the cattle inventory (a minimum of a monthly inventory through counting). Check the real losses and their causes, and compare the information from each year in terms of the percentages or mortality and its causes.
- In other countries, shepherd dogs have been used, which, when of sufficient size and number, are very effective in preventing problems of depredation, especially with small species such as sheep and goats. Also, the use of propane explosives and pyrotechnic material has been employed with success to reduce depredations. These explosive canons can obligate predators to move their areas of occupation or their pathways nearing the herd.

It is important to mention that predatory felines posses a great capacity for adaptation to new situations, and they can habituate to some of the measures mentioned herein. No technique exists that is totally effective; the best option will always be the utilization of a combination of methods in an additive or substitutive manner.

7.3) COMPENSATION MECHANISMS FOR LOSSES DUE TO DEPREDATION:

The payment of compensations for the loss of domestic animals is a way to encourage cattle ranch owners to tolerate the presence of felines on their properties. The compensations can be paid by the government or by conservation organizations, and they have been organized in Switzerland, the US, India, and Argentina (Nowell and Jackson, 1996; Oli, 1991; Perovic, 1993). This last author (Perovic, in press), points out that in northwest Argentina, programs of compensation for losses confirmed to be from

jaguar depredation, noted as a positive result that throughout the duration of the program (1991-1994), no individual was hunted. Nevertheless, he concludes that these programs are not recommendable in the long term for the great effort that they require, and because they accustom owners to receiving this compensation for the loss of their livestock, thus they do not look for other solutions, and perhaps more efficient changes in management practices.

This could be a valid proposal for the conservation of felines on private cattle ranches in Latin America, in conjunction with private conservation organizations, if it is accompanied by the protection of faunal populations that constitute the feline's principal prey, preventing the indiscriminate and opportunistic hunting of jaguars and pumas, and the implementation of previously outlined cattle management practices tending to minimize depredations. It would also be necessary to determine the destination of any cat declared to be a "killer"; the most advisable solution being its capture and relocation to a zoo, or its euthanasia. Nevertheless, these programs will not be effective if they are not accompanied by legal mechanisms that prevent the opportunistic hunting of cats, with strong penalties for the violators, and control of furtive hunting of its prey.

An interesting situation (described by Crawshaw (in press), as it relates to the conservation of the jaguar, is occurring in the Pantanal of Mato-Grosso, Brazil. In this area, depredations by felines always generate the same negative attitudes on the part of ranchers. Nevertheless, in recent years a retraction in the cattle industry in general, combined with a series of strong floods in the Pantanal in particular, have forced many ranchers out of business, with some not even being able to remove isolated cattle from some remote areas. With a smaller number of people living and working on these ranches, wildlife populations in general have increased, providing, along with the cattle, an ample source of prey for the jaguar. The collapse of the cattle market has forced various ranch owners to consider other economic alternatives, one of the most common being eco-tourism. As a result of greater conscientiousness on a global and national level toward environmental education and the conservation of natural resources, including wildlife, a growing number of people are willing to pay for the possibility of seeing the true Pantanal. The possibility of seeing a jaguar in its natural setting is now considered an advertising advantage, and the economic result more than compensates

for any loss due to depredation. According to one rancher, “the loss of 20-30 head (of cattle) a year is compensated by having 30 guests on my ranch for just one night”.

A conservation strategy for the jaguar, and for felines in general, must resolve the following factors summarized by Rabinowitz (1995), on the basis of suggestions by Quigley and Crawshaw (1992), Rabinowitz (1992), and Hoogesteijn et al. (1993), in order to be successful:

- The creation of larger and more extensive protected areas throughout their range. The ones that currently exist are insufficient to guarantee their survival, yet the conflicting pressures of land use make difficult the acquiring of sufficiently large, completely protected areas. If it is impossible to organize totally protected areas, multi-use areas containing abundant forest and water resources, where the hunting of jaguars and their prey is not permitted, can be designated.
- Education and management programs for local ranchers. Many traditionalist ranchers ignore how the improvement of the management of their herds can provide them with significant increases in their economic incomes, including the management practices previously explained.
- Government assistance to ranchers who experience problems of depredation is very necessary. In spite of all the precautions and changes in management practices, there will always be cases of problem cats. When these depredations are verified, there should be monetary compensations made to the ranchers, and hunters authorized by the government should kill or capture the offending feline, being sure to eliminate the one responsible for the depredation.
- More dissuasive mechanisms to prevent the illegal killing of jaguars and pumas should be instituted, as well as the patrolling and enforcing of wildlife protection laws, as currently furtive and illegal hunters act under conditions of complete impunity.
- Education for the conservation of the jaguar and the puma. Many ranchers continue to believe that felines have little or no economic value, and that they constitute a threat to their way of life. There is very little consciousness of the important role that predators play in maintaining the communities of their natural prey, and the integrity of natural ecosystems.

8) BIBLIOGRAPHY:

Ackerman , B.B., F.G. Lindzey and T.P. Hemker.1984. Cougar food habits in southern Utah. J. Wildl. Manag. 48: 147-155.

Almeida, A. de. 1984. Some feeding and other habits of jaguar in the Pantanal. Trabajo dactilografiado. 15 pp. Sao Paulo.

Almeida, A. de. 1986. A survey and estimate of jaguar populations in some areas of Mato Grosso. In: Trans. Symp. Wildlife Management in Neotropical Moist Forests, Manaus, Brasil. Int. Council for the Conservation of Game, Paris, France: 80-89.

Aranda, M. 1994. Diferenciación entre las huellas de jaguar y puma: Un análisis de criterios.Acta Zool. Mex. (n.s.) 63: 75-78.

Bowland, A. E., M.G. Mills and D. Lawson. 1992. Predators and Farmers. Endangered Wildlife Trust, Parkview, South Africa.

Burns, R., D. Zemilcka and P. Savarie. 1996. Effectiveness of large livestock protection collars against depredating coyotes. Wildlife Society Bulletin 24: 123-127.

Childs, J. 1998. Tracking the Felids of the Borderlands. Arizona-New Mexico Jaguar Conservation Team. Malpai Borderlands Group.75 pp.

Crawshaw, P. In press. Jaguar Conservation: The Pantanal and Iguaçu National Park in Brazil. Symposium Jaguars in the New Millenium. WCS and UNAM, Mexico City March 1999.

Crawshaw P. y H. Quigley. 1984. A ecologia do Jaguar ou onca pintada no Pantanal. Relatorio entregue ao Instituto Brasileiro de Desenvolvimiento Florestal (IBDF)/DN (Brasilia). 110 pp.

Crawshaw, P. and H. Quigley. In Press. Jaguar and Puma feeding habits in the Pantanal of Mato Grosso, Brazil, with implications for their management and conservation. Symposium jaguars in the New Millenium. WCS and UNAM, Mexico City March 1999

Ewans, E. 1983. The cougar in New Mexico, biology, status, depredation of livestock and management recommendations. New Mexico Department of Game and Fish. 40 pp.

Farrell, L.E. 1999. The ecology of the puma and the jaguar in the Venezuelan Llanos. Master of Science Thesis. Univ. of Florida, Gainesville

González Fernández, A. 1995. Livestock predation in the Venezuelan Llanos. Cat News. 22:14-15.

Hamilton, P.H. 1981. The Leopard (Panthera pardus) and the Cheetah (Acynonix jubatus) in Kenya. Unpublished report for the U.S. Fish and Wildlife Service, The African Leadership Foundation and the Government of Kenya.

Hoogesteijn, R. y E. Mondolfi, 1992. El Jaguar, Tigre Americano. Ediciones Armitano, Caracas. Venezuela.

Hoogesteijn, R., A. Hoogesteijn and E. Mondolfi. 1993. Jaguar predation vs. conservation: cattle mortality by felines on three ranches in the Venezuelan Llanos. In N. Dunstone and M.L. Gorman, eds. Mammals as predators. Proc. Symp. Zool. Soc. London. 65. Clarendon, Oxford.

Hoogesteijn, R., R. McBride, M. Sunquist, A. Hoogesteijn and L. Farrell. 1996. Medetomidine and Rubber-padded Leg-hold Traps in Venezuelan Cat Studies. Cat News 25 Autumn 1996: 22-23. Cat News 26-Spring 1997: 24. Correction: Hoogesteijn et al. 1997.

Hoogesteijn, R. and E. Mondolfi. 1996. Body mass and skull measurements in four jaguar populations and observations on their prey base. Bull. Florida Mus. Nat. Hist. 39(6): 195-219.

Hoogesteijn, R. and C. Chapman. 1997. Large ranches as conservation tools in the Venezuelan Llanos. Oryx. 31 (4): 274-284.

Hoogesteijn, R.; E. O. Boede y E. Mondolfi. En Prensa. Observaciones sobre la depredación de jaguares sobre bovinos en Venezuela y los programas de control gubernamentales. Symposium jaguares en el nuevo milenio. WCS y UNAM, Ciudad de México. Marzo 1999.

Hoogesteijn, R. y P. Crawshaw. 2.000. Problemas de depredación de felinos en hatos ganaderos. Causas y posibles soluciones. En: R. Romero, N. Peña de Borsotti y D. Plasse (Eds.). XVI Cursillo sobre Bovinos de Carne. Universidad Central de Venezuela. Facultad de Ciencias Veterinarias. Maracay, Venezuela.

Linnell, J., R. Aanes and J. Swenson. 1997. Translocation of carnivores as a method for managing problem animals: A review. Biodiversity and Conservation 6, 1245-1257.

Medina, G., J.L. Méndez-Arocha y E. Siso. 1993. Alternativas para la preservación y el manejo del yaguar en Venezuela. Pp. 291-299 en: Felinos de Venezuela. FUDECI. Raúl Clemente Editores. Caracas. Venezuela.

Miller, B. and A. Rabinowitz. In press. Why conserve jaguars?. Symposium Jaguars in the New Millenium. WCS and UNAM, Mexico City March 1999

Myers, N. 1973. The spotted cats and the fur trade. In: “The World Cats”. Wordlife Safari.Winston, Oregon. 1:276-326.

Norton, P.M. 1986. Recommendations on a conservation strategy for leopards in the mountains of the Cape Province. Cape Dept. of Nature and Environmental Conservation. South Africa.

Nowell K. and P. Jackson.,1996. Wild Cats, Status Survey and Conservation Action Plan. IUCN. Gland, Switzerland.

Ojasti, L. 1984. Hunting and conservation of mammals in Latin America. Acta Zool. Fennica, 172: 177-181.

Ojasti, J. 1986. Wildlife management in neotropical forests, overviews and prospects. In: Trans. Symp. Wildlife Management in Neotropical Moist Forests, Manaus, Brasil. Int. Council for the Conservation of Game, Paris, France: 96-119.

Oli, M.K. 1991. The ecology and conservation of the snow leopard (Panthera uncia) in the Annapurna Conservation Area, Nepal. M.Phil. thesis, Univ.Edinburgh, Edinburgh.

Oliveira, T. 1992. Ecology and conservation of neotropical felids. M.S. thesis, Univ. Florida, Gainesville, 203 pp.

Perovic, P. 1993. Evaluación del daño sobre la ganadería, por actividad del overo (Panthera onca) y propuestas para su manejo en un área de las Yungas, Departamento Palpala, Provincia de Jujuy Argentina. 22 pp.

Perovic, P. En prensa. Conservación del jaguar en el noroeste de Argentina. Symposium jaguares en el nuevo milenio. WCS y UNAM, Ciudad de México. Marzo 1999.

Plasse, D., H. Fossi y R. Hoogesteijn. 1993. Mortalidad y pérdida en ganado de carne. En: D. Plasse, N. Peña de Borsotti y J. Arango (Eds.). IX Cursillo sobre Bovinos de Carne. Universidad Central de Venezuela, Facultad de Ciencias Veterinarias. Maracay, Venezuela. pp 1-46.

Polisar, J. 2000. Jaguars, Pumas, their Prey Base and Cattle Ranching: Ecological Perspectives of a Management Issue. PhD Thesis, University of Florida, Gainesville.

Rabinowitz, A. 1986a. Jaguar predation on domestic livestock in Belize. Wild. Soc. Bull. 14: 170-174.

Rabinowitz, A. 1986b. Jaguar: Struggle and triumph in the jungles of Belize. Arbor House. New York.

Rabinowitz, A. and B. Nottingham. 1986. Ecology and behavior of the jaguar (Panthera onca) in Belize, Central America. J. Zool. London (A)210: 149-159.

Rabinowitz, A. 1992. Chasing the dragon´s tail: the struggle to save Thailand´s wild cats. Doubleday, New York.

Rabinowitz, A. 1995. Jaguar conflict and conservation, a strategy for the future. Pp. 394-397 in J.A. Bisonnette and P.R. Krausman, eds. Integrating people and wildlife for a sustainable future. Proceedings of the First International Wildlife Management Congress. The Wildlife Society, Bethesda, Md.

Roosevelt, 1914. In the Brasilian Wilderness. Charles Scribner´s Sons. New York.

Ruth, T.; K. Logan, L. Sweanor, M. Hornocker and L. Temple. 1998. Evaluating cougar translocation in New Mexico. Journal of Wildlife Management 62(4): 1264-1275.

Saenz, J. y E. Carrillo. En prensa. Jaguares depredadores de ganado en Costa Rica: ¿Un problema sin solución?. Symposium jaguares en el nuevo milenio. WCS y UNAM, Ciudad de México. Marzo 1999.

Seymour, K.L. 1989. Panthera onca. Mammalian Species 340: 1-9.

Schaller, G. 1983. Mammals and their biomass on a Brazilian ranch. Arq. Zoo. Sao Paulo 31(1): 1-36.

Shaw, H.G.1.977. Impact of mountain lion on mule deer and cattle in nortwestern Arizona. Pp. 17-32 in: R.I. Phillips and C. Jonkel, eds. Proc. 1975 Predator Symp.., Montana For. And Cons. Exp. Stn. Univ. Montana. Missoula.

Shaw, H. 1990. Mountain Lion Field Guide. Special Report # 9. Arizona Game and Fish Department. Fourth Edition. 36 pp.

Sunquist, M. 1981. The social organization of tiger (Panthera tigris) in Royal Chitawan National Park, Nepal. Smithsonian Contribution to Zoology No. 336. Smithsonian Institution Press. Washington.

Swank, W. and J. Teer. 1989. Status of the jaguar-1987. Oryx 23: 14-21.

Swank, W. and J. Teer. 1992. A proposed program for sustained jaguar populations. Pp. 95-107 in: Felinos de Venezuela. FUDECI. Raúl Clemente Editores. Caracas. Venezuela.

Taber, A., A. Novaro, N. Neris and F. Colman. 1997. The food habits of sympatric jaguar and puma in the Paraguayan Chaco. Biotropica 29 (2): 204-213.

Terborgh, J. 1988. The big things that rule the world - a sequel to E. O. Wilson. Conservation Biology 2: 402-403.

Figure 1. Tracks of front paw (below) and rear paw of Jaguar, Puma and Dog (from left to right). These three species show variations in size. Tracks are not drawn according to scale. Adapted from Aranda (1994) and Shaw (1993) (see text).