

Jaguar and puma attacks on livestock in Costa Rica

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Abstract: Human–felid conflicts threaten long-term conservation of jaguars (*Panthera onca*) and pumas (*Puma concolor*). We interviewed ranchers from 50 ranches and inspected farms in northern Costa Rica that reported recent attacks on livestock by these 2 felids. We analyzed ranch characteristics, livestock management practices, details of predation, estimated market-value of economic losses, and ranchers' perception of damage. Ranchers reported 81 felid attacks on livestock, including 60 head of cattle, 16 horses, 3 sheep, 1 pig, and 1 goat. Mean size of ranches was 233 km², and mean livestock herd size was 109, including cattle, horses, pigs, sheep, goats, and water buffalo (*Bubalus bubalis*). Mean value of an attacked animal was U.S. \$177.75 (range = \$15 to \$854, $n = 51$), and cumulative loss for all cattle was U.S. \$9,065. Eighty-four percent of ranchers reported the presence of jaguars on their property, and 36% perceived the presence of pumas. Economic losses were overestimated by ranchers. Management strategies to address these problems must take into account the small size of ranches and limitations of the cattle and livestock production system in Costa Rica. Damage quantification based on market values can provide a guide to establish an incentive program, but provisions are needed due to ranchers' potential discontent. The results of this study form the basis of Costa Rica's current technical assistance projects, as well as provide a protocol to evaluate reports of jaguar and puma attacks on domestic animals in the country.

Key words: attacks on livestock, cattle management, Costa Rica, damage assessment, human–wildlife conflicts, jaguar, livestock predation, *Panthera onca*, *Puma concolor*

CONSERVATION OF WILD PREDATORS is a challenge when they interfere with human activities. Predation on domestic animals can provoke the animosity of livestock owners, who kill predators in retaliation. According to Inskip and Zimmermann (2009), 75% of the world's felid species come into conflict with humans. Livestock predation by jaguars (*Panthera onca*) has increased in Latin America in recent years (Hoogesteijn and Hoogesteijn 2011). These conflicts arise from the loss and fragmentation of felid habitat and the consequent reduction in wild prey populations, which is further aggravated by indiscriminate hunting of the wildlife upon which these felid depend for prey (Crawshaw 2003). Factors, such as landscape characteristics and inadequate cattle management, also contribute to the conflict (Thirgood et al. 2005, Azevedo and Murray 2007, Palmeira et al. 2008, Escobedo 2011). Young jaguars and pumas (*Puma concolor*), as well as females with cubs and older or wounded animals, are more likely to move into cattle-ranching areas (Leite et al. 2002).

In Costa Rica, human–felid conflicts pose

the most significant threat to the long-term conservation of jaguar and puma populations (Amit et al. 2009). The disappearance of these felids affects the natural balance of wild herbivore and smaller predator populations and, consequently, alters ecosystem dynamics (Miller and Rabinowitz 2002).

Preventive measures to avoid damage and to minimize the impact of the damage, such as removal of predators, must be implemented with caution. A strategy for resolving conflicts between felids and humans must allow for the adaptation of conflict management measures and take into account information about the specific situation in each case.

Methods

Study area

We carried out our research in northern Costa Rica (10° 02'13" to 11° 01'32" N, 83° 30'17" to 85° 42'29" W), mainly in the Chorotega and Huetar Norte regions, due to the concentration of cattle and livestock production in this area (557,720 animal units and 16,495 ranches with mean size of 43 ha; Corporación de Fomento

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Ganadero 2000; Figure 1). We inspected 50 ranches that had 81 livestock to felid attacks from March 2008 to September 2009. Twenty-three ranches were in Huetar Norte region, 20 ranches in Chorotega, 5 ranches in Huetar Atlántica, and 2 ranches in the Central regions.

The Costa Rican landscape is extremely diverse from coast to coast, with mountain ranges influencing climate and tropical vegetation of the area. Ecosystems vary from dry to rain forest and from basal to mountain floors (Holdridge 1967), as well as wetlands. There is a longer dry season on the Pacific side, and annual precipitation is greater than on the Caribbean slope (Instituto Meteorológico Nacional 2008). Land uses include primarily agriculture, ranching, forestry, and protected areas, including Arenal (121 km²), Tenorio (128 km²), Rincón de la Vieja (141 km²) and Tortuguero (266 km²) national parks, Miravalles Protected Zone (116 km²), Caño Negro Wildlife Refuge (101 km²), and Cordillera Volcánica Central Forest Reserve (133 km²).

From August 2007 to September 2009, we looked for reports of feline attacks by contacting governmental authorities and informants using referral sampling (Berg 1988). Each report contained a description of the incident, when the incident occurred, and contact information for the ranch. From January to October 2009, we inspected ranches and applied a directed-structured oral questionnaire to the owner or manager of the ranch.

We collected information on livestock management practices used, characteristics of the property, including ranch size, livestock, breeds used, main economic activity of the ranch, type of production management system (extensive, strategic supplementary feeding, semi-stabled or other; Arronis Díaz 2003), and livestock birthing place (open pasture, maternity pasture, or corral). We also asked managers what they considered to be the 2 main causes of livestock mortality. With the aid of illustrations, we inquired about perceived presence of pumas and jaguars on their property. We also

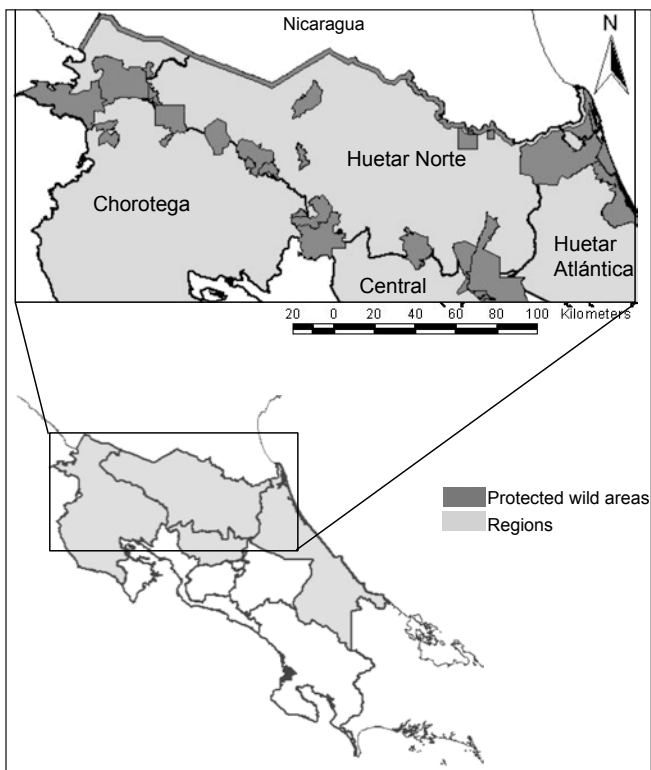


Figure 1. Location of study area, northern Costa Rica.

requested information about characteristics of the last and second-to-last animals allegedly attacked by felids, including the date, species attacked, breed, age in months, sex, weight, the animal's estimated value in *colones* (local currency varied from 546 to 584 *colones* per U.S. dollar during the study period), and cost of veterinary care for wounded animals.

Analysis

We assigned categories to nominal variables (i.e., type of economic activity or management system) to obtain relative values (percentages). Sample size varied with each category due to data availability for each attack. We calculated the market value of each attacked animal according to its weight, sex, and age by using a monthly price list for cattle sales at auctions held by the Corporación Ganadera Nacional (Federación de Subastas Ganaderas 2010). We converted this amount to U.S. dollars using the exchange rate on the date of the attack, as reported by the Banco Central de Costa Rica. We asked affected ranchers for their estimate of the value of each attacked animal to determine

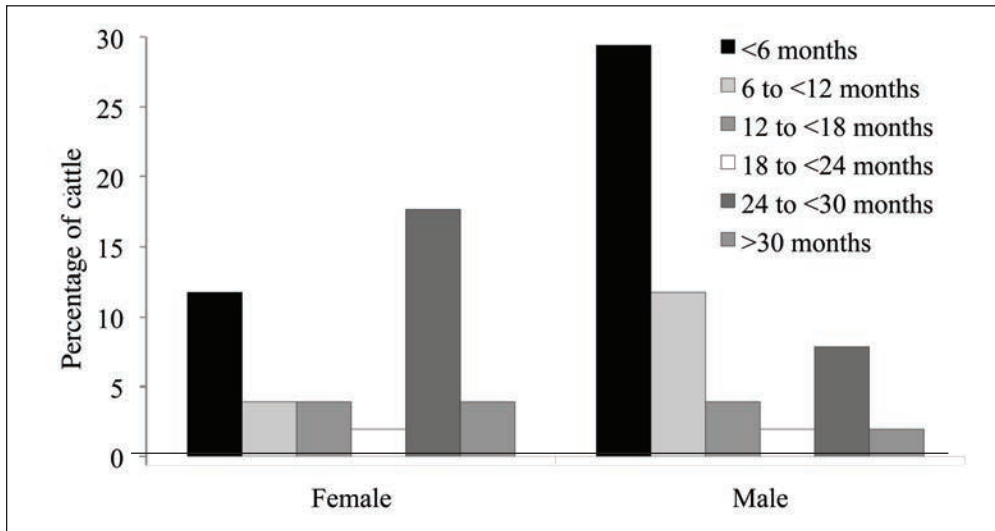


Figure 2. Percentage of attacked head of cattle according to sex and age of cattle in northern Costa Rica ($n = 50$).

the difference between actual market value loss and perceived loss. We used a paired t -test (Sokal and Rolf 1995) to compare perceived to actual losses after a LOG 10 transformation, using Statgraphics Centurio, version 15.2.14, software (StatPoint Inc., Warrenton, Va.).

Results

Ranches and livestock management

We located 50 ranches that lost livestock to felids; their mean size was 2.33 km² (range 0.028 to 50). The mean number of head of livestock was 109 animals (range = 1 to 968), with a mean of 96 cattle (range = 0 to 872), and 10 horses (range = 0 to 105). There was a mean of 7 head of livestock (maximum = 51) per ranch, including pigs, sheep, goats, and water buffalo. Among the bovine breeds, 39% were *Bos taurus* (Simmental, Holstein, Jersey, and Brown Swiss); 28% were *Bos indicus* (Brahman and Nelore); and 33% were hybrids.

Half of ranches affected by felid attacks were devoted to cattle ranching for dual purposes (e.g., dairy and meat production) as the main production activity; others were in cow-calf operation and meat production (17%), dairy production (17%), and other activities (17%), including forestry, tourism, and agriculture. Sixty-eight percent of the production management system used was extensive (free grazing in unfenced pastures); 24% corresponded to strategic supplementary

feeding systems (grazing supplemented with minerals and grain); and 8% to a semi-stabled system. The birthing place of livestock of 54% of ranches was open pasture; 38% was closed pastures (maternity pastures); and 8% of ranches used corrals near human settlements.

Characteristics of attacked animals

Animals attacked by felids included 60 head of cattle, 16 horses, 3 sheep, 1 pig, and 1 goat. Most attacked bovines were mixed-breed (37%), *B. indicus* (37%), and *B. taurus* (27%). Attacked horses were mixed-breed (50%), quarter horses (25%), Costa Rican saddle horses (12%), and English saddle horses (12.5%). We recorded the age and weight for 51 attacked cattle; mean age was 12.4 months (range = 0.3 to 48), and mean weight was 183 kg (range = 20 to 400 kg). For the 16 horses, mean age was 4.2 months (range = 0.5 to 24), and mean weight was 102 kg (range = 30 to 300 kg). For the other species attacked, mean weight was 42 kg. Males of all species were attacked slightly more frequently than females (29:22 males:females in cattle and 9:7 in horses); 56% of horses and 41% of cattle were <12 months old (Figure 2).

Quantification of losses

Eighty-six percent of the domestic animals that were attacked died at the site of attack; 11 individuals (8 cattle, 2 horses, and 1 sheep) were wounded (Figure 3). Only 5 wounded cattle and

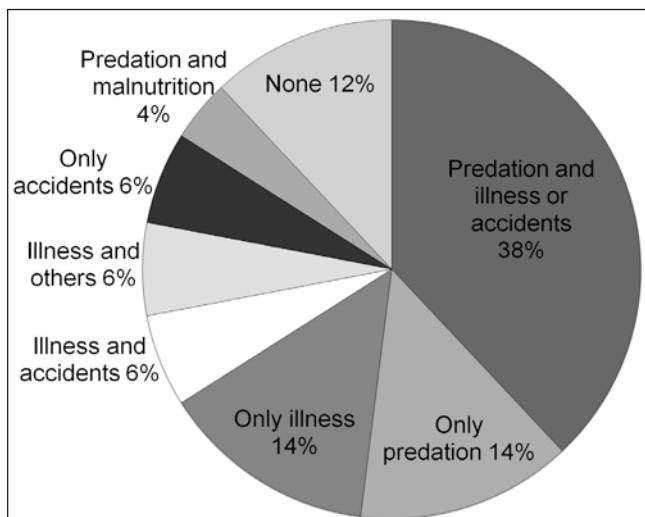


Figure 3. Main causes of livestock mortality reported by ranchers affected by felid attacks ($n = 50$).

1 wounded horse received veterinary care, at a mean cost of \$50 (henceforth, all dollar amounts in U.S. dollars; range = 18 to \$90) as reported by ranchers; seven of the wounded animals (4 cattle, 2 horses, and 1 sheep) survived. All ranchers claimed that wounds easily became infected; some ranchers used chemicals, such as methylene blue (methylthionine chloride), kerosene, and crocodile fat (obtained illegally) to treat animals injured by felids.

We were able to estimate market value for 51 attacked cattle; mean value was \$177 (range 5 to \$854), and cumulative loss for all cattle was \$9,065. Losses of other livestock species could not be standardized, as sales are individually negotiated in local markets.

Ranchers’ perception

Our results showed that 50 ranchers (84%) reported a presence of jaguars on their property, and 36% reported pumas on their properties. Further, 38% of ranchers reported predation by felids along with illness or accidents as the main causes of livestock mortality, and 14% affirmed that predation was the only source of mortality among their livestock (Figure 4).

According to rancher estimates ($n = 51$), mean value of an attacked head of cattle was \$289 (range 17 to \$1,052), and cumulative loss for all cattle resulted in \$14,562. Ranchers estimated losses of \$4,074 and \$769 from felid attacks on horses and the other livestock species, respectively. Mean difference between

perceived and actual market losses were \$110 (CI 95% = \$56) per head of cattle, showing an overestimation of damage ($t_{44} = 3.172, P = 0.003$).

Discussion

Big livestock ranches in Latin American countries can employ diverse strategies to resolve conflicts with felids that often are not affordable by small ranchers (Polisar et al. 2003, Hoogesteijn and Hoogesteijn 2008, Rosas-Rosas and Valdez 2010, Hoogesteijn and Hoogesteijn 2011). For example, replacing or combining cattle with water buffalo has many productive advantages, as buffalo demonstrate defensive behavior against jaguars (Hoogesteijn and Hoogesteijn 2008, Díaz et al. 2009).

In developing countries, livestock systems vary from extensive pastoral productions for subsistence to large-scale industrial productions (McDermott et al. 2010). Various types of management strategies can be adapted to promote conservation and coexistence with predators in Latin America (Hoogesteijn and Hoogesteijn 2011). Management practices should be adjusted to reduce the probability of felid attacks on livestock, including placing animals in sheds at night and moving females that are about to give birth into safer areas (Hoogesteijn et al. 1993, Rosas-Rosas et al. 2008, Hoogesteijn and Hoogesteijn 2011).

We found that felids were more likely to kill horses and cattle that were <1 year old than older individuals; this same pattern was observed in Mexico (Rosas-Rosas et al.



Figure 4. Wounded head of cattle after felid attack.

2008), Brazil (Azevedo 2006), Guatemala (Soto 2008, Soto and Giuliano 2011), and Venezuela (Polisar et al. 2003). Ranchers, having noticed this pattern, are beginning to pen livestock until they reach 1 year of age.

Quantification of losses

Governmental programs need a reference valuation of jaguar and puma damage on domestic animals to design financial strategies for providing incentives for tolerance (e.g., damage compensation, livestock insurances, or payment for environmental services; Casey et al. 2006). Market price of attacked animals should be set as base for incentives. Inskip and Zimmermann (2009) suggested standardizing quantification of economic impact of attacks by felids as a proportion of total holdings by owners to indicate where losses have the greatest financial impact. For example, losses to jaguar predation in Brazil were estimated to be from 0.3 to 5% of total livestock holdings (Jackson and Nowell 1996, Dalponte 2002, Conforti and Azevedo 2003, Palmeira 2004, Palmeira and Barella 2007).

Although our study does not assess significance of economic losses in livestock activity in general, other studies have shown that jaguar and puma predation is usually minor compared to losses caused by theft or sickness (Hoogesteijn et al. 1993, Zacari and Pacheco 2005, Rosas-Rosas et al. 2008). Our study was limited by the memory of interviewees, as they rarely maintain a production record book. New projects in Costa Rica are promoting the use of record books to enable ranchers to make more informed decisions regarding their production and to measure the impact of felids (Amit 2011, Corrales-Gutiérrez and Salom-Pérez 2011).

Veterinary care expenses when domestic animals are injured by an attack are another source of ranchers' intolerance toward felids. Azevedo (2008) reported that 18% of total livestock attacked by jaguars in south Brazil were wounded. Although seldom reported in the literature, wounded animals can have persistent health issues from bite and claw marks lasting from months to several years (Hoogesteijn and Mondolfi 1992, Azevedo 2008).

Ranchers' perception of damage

Both jaguars and pumas occur in the study

area, but more ranchers reported the presence of jaguars. Similarly, Conforti and Azevedo (2003) in Brazil and Bustamante et al. (2011) in southern Costa Rica found that jaguars were frequently blamed for puma predation of livestock. However, ranchers' identification of tracks and predatory evidence often are not reliable (Amit et al. 2009). By teaching ranchers the characteristics of both species, these perceptions could be modified in the future. Proper identification and systematic records of causes of mortality should promote a more accurate perception of felids and injury to livestock caused by felids.

Affected ranchers may have positive or negative attitudes toward felids, depending not only on recent or past economic losses, but also on subjective perceptions (i.e., the same loss may be rated as more or less significant, based on perceptions; Conforti and Azevedo 2003; Zimmermann et al. 2005; Cavalcanti et al. 2010). Ranchers' overestimation of damage in our study probably increased the ranchers' negative attitude toward felids.

Management implications

Thirty-two percent of ranchers interviewed in Costa Rica applied measures to reduce probabilities of attacks by jaguars and pumas (Amit et al. 2009). However, 93% of ranchers indicated that they would be willing to apply such measures in the future (Gordillo-Chávez 2010). In 2010, Amit (2011) used the baseline information of our study and those previous experiences to encourage 14 affected ranchers in northwest Costa Rica to implement preventive measures. Results on reducing attacks from jaguar and pumas are still being monitored, but ranchers' attitude indicators suggest a positive change in attitude toward felids. This initiative takes into account both social and environmental welfare of small-holder livestock systems, and similar projects are following this line (Hoogesteijn and Hoogesteijn 2010, McDermott 2010, Bustamante et al. 2011, Corrales-Gutiérrez and Salom-Pérez 2011).

An up-to-date local and national database on conflicts between felids and humans is necessary to detect patterns and to identify priorities that can help to avoid or minimize damage. In Mexico, a jaguar conservation action program uses standardized data collection

and integral procedures (Secretaría de Medio Ambiente y Recursos Naturales-Comisión Nacional de Áreas Naturales Protegidas 2009). In Honduras, a national conservation plan includes the monitoring of conflicts and the organization of a specialist group to address conflicts (Instituto Nacional de Conservación y Desarrollo Forestal 2011). In Costa Rica, an interinstitutional protocol is being developed to record data about jaguar and puma attacks on domestic animals.

Acknowledgments

We thank the personnel of the Guanacaste, Arenal-Tempisque, Huetar Norte, Tortuguero and Cordillera Volcánica Central Conservation Areas, Las Pumas Rescue Center, and our supporting lodges, Hacienda Guachipelín, Rincón de la Vieja Lodge, Hacienda Borinquen, and Buena Vista Lodge. We thank the Wildlife Without Borders Program of the U.S. Fish and Wildlife Service. We also thank W. Campos, R. Blanco, G. Aguilar, W. Orozco, A. Guevara, M. Cordero, C. Robles, C. Ulate, L. Leonardi, V. Montalvo, L. Fonseca, A. Hernández, and F. Morazán for their help. Finally, we especially acknowledge M. McCoy, K. Rojas, L. Pacheco, and 2 anonymous reviewers of the manuscript.

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