Human–Wildlife Interactions 7(1):77–84, Spring 2013

Jaguar and puma attacks on livestock in Costa Rica

Ronit Amit[1], Instituto Internacional en Conservación de Vida Silvestre, Universidad Nacional, Heredia, Costa Rica *jaguar.rar@gmail.com*

Elias José Gordillo-Chávez, División Académica de Ciencias Biológicas, Universidad Juárez Autónoma de Tabasco, México

Raquel Bone, Escuela de Biología, Universidad de Costa Rica, San José, Costa Rica

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 km^2, 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

[1]Present address: Programa Gente y Fauna, Confraternidad Guanacasteca, Guanacasteca, Costa Rica

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 km^2), Tenorio (128 km^2), Rincón de la Vieja (141 km^2) and Tortuguero (266 km^2) national parks, Miravalles Protected Zone (116 km^2), Caño Negro Wildlife Refuge (101 km^2), and Cordillera Volcánica Central Forest Reserve (133 km^2).

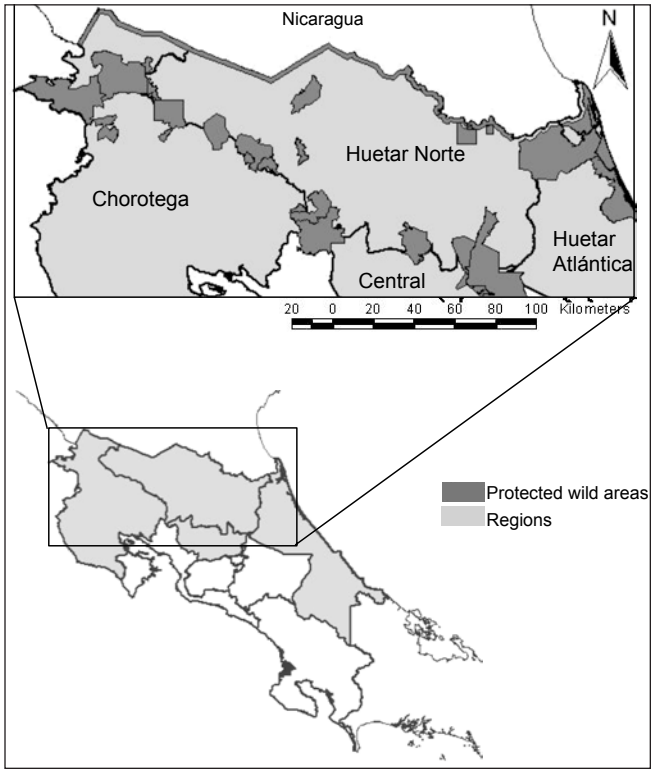

Figure 1. Location of study area, northern Costa Rica.

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 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

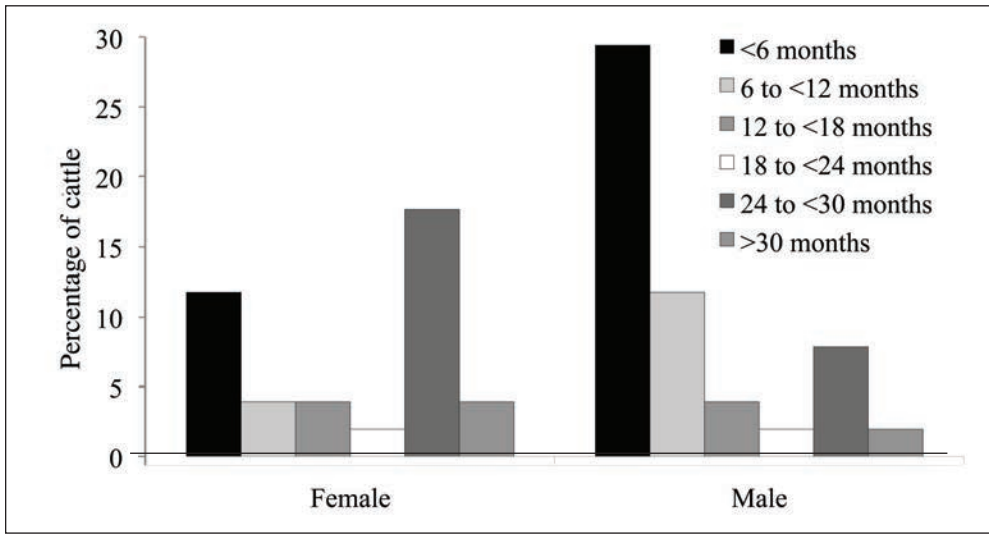

Figure 2. Percentage of attacked head of cattle according to sex and age of cattle in northern Costa Rica (n = 50).

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 km^2 (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

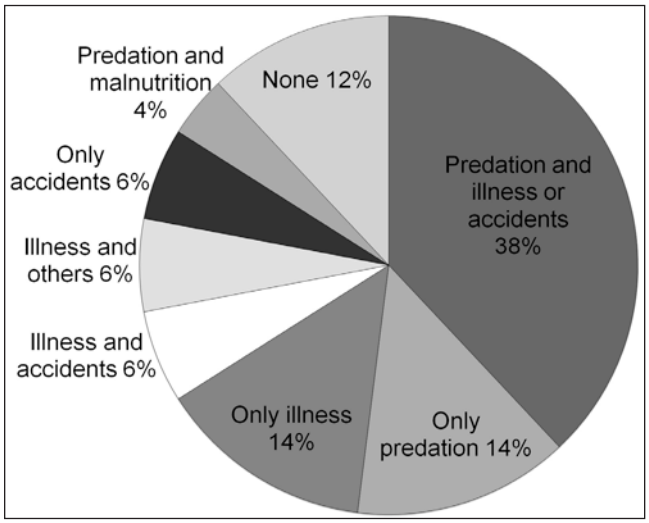

Figure 3. Main causes of livestock mortality reported by ranchers affected by felid attacks (n = 50).

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% = $56) per head of cattle, showing an overestimation of damage ($t44 = 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.

Literature cited

Amit, R. 2011. Proyecto Asistencia Técnica como Incentivo para la conservación de felinos en fincas (technical report). ICOMVIS-UNA, Heredia, Costa Rica.

Amit, R., K. Rojas, L. D. Alfaro, and E. Carrillo. 2009. Conservación de Felinos y sus presas dentro de Fincas Ganaderas. Technical report. Programa Jaguar-ICOMVIS-UNA. Heredia, Costa Rica.

Arronis Díaz, V. 2003. Recomendaciones técnicas sobre sistemas intensivos de producción de carne: estabulación, semiestabulación y suplementación estratégica en pastoreo. MAG, San José, Costa Rica.

Azevedo, F. C. C. 2006. Predation patterns of jaguars (*Panthera onca*) in a seasonally flooded forest in the southern region of Pantanal, Brazil. Dissertation, University of Idaho. Moscow, Idaho, U.S.A.

Azevedo, F. C. C. 2008. Food habits and livestock depredation of sympatric jaguars and pumas in the Iguacu National Park Area, South Brazil. Biotropica 40:494–500.

Azevedo, F. C. C., and D. L. Murray. 2007. Evaluation of potential factors predisposing livestock to predation by jaguars. Journal of Wildlife Management 71:2379–2386.

Berg, S. 1988. Snowball sampling. Pages 529–532 *in* S. Kotz and N. L. Johnson, editors. Encyclopedia of Statistical Sciences, Volume 8. Wiley, New York, New York, USA.

Bustamante, A., R. Moreno, A. Artavia, and C. Boldero. 2011. En busca de soluciones para la sobrevivencia del jaguar en la Península de Osa, Costa Rica. Mesoamericana 15:342.

Casey, F., S. Vickerman, C. Hummon, and B. Taylor. 2006. Incentives for biodiversity conservation: an ecological and economic assessment. Defenders of Wildlife, Washington, D.C., USA.

Cavalcanti, S., S. Marchini, A. Zirnmerrnann, E. M. Gese, and D. W. Macdonald. 2010. Jaguars, livestock and people in Brazil: realities and perceptions behind the conflict. Pages 383–402 *in* D. Macdonald and A. Loveridge, editors. The biology and conservation of wild felids. Oxford University Press, Oxford, United Kingdom.

Conforti, V. A., and F. C. C. de Azevedo. 2003. Local perceptions of jaguars (*Panthera onca*) and pumas (*Puma concolor*) in the Iguacu National Park area, south Brazil. Biological Conservation 111:215–221.

Corporación de Fomento Ganadero. 2000. Censo Ganadero 2000. Corporación de Fomento Ganadero, San José, Costa Rica.

Corrales-Gutiérrez, D. and R. Salom-Pérez. 2011. Reduciendo los conflictos entre el ser humano y grandes felinos en Costa Rica. Memoria del simposio: coexistencia entre grandes carnívoros y el ser humano en América: estado actual y soluciones prácticas. XV Congreso de la Sociedad Mesoamericana para la Biología y la Conservación. Yucatán, México.

Crawshaw, P. G., Jr. 2003. A personal view on the depredation of domestic animals by large cats in Brazil. Natureza Conservacao 1:71–73.

Dalponte, J. C. 2002. Jaguar diet and predation on livestock in the northern Pantanal, Brazil. Pages 209–221 *in* R. A. Medellin, C. B. Chetkiewicz, A. R. Rabinowitz, K. H. Redford, J. Robinson, E. W. Sanderson, and A. B. Taber, editors. El jaguar en el nuevo milenio. Universidad Nacional Autónoma de México/Wildlife Conservation Society, Mexico City, Mexico.

Díaz, C., R. WingChing-Jones, and R. Rosales. 2009. Factibilidad del establecimiento de un

sistema de producción de engorde de búfalos en pastoreo. Agronomía Costarricense 33:183–191.

Escobedo, A. 2011. Influencia del paisaje y del tipo de manejo de fincas ganaderas sobre los ataques de grandes felinos (*Panthera onca* y *Puma concolor*) a animales domésticos en Costa Rica. Thesis, Centro Agronómico Tropical de Investigación y Enseñanza, Turrialba, Costa Rica.

Federación de Subastas Ganaderas. 2010. Precios de venta de bovinos comercializados en subastas. Corporación de Fomento Ganadero, San José, Costa Rica.

Gordillo-Chávez, E. J. 2010. Depredación de ganado por jaguares y pumas en el noroeste de Costa Rica y la percepción de los finqueros hacia el problema. Thesis, Universidad Nacional. Heredia, Costa Rica.

Holdridge, L. R. 1967. Life zone ecology. Tropical Science Center, San José, Costa Rica.

Hoogesteijn, R., and A. Hoogesteijn. 2008. Cattle and water buffalo jaguar-related mortality—could water buffalo facilitate jaguar conservation and cost-effective ranching in the neotropics? Oryx 42:132–138.

Hoogesteijn, A., and R. Hoogesteijn. 2010. Cattle ranching and biodiversity conservation as allies in South America's flooded savannas. Great Plains Research 20:37–50.

Hoogesteijn, R., and A. Hoogesteijn. 2011. Estrategias anti-depredación para fincas ganaderas en Latinoamérica: una guía. Panthera, Gráfica y Editora Microart Ltda., Campo Grande, Brazil.

Hoogesteijn, R., A. Hoogesteijn, and E. Mondolfi. 1993. Jaguar predation vs. conservation: cattle mortality by felines on three ranches in the Venezuelan Llanos. Pages 391–407 *in* N. Dunstone and M. L. Gorman, editors. Mammals as predators: proceedings symposia of the Zoological Society of London. Clarendon, Oxford, United Kingdom.

Hoogesteijn, R., and E. Mondolfi. 1992. El jaguar, tigre Americano. Armitano Publishers, Caracas,Venezuela.

Inskip, C., and A. Zimmerman. 2009. Human–felid conflict: a review of patterns and priorities worldwide. Oryx 43:18–34.

Instituto Meteorológico Nacional. 2008. Atlas climatológico de Costa Rica. Instituto Meteorológico de Costa Rica, <http://www.imn.ac.cr/mapa_clima/interactivo/index.html>. Accessed October 15, 2012.

Instituto Nacional de Conservación y Desarrollo Forestal. 2011. Plan nacional para la conservación del jaguar (*Panthera onca*); promoviendo la convivencia comunidad—jaguar. Departamento de Vida Silvestre/Instituto Nacional de Conservación y Desarrollo Forestal, Áreas protegidas y Vida Silvestre-Proyecto Ecosistemas-Fundación Panthera, Tegucigalpa, Honduras.

Jackson, P., and K. Nowell. 1996. Problems and possible solutions in management of felid predators. Journal of Wildlife Research 1:304–314.

Leite, M. R. P., R. L. P. Boulhosa, F. Galvao, and L. Cullen Jr. 2002. Conservación del jaguar en las áreas protegidas del Bosque Atlántico de la costa de Brasil. Pages 25–42 *in* R. A. Medellin, C. B. Chetkiewicz, A. R. Rabinowitz, K. H. Redford, J. Robinson, E. W. Sanderson, and A. B. Taber, editors. El jaguar en el nuevo milenio. Universidad Nacional Autónoma de México/ Wildlife Conservation Society, Mexico City, Mexico.

McDermott, J. J., S. J. Staal, H. A. Freeman, M. Herrero, and J. A. Van de Steeg. 2010. Sustaining intensification of smallholder livestock systems in the tropics. Livestock Science 130:95–109.

Miller, B., and A. Rabinowitz. 2002. ¿Por qué conservar al jaguar? Pages 303–315 *in* R. A. Medellin, C. B. Chetkiewicz, A. R. Rabinowitz, K. H. Redford, J. Robinson, E. W. Sanderson, and A. B. Taber, editors. El jaguar en el nuevo milenio. Universidad Nacional Autónoma de México/Wildlife Conservation Society, Mexico City, Mexico.

Palmeira, F. B. L. 2004. Predação de bovinos por oncas no notre do estado de Goias. Thesis, Universidade de São Paulo, Brazil, São Paulo, Brazil.

Palmeira, F. B. L., and W. Barrella. 2007. Conflitos causados pela predação de rebanhos domésticos por grandes felinos em communidades quilombolas na Mata Atlântica. Biota Neotropica 7:21–30.

Palmeira, F. B. L., P. G. Crawshaw, C. M. Haddad, K. M. Ferraz, and L. M. Verdade. 2008. Cattle depredation by puma (*Puma concolor*) and jaguar (*Panthera onca*) in central-western Brazil. Biological Conservation 141:118–125.

Polisar, J., I. Maxit, D. Scognamillo, L. Farrell, M. Sunquist, and J. F. Eisenberg. 2003. Jaguars,

pumas, their prey base, and cattle ranching: ecological interpretations of a management problem. Biological Conservation 109:297–310.

Rosas-Rosas, C. O., L. C. Bender, and R. Valdez. 2008. Jaguar and puma predation on cattle calves in northeastern Sonora, Mexico. Rangeland Ecological Management 61:554–560.

Rosas-Rosas, C. O., and R. Valdez. 2010. The role of landowners in jaguar conservation in Sonora, Mexico. Conservation Biology 24:366–371.

Secretaría de Medio Ambiente y Recursos Naturales-Comisión Nacional de Áreas Naturales Protegidas. 2009. Programa de acción para la conservación de la especie: jaguar (*Panthera onca*). Secretaría de Medio Ambiente y Recursos Naturales-Comisión Nacional de Áreas Naturales Protegidas. Gobierno Federal, Mexico City, Mexico.

Soto, J. R. 2008. Patterns and determinants of human–carnivore conflicts in the tropical lowlands of Guatemala. Dissertation, University of Florida, Gainesville, Florida, USA.

Soto, J. R., and W. M. Giuliano. 2011. Predation on livestock by large carnivores in the tropical lowlands of Guatemala. Oryx 45:561–568.

Sokal, R. R., and F. J. Rohlf. 1995. Biometry. Freeman and Company, New York, New York, USA.

Thirgood, S., R. Woodroffe, and A. Rabinowitz. 2005. The impact of human–wildlife conflict on human lives and livelihoods. Pages 13–26 *in* R. Woodroffe, S. Thirgood, and A. Rabinowitz, editors. People and wildlife, conflict or coexistence? Cambridge University Press, Cambridge, United Kingdom.

Zacari, M. A., and L. F. Pacheco. 2005. Predation vs. disease problems as mortality causes for camelid livestock in Sajama National Park. Ecología en Bolivia 40:58–61.

Zimmermann, A., M. J. Walpole, and N. Leader-Williams. 2005. Cattle ranchers' attitudes to conflicts with jaguar *Panthera onca* in the Pantanal of Brazil. Oryx 39:406–412.

Ronit Amit is a biologist specializing in wildlife management and conservation and is currently enrolled in the Wildlife Ecology and Conservation doctoral program at the University of Florida. Her emphasis is on human dimensions of wildlife conservation, focusing in human–felid coexistence through integral strategies of technical assistance and community involvement.

Elias José Gordillo-Chávez studied ecology at the Universidad Juarez Autónoma de Tabasco of Mexico and received a M.Sc. degree in wildlife conservation and management at the International Institute on Wildlife Management and Conservation of Universidad Nacional de Costa Rica. He worked on interactions between jaguars and ranchers in Costa Rica. Currently, he is working at the Universidad Juarez Autónoma de Tabasco in Mexico as a researcher monitoring wildlife for delimitation of biological corridors in Mexico and road ecology.

Raquel Bone recently received her B.Sc. degree in biology at the University of Costa Rica, where she continues her studies. She has worked in conservation programs for coexistence with wild mammals, especially big cats and bats of Costa Rica. She has also worked in environmental education with children. Her interests are investigation of ecological aspects of mammals and their interactions in the ecosystem and finding ways of coexistence without conflict.