Human–sun bear conflicts in East Kalimantan, Indonesian Borneo

Gabriella Fredriksson[1]

Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam
Mauritskade 61, 1090 GT Amsterdam, Netherlands

Abstract: Interviews with farmers (1998–2000) in 5 communities along the edge of the Sungai Wain Protection Forest, East Kalimantan, Indonesian Borneo, indicated that crop damage caused by sun bears (*Helarctos malayanus*) was higher than normal following the 1997–98 El Niño Southern Oscillation Event. Widespread drought and forest fires reduced habitat and fruit availability for sun bears on the islands of Borneo and Sumatra. The main source of antagonism toward bears resulted from the damage they caused to stands of old coconut trees, which frequently killed the trees. This prompted farmers to seek removal of the bears. Bear damage to annual crops generally spurred a less hostile reaction. Experiments with metal sheeting affixed to the trunks of coconut trees to deter climbing by bears were successful, at least in the short term (<3 years). Inexpensive and easily applicable crop-protection devices such as this could help protect sun bears in the future, as increased human–bear conflicts are anticipated due to rapid human population growth, unabated forest destruction and fragmentation, and increased susceptibility of remaining forests to fires.

Key words: coconut, crop damage, *Helarctos malayanus*, Indonesia, Kalimantan, sun bear, tree protection

Ursus 16(1):130–137 (2005)

Most species of bears are opportunistic omnivores that may be considered pests when attracted to human-related foods. North American bears (grizzly bears *Ursus arctos* and American black bears *U. americanus*) are known to use apiaries, crops, orchard fruits, garbage, and livestock for food (Ambrose and Sanders 1978, Knight and Judd 1983, Garshelis et al. 1999). They also may afflict considerable damage to timber stands (Stewart et al. 1999). In Japan, Asiatic black bears (*U. thibetanus*) raid crops, orchards, and fish farms (Huygens and Hayashi 1999). Sloth bears (*Melursus ursinus*) have been reported to damage sugarcane and groundnut plantations (Iswariah 1984). Andean bears (*Tremarctos ornatus*) in South America have been reported to predate on livestock (Goldstein 2002). Until a few decades ago bounties were commonly used as a means of reducing or eliminating bears to protect crops or livestock (Azuma and Torii 1980, Swenson et al. 1994, Mattson and Merrill 2002).

In Southeast Asia, sun bears (*Helarctos malayanus*) probably commenced crop-raiding when attractive foods were first planted close to forest habitat. Early reports from colonialists in Indonesia described ways of deterring or killing marauding bears in fruit plantations (O-Viri 1925), even when adjacent forest habitat was still extensive. In recent years, the combined effects of timber harvesting and forest fires have significantly reduced forest coverage in Kalimantan (Curran et al. 2004, Fuller et al. 2004). Increased human encroachment on Indonesian forests has led to increased human–wildlife conflicts (Meijaard 1999, Rijksen and Meijaard 1999), although little information is available on conflicts specifically with sun bears.

On the islands of Borneo and Sumatra, sun bear habitat has recently been severely reduced or damaged by forest fires linked to the 1997–98 El Niño Southern Oscillation (ENSO) event. Approximately 5.2 million ha of land, of which 2.6 million ha were forest, were burned in 4 months in the province of East Kalimantan alone (Siegert et al. 2001). Sun bear fruit resources (mainly tree-borne fruits) declined significantly in burned forests, with tree mortality (≥10 cm dbh) reaching >90% in certain areas (van Nieuwstadt 2002, G. Fredriksson, unpublished data). Insects, an alternative bear food (Wong et al. 2002), were also reduced significantly (G. Fredriksson,

[1]gmfred@indo.net.id

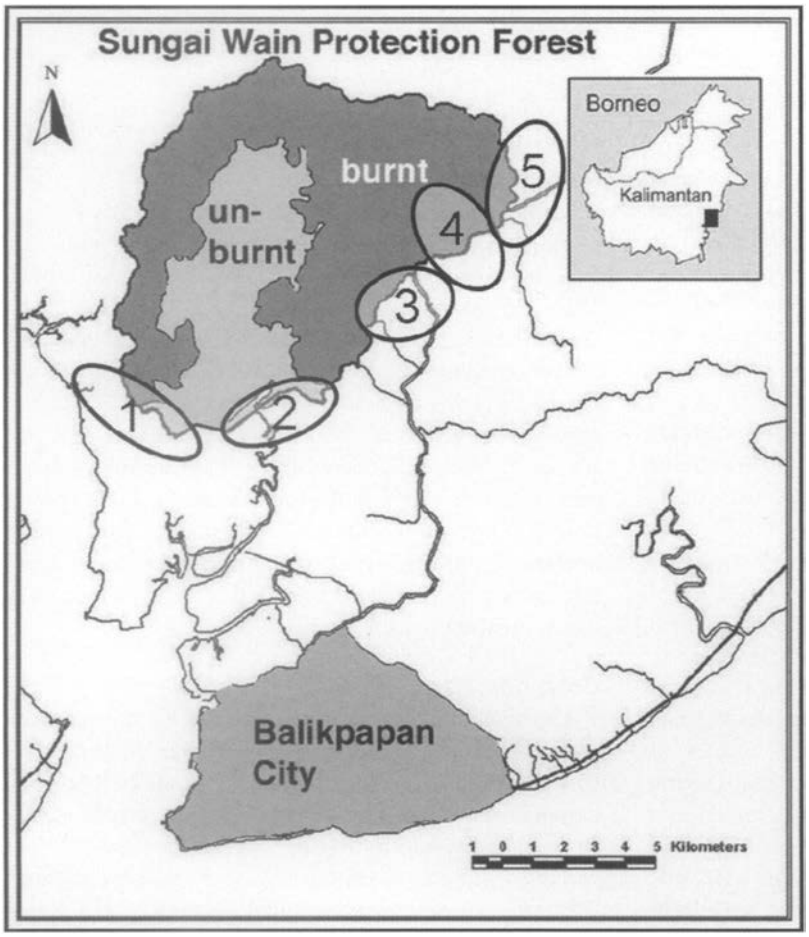

Fig. 1. Five farming communities adjacent to the Sungai Wain Protection Forest, East Kalimantan, Indonesia, surveyed for sun bear damage, 1990–2000.

unpublished data). Suitable sun bear habitat in these fire-affected areas has become progressively fragmented, increasing the chances of edge-related conflict with humans (Woodroffe and Ginsberg 1998).

Although some fruits (e.g. *Ficus* spp.) are generally available year-round, abundant fruiting in forests in this region occurs at intervals of about 2–10 years (Medway 1972, Ashton et al. 1988, Curran and Leigthon 2000). After the large-scale forest fires in 1997–98, a widespread fruiting failure prevailed for more than one year. The combination of rapid loss of habitat as well as interannual shortages of food may increasingly compel sun bears to seek nearby human food sources, especially crops planted along the forest edge.

The objectives of this study were: (1) to determine type and extent of crop damage caused by sun bears; (2) to assess reactions of farmers to different types of bear-related crop damage; and (3) to find ways of alleviating the most disturbing types of sun bear damage.

Study area

The study was carried out in 5 farming communities along the southern and eastern periphery of the Sungai Wain Protection Forest (SWPF), near Balikpapan, East Kalimantan, Indonesian Borneo (1°16′S and 116°54′E; Fig. 1). The reserve covers a lowland dipterocarp forest water catchment area of approximately 10,000 ha.

Forest fires entered the SWPF in early March 1998, initially from a neighboring state-owned logging concession, but subsequently from surrounding agricultural fields, affecting some 60% of the reserve. After the fires in 1998, connections to forest areas north and west of the reserve were significantly reduced. To the south and east the reserve is bordered by agricultural plots, unproductive grassland, and shrublands. At the time this study commenced, the SWPF consisted of approximately 40 km^2 of primary forest and 40 km^2 of regenerating burned forest; 20 km^2 was affected by human encroachment (Fredriksson 2002).

Methods

Interviews

Informal household interviews were conducted in 5 farming communities around the SWPF (Fig. 1) to compile information on sun bear damage to crops and orchards. Interviews were initiated just after the 1998 fires and continued in 1999 and 2000. Each year, my assistants and I interviewed 99 farmers representing 40% of the 246 families in these communities. The number of farmers interviewed in each community was proportional to the number of inhabitants in that community. We attempted to carry out the same number of interviews annually in each community, though the identity of interviewees differed slightly over the years. We focused on farmers who had lived in the area at least 5 years before the fires and those who frequently visited or worked in their gardens, as opposed to landowners who visit their

orchards on an irregular basis. Because our selection of farmers for interviewing was not random, we cannot be sure that inadvertent biases did not arise. In one community all families relied on farming for their income; in the remaining 4 communities approximately 80% of families did. We posed questions regarding ethnic origin of farmers, farming history, farming practices, types and amount of crops grown, and location of the farm in relation to the forest edge. Information on crop damage was recorded through interviews with as much detail as possible, including species and quantity of crops fed upon, number of trees damaged and type of damage, frequency of bear visits, bear crop raiding behavior, damage to crops by other wildlife species, and methods used to reduce wildlife-related crop damage. Whenever possible we directly observed crop damage in the gardens.

Damage mitigation trials

We attempted to reduce sun bear consumption of farmer's fruits through conditioned taste aversion with thiabendazole (TBZ). TBZ-induced conditioned taste aversion has been used to reduce consumption of human-related foods and livestock by American black bears (Ternent and Garshelis 1999) and several species of canids (Gustavson et al. 1983). TBZ powder (Sigma Chemical, Saint Louis, Missouri, USA) was mixed into samples of ripe fruit (14–23 mg TBZ/g food) that were targeted by sun bears in gardens or orchards. TBZ was mixed thoroughly in the soft, ripe pulp of breadfruit, pineapple, and papaya. Diluted TBZ, as opposed to TBZ powder, was injected into snakefruit because it has a hard mesocarp. Treated fruits were placed where farmers indicated that sun bears had entered their gardens recently.

We attempted to inhibit sun bears from climbing and damaging coconut palms by nailing smooth metal sheeting around the tree trunks, between the heights of 0.5–1 m from the base extending 2–3 m up the trunk. Two types of metal sheeting were used: new zinc sheets and recycled metal sheets produced from old food containers. The price of the latter was 50% less/m^2 than zinc plates. In one garden all remaining undamaged coconut trees (n = 15) were protected with metal sheeting. In 5 gardens that had been repeatedly targeted by sun bears, 2–4 coconut trees were protected with metal sheeting interspersed among unprotected palm trees. Because one of the aims was to test an inexpensive method to discourage sun bears from damaging trees, farmers were involved in placing the metal sheeting. During subsequent interviews, we evaluated success of the metal sheeting in deterring bears from climbing as well as condition of the sheeting. Unprotected coconut trees growing near protected trees ($n \approx 75$) were monitored simultaneously.

Results

Farmer profiles and practices

Most interviewed farmers near the SWPF were immigrants from other islands (Sulawesi, Java), with only 18% originating from Borneo (Dayak or Pasir tribes). The average size of gardens, owned or leased, was 2.6 ha (SD = 0.4). Farmers had lived in the area on average for 20 years (SD = 7). Mixed orchards (43%), snakefruit plantations (24%), bananas (8%), vegetables (7%, such as cassava, beans [Fabaceae], spinach [Basellaceae]), rice (Poaceae, 7%) and coconut trees (Palmae, 6%), constituted the main crops in the area. Snakefruit is a continuously fruiting low-growing palm species, and several tree species in the mixed orchards also produced fruits throughout the year, even though their wild congeners in the forest were more seasonal.

Crop damage

The main wildlife species reported to raid gardens throughout the study period were bearded pigs (*Sus barbatus*, 98% of gardens), followed by sun bears (43%), barking deer (*Muntiacus* spp., 42%), civets (20%, [Viverridae]), squirrels (12%, [Sciuridae]), and other species, including macaques [*Macaca* spp.] and pythons [*Python reticulatus*] (raiding chicken coops). Nearly one-quarter (22%) of farmers reported that sun bears raided their gardens before the 1997–98 forest fires and fruiting failure. This increased to over half (56%) in 1998 and 1999, the first 2 post-fire years, and declined to 39% in 2000.

Sun bears most often damaged coconut trees (36%), followed by snakefruit (32%) and a variety of fruits in mixed orchards (breadfruit [Moraceae] 12%; durian [Bombacaceae] 8%; rambutan [Sapindaceae] 8%; mango [Anacardiaceae] 4%). Damage to coconut trees was particularly disliked by farmers because sun bears fed primarily on the growth shoot (palmite), frequently killing >20 year-old fruit-bearing trees (Fig. 2). Only on rare occasions did sun bears feed on the coconut fruits. Farmers had less antagonism toward bears that fed on ripe fruits from orchards or snakefruit, because trees or snakefruit palms were rarely damaged and usually only a small portion of the crop was consumed by bears. The only account of attempted livestock depredation involved a sun bear trying to break into a chicken coop.

Farmers generally considered financial losses related to sun bear damage to be low and few farmers felt that

Fig. 2. Coconut palm tree damaged (and probably killed) by a sun bear in a garden adjacent to the Sungai Wain Protection Forest, East Kalimantan, Indonesia 1998 (photo courtesy D. & J. Garshelis).

financial compensation was justified. Moreover, no active wildlife authority existed in the district to whom farmers could forward complaints or damage claims. In a few cases, where entire coconut stands had been killed by bears or when a large portion of a small stand of snakefruit had been consumed by a bear, farmers asked our survey team for compensation or removal of the bear.

Mitigation practices and trials

Most farmers (57%) used dogs to guard their gardens, followed by small wooden fences (32%), and regular nocturnal check-ups of their gardens (6%). None of these were efficient in keeping sun bears out. Poisoned fruit baits were put out by a small number of farmers. Although these poisoned baits were primarily targeted against bearded pigs, a variety of wildlife could be killed by this. Some farmers surrounded their garden with wire neck snares, mainly for pigs and barking deer, but a few also put out locally made foot snares designed to capture bears. Two farmers indicated that they had looked into hiring a hunter who could spear a bear climbing down from a coconut tree. Only 2 farmers admitted to killing bears before this study period, but this type of information was difficult to obtain during interviews, as such killing is illegal and farmers may have feared prosecution.

Sun bears did not consume any of the 15 TBZ-treated fruit samples that we placed in gardens in an attempt to create conditioned taste aversions toward garden fruits. None of the ~30 coconut trees that we protected with metal sheeting were subsequently climbed by bears. Several unprotected trees ($n = 27$) growing near protected trees were damaged by bears. An additional small number of coconut trees were covered with metal sheeting by farmers, and none of these were subsequently climbed by bears during the study.

Sun bear crop-raiding behavior

All farmers who reported sun bear visits to their gardens stated that sun bears entered their gardens during the night. Frequently, sun bears built nests in small orchard trees, usually close to the main trunk, 2–5 m from the ground. These nests were created by bears breaking surrounding branches toward them and constructing a 'V' shaped structure (in contrast to flat platforms usually out on limbs constructed by orangutans [*Pongo pygmaeus*], which also live in the surrounding forest). These nests appeared to function as resting platforms rather than feeding platforms, which were occasionally encountered in fruiting trees within the forest. Such nests in orchards possibly provide some security, because they are off the ground and offer a wider olfactory 'view' to detect approaching humans or dogs. Bears probably left these nests before daybreak as no farmer reported seeing bears in the morning.

Discussion

Main causes for human–carnivore conflicts concern the perceived risk of predation on humans and livestock (Sillero-Zubiri and Laurenson 2001, Treves and Karanth

2003). In places where bears are feared and hated, it is generally for either or both of these reasons (polar bear [*Ursus maritimus*], Gjertz and Persen 1987; brown bear and American black bear, Herrero 1985; sloth bear, Rajpurohit and Krausman 2000; Asiatic black bear, Chauhan 2003; Andean bear, Goldstein 2002). No reliable reports of sun bears killing humans or livestock were found in the literature or discovered during this study. Hence, there has been little negative publicity regarding this species. During this study, however, some farmers found them to be troublesome pests, especially in the 2 years after the fires and during the subsequent fruiting failure in the neighboring forest.

Although bearded pigs were the main agricultural pest in the gardens around the SWPF, farmers were less antagonistic toward this species than toward sun bears. This was because bearded pigs primarily targeted annual crops (corn, cassava, pineapples), whereas bears frequently killed productive coconut trees by feeding on the palmite. If bears had only eaten the coconuts, the effect would have been much less detrimental, and even could have been beneficial, to fruit production (Siex and Struhsaker 1999).

Few recent reports have been written about sun bear crop raiding. Fetherstonhaugh (1940:21) reported that "the Malayan sun bear is an inoffensive jungle dweller and unlike some species, conflicts very little with human activities when it comes in contact with cultivation, the glaring exception being coconuts to which the bears are a positive menace ... but there is nothing to fear from their presence near other forms of cultivation". O-Viri (1925), on the other hand, described at length how sun bears devastated coconut plantations where they fed on the palmite and damaged papaya plantations, sugarcane, pineapple, and fruit orchards. Several Dutch colonial sources mention damage in plantations due to sun bear depredations, especially to coconut stands (van Balen 1914, Feuilletau-de Bruyn 1933, Nederlandsch-Indische Vereeniging 1939). In other parts of Borneo and Sumatra, sun bears have been reported to enter sugarcane fields (L. Nyagang, local resident, Long Apari, East Kalimantan, Indonesia, personal communication, 2001), and more recently to feed on fruits in oil palm plantations (Nomura 2003; T. Maddox, Zoological Society of London, Jambi, Sumatra, Indonesia, personal communication, 2001).

Sun bears were frequently killed by colonial plantation owners at the turn of the twentieth century by various means, the most effective being shooting bears when they climb down a fruit tree. Poisons, primarily phosphor, were used to kill nuisance pigs in those days, and although meant to target sun bears as well, these were rarely effective (O-Viri 1925). TBZ trials attempted during this study were unsuccessful, possibly because of the availability of untreated fruits in gardens or due to human or chemical scent residues on treated fruits which repelled the bears.

Reducing availability of crops near forested areas is likely to be the most effective means of mitigating human–wildlife conflicts. Naughton-Treves et al. (1998) recommended that, in general, crops attractive to wildlife should be planted >500 m from the forest edge and that non-palatable plants should be planted between the forest and human agricultural fields. This recommendation is not be feasible around Sungai Wain, where >250 farmers would need to be translocated and their fields replaced with unpalatable vegetation. High human population densities and the complicating factors linked to land-ownership and compensation issues obstruct these mitigation options in the Indonesian context.

Electric fencing has been an effective deterrent against damage to agricultural crops and apiaries in North America and Japan (Jonker et al. 1998, Garshelis et al. 1999, Huygens and Hayashi 1999). We did not experiment with electric fences, as this type of mitigation was not deemed applicable for small-scale private farmers in Indonesia. Farmers in Borneo or Sumatra would not have funds or easy access to the necessary materials. This method should be tested in the future as it could potentially mitigate sun bear–human conflicts near protected areas or commercial plantations.

Compensation for financial losses due to bear depredation has been used on private lands in North America and Europe (Cozza et al. 1996, Wagner et al. 1997). Although popular with the public, compensation does not address the source of the problem (Witmer and Whittaker 2001). In some cases translocation or removal of the nuisance bears has been used (Azuma and Torii 1980, Garshelis 1989). Neither of these mitigation procedures would currently apply to the Indonesian context as forest conservation and wildlife management have not reached a sufficient level of attention or public support.

Increased human–wildlife conflicts in Indonesia are likely linked to the rapid reduction of forest habitats. We noticed a sharp increase in conflicts with bears shortly after much of the adjacent forest burned, coincident with a fruiting failure. Despite the increased problems that this caused, no government officials assisted local farmers with wildlife conflicts. This led local farmers to feel that they had no choice but to attempt killing nuisance animals themselves, even though this was prohibited by law. Often farmers requested help from

Fig. 3. Balikpapan district logo, East Kalimantan, Indonesia, featuring the sun bear as its new mascot.

our research team, and we helped them develop non-lethal means of protecting their crops.

Metal sheeting placed around the trunks of large coconut trees functioned well to deter sun bears from climbing up to the growth shoot. These metal sheets can be obtained locally, at a low cost, and are easily installed. The sheeting will likely need to be replaced every 3–4 years, as it deteriorates quickly due to high humidity, but this appears manageable to these farmers. This method is likely to become more widespread as its effectiveness becomes known, and this process could be hastened through conservation education programs.

During this study conservation education programs were initiated targeting schools, local communities, and local government agencies, focusing on forest functions and the role of wildlife. These programs slowly brought about a local change in attitude toward forest conservation and sun bears. In 2001 the sun bear was chosen by the local government via a public poll to become the official logo and mascot of the Balikpapan district where this study was carried out (each district in Indonesia has a native species as its logo, which is also used as a mascot to represent the district on postage stamps, for local sports teams, and at public events). The selection of the sun bear as the official logo and mascot (Fig. 3) seemed to instill a sense of pride and ownership in the species.

In addition, a multi-stakeholder management body was established for management of the reserve, fully funded by the local government, where the issue of human–wildlife conflicts has finally received a place on the management agenda. It still remains to be seen, though, whether this slow attitude change toward bears and forest conservation will translate into behavioral changes and tolerance of low-level agricultural losses related to crop raiding, associated with living and farming at a forest edge.

Acknowledgments

I am grateful to the Indonesian Institute of Sciences (LIPI) for permitting me to do field research on sun bears, as well as to the Forest Research Institute (BPK-Samarinda) for their research invitation and support. I thank my field assistants L. Nyagang, Trisno, Rachman, Agusdin, Babam and Iman from Sungai Wain, and students Whiwien, Eko, Joned, and Ali from the Mulawarman University, Samarinda, for their assistance with the surveys. Financial support for field work was received from the Tropenbos Foundation. D. Garshelis provided ongoing logistical and technical support for the study, provided useful comments on an earlier draft of the manuscript, as well as the TBZ for the taste-aversion trials. S.B.J. Menken, V. Nijman, and M. Lammertink, O. Huygens and E. Meijaard are also thanked for useful comments on earlier drafts of this paper.

Literature cited

AMBROSE, J.T., AND O.T. SANDERS. 1978. Magnitude of black bear depredation on apiaries in North Carolina. Proceedings of the Eastern Black Bear Workshop 4:167–177.

ASHTON, P.S., T.J. GIVNISH, AND S. APPANAH. 1988. Staggered flowering in the Dipterocarpaceae—New insights into floral induction and the evolution of mast fruiting in the aseasonal tropics. American Naturalist 132:44–66.

AZUMA, S., AND H. TORII. 1980. Impact of human activities on survival of the Japanese black bear. International Conference on Bear Research and Management 4:171–179.

CHAUHAN, N.P.S. 2003. Human casualties and livestock depredation by black and brown bears in the Indian Himalaya, 1989–98. Ursus 14:84–87.

COZZA, K., R. FICO, M.L. BATTISTINI, AND E. ROGERS. 1996. The damage–conservation interface illustrated by predation

on domestic livestock in central Italy. Biological Conservation 78:329–336.

CURRAN, L.M., AND M. LEIGHTON. 2000. Vertebrate responses to spatiotemporal variation in seed production of mast-fruiting dipterocarpaceae. Ecological Monographs 70:101–128.

———, S.N. TRIGG, A.K. MCDONALD, D. ASTIANTI, Y.M. HARDIONO, P. SIREGAR, I. CANIAGO, AND E. KASISCHKE. 2004. Lowland forest loss in protected areas of Indonesian Borneo. Science 303:1000–1003.

FETHERSTONHAUGH, A.H. 1940. Some notes on Malayan bears. The Malayan Nature Journal 1:15–22.

FEUILLETAU-DE BRUYN, W.K.H. 1933. Bijdrage tot de kennis van de afdeeling Hoeloe Soengei (Z. en O.- afdeeling Borneo). Koloniale Studiën 17:53–93, 183–211. (In Dutch.)

FREDRIKSSON, G.M. 2002. Extinguishing the 1998 forest fires and subsequent coal fires in the Sungai Wain Protection Forest, East Kalimantan, Indonesia. Pages 74–81 *in* P. Moore, D. Ganz, L.C. Tan, T. Enters, and P.B. Durst, editors. Communities in flames: proceedings of an international conference on community involvement in fire management. Food and Agricultural Organization and FireFight SE Asia, Bangkok, Thailand.

FULLER, D.O., T.C. JESSUP, AND A. SALIM. 2004. Loss of forest cover in Kalimantan, Indonesia, since the 1997–1998 El Niño. Conservation Biology 18:249–254.

GARSHELIS, D.L. 1989. Nuisance bear activity and management in Minnesota. Pages 169–180 *in* M. Bromley, editor. Bear–people conflicts: Proceedings of a symposium on management strategies. Northwest Territories Department of Renewable Resources, Yellowknife, Northwest Territories, Canada.

———, R.S. SIKES, D.E. ANDERSEN, AND E.C. BIRNEY. 1999. Landowners' perceptions of crop damage and management practices related to black bears in east-central Minnesota. Ursus 11:219–224.

GJERTZ, I., AND E. PERSEN. 1987. Confrontations between humans and polar bears in Svalbard (Norway). Polar Research 5:253–256.

GOLDSTEIN, I. 2002. Andean bear–cattle interactions and tree nest use in Bolivia and Venezuela. Ursus 13:369–372.

GUSTAVSON, C.R., J.C. GUSTAVSON, AND G.A. HOLZER. 1983. Thiabendazole-based taste aversion in dingoes (*Canis familiaris dingo*) and New Guinea wild dogs (*Canis familiaris hallstromi*). Applied Animal Ethology 10: 385–388.

HERRERO, S. 1985. Bear attacks: Their causes and avoidance. Nick Lyons Books, New York, USA.

HUYGENS, O.C., AND H. HAYASHI. 1999. Using electric fences to reduce Asiatic black bear depredation in Nagano prefecture, central Japan. Wildlife Society Bulletin 27:959–964.

ISWARIAH, V. 1984. Status survey report and recommendations for conservation of the sloth bear in Ramnagaram Taluk, Karnataka. World Wildlife Fund-India, Bangalore, India.

JONKER, S.A., J.A. PARKHURST, R. FIELD, AND T.K. FULLER. 1998. Black bear depredation on agricultural commodities in Massachusetts. Wildlife Society Bulletin 26:318–324.

KNIGHT, R.R., AND S.L. JUDD. 1983. Grizzly bears that kill livestock. International Conference on Bear Research and Management 5:186–190.

MATTSON, D.J., AND T. MERRILL. 2002. Extirpation of grizzly bears in the contiguous United States, 1850–2000. Conservation Biology 16:1123–1136.

MEDWAY, L. 1972. Phenology of a tropical rain forest in Malaya. Biological Journal of the Linnean Society 4:117–146.

MEIJAARD, E. 1999. Human-imposed threats to sun bears in Borneo. Ursus 11:185–192.

NAUGHTON-TREVES, L., A. TREVES, C. CHAPMAN, AND R. WRANGHAM. 1998. Temporal patterns of crop-raiding by primates: linking food availability in croplands and adjacent forest. Journal of Applied Ecology 35:596–606.

NEDERLANDSCH-INDISCHE VEREENIGING TOT NATUURBESCHERMING. 1939. Natuur in Zuid- en Oost-Borneo. Pages 334–411 *in* Fauna, flora en natuurbescherming in de Zuider- en Ooster-Afdeeling van Borneo. 3 Jaren Indisch natuur leven. Opstellen over landschappen, dieren en planten. Elfde verslag (1936–1938), Batavia, Indonesia. (In Dutch.)

NOMURA F. 2003. Seasonal trends of habitat usage in two ursine species, a destructive beast *Ursus arctos yesoensis* and an agricultural pest *Helarctos malayanus*. PhD Thesis, University of Hokkaido, Sapporo, Japan.

O-VIRI. 1925. Tusschen de beren. de Tropische Natuur XIV: 81–88. (In Dutch.)

RAJPUROHIT, K.S., AND P.R. KRAUSMAN. 2000. Human–sloth bear conflicts in Madhya Pradesh, India. Wildlife Society Bulletin 28:393–399.

RIJKSEN, H.D., AND E. MEIJAARD. 1999. Our vanishing relative. The status of orangutans at the close of the century. Tropenbos, Kluwer Academic Publishers, London, UK.

SIEGERT, F., G. RUECKER, A. HINRICHS, AND A.A. HOFFMANN. 2001. Increased damage from fires in logged forests during droughts caused by El Niño. Nature 414:437–440.

SIEX, K.S., AND T.T. STRUHSAKER. 1999. Colobus monkeys and coconuts: a study of perceived human–wildlife conflicts. Journal of Applied Ecology 36:1009–1020.

SILLERO-ZUBIRI, C., AND K. LAURENSON. 2001. Interactions between carnivores and local communities: conflict or coexistence? Pages 282–312 *in* J.L. Gittleman, S.M. Funk, D.W. MacDonald, and R.K. Wayne, editors. Carnivore conservation. University of Cambridge Press, Cambridge, UK.

STEWART, W.B., G.W. WITMER, AND G.M. KOEHLER. 1999. Black bear damage to forest stands in Western Washington. Western Journal of Applied Forestry 14:128–131.

SWENSON, J.E., F. SANDEGREN, A. BJARVALL, A. SODERBERG, P. WABAKKEN, AND R. FRANZEN. 1994. Size, trend, distribution and conservation of the brown bear *Ursus arctos* population in Sweden. Biological Conservation 70:9–17.

TERNENT, M.A., AND D.L. GARSHELIS. 1999. Taste-aversion conditioning to reduce nuisance activity by black bears in

a Minnesota military reservation. Wildlife Society Bulletin 27:720–728.

TREVES, A., AND K.U. KARANTH. 2003. Human–carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology 17:1491–1499.

VAN BALEN, J.H. 1914. De dierenwereld van Insulinde in woord en beeld. I. De Zoogdieren. W.J. Thieme and Cie, Zutphen, the Netherlands. (In Dutch.)

VAN NIEUWSTADT, M.G.L. 2002. Trial by fire-postfire development of a dipterocarp forest. PhD Thesis, University of Utrecht, Utrecht, Netherlands.

WAGNER, K.K., R.H. SCHMIDT, AND M.R. CONOVER. 1997. Compensation programs for wildlife damage in North America. Wildlife Society Bulletin 25:312–319.

WITMER, G.W., AND D.G. WHITTAKER. 2001. Dealing with nuisance and depredating black bears. Proceedings of the Western Black Bear Workshop 7:73–82.

WONG, S.T., C. SERVHEEN, AND L. AMBU. 2002. Food habits of Malayan sun bears in lowland tropical forests of Borneo. Ursus 13:127–136.

WOODROFFE, R., AND J.R. GINSBERG. 1998. Edge effects and the extinction of populations inside protected areas. Science 280:2126–2128.

Received: 21 April 2004
Accepted: 23 December 2004
Associate Editor: C. McLaughlin