The harmful effects of illegal hunting

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For export: 183,000 jaguars (*on facing page*) and 804,000 ocelots (*at left*) and margays were killed by hunters in Amazonia during the 20th century; below, pelts on display at a tannery in Manaus during the 1950s

PHOTOS **1** PAUMARI INDIGENOUS PEOPLE, ANDRÉ P. ANTUNES AND EDUARDO VON MÜHLEN **2** MILENE THYSSEN / WIKIPEDIA **3** IBGE VIRTUAL LIBRARY

Banned in Brazil since the 1960s, hunting has reduced the populations of several animal species and increased the risk of environmental imbalance

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The period between 1930 and 1960 is called a "fantasy era" in many parts of Amazonia. "Fantasy" refers to the felid furs exported to the American and European fashion markets. The sale of hides of only the most heavily exploited species—which included alligators, manatees, deer, peccaries, capybaras and giant otters—generated approximately US$500 million (at current value) during the commercial peak of such trading. Between 1904 and 1969, approximately 23 million wild animals from at least 20 species were killed to supply the consumer market for hides and furs. These data, presented in a paper published in *Science Advances* in October 2016, cover only what occurred in the Brazilian states of Rondônia, Acre, Roraima and Amazonas.

Biologist André Antunes, the paper's lead author, calculated the number of animals killed during the period by combining the data available at commercial and port registries with cargo manifests—detailed lists of materials transported by ships that sailed from interior regions of the Amazon regions to the port of Manaus.

Using the data he gathered during his doctoral studies at the National Institute for Research on the Amazon (INPA), Antunes collaborated with other researchers from Brazil, New Zealand, England and the United States to reconstruct the history of the hide trade in Western Amazonia during much of the 20th century. Thus, he and his collaborators were able to get a clearer picture of the impact of such trade on the populations of the most widely hunted species.

Easy prey: capybaras and collared peccaries, usually found in small bands, (*at right*) are among the most widely hunted animals in Amazonia

"Most of the records have been lost," notes the biologist, who is now a researcher for the Wildlife Conservation Society, a nongovernmental organization that focuses on conservation of fauna in the Amazon and other regions of the world. "Fortunately, the remaining data are very detailed." In some cases, however, the documents did not indicate which animals the transported hides were sourced from. In other instances, they only stated the weight of the material and, for certain periods, information is inexistent. These gaps in the records required the use of computer modeling so that the researchers could estimate the number of hides from each species sold during that period, based on general trends and statistical probability.

The period from 1930 to 1960 is called a "fantasy era" in Amazonia

According to the researchers' calculations, in little over 60 years, at least 13.9 million terrestrial mammals of six species were harvested in the Amazon: collared peccary (*Pecari tajacu*), red brocket deer (*Mazama americana*), white-lipped peccary (*Tayassu pecari*), ocelot (*Leopardus pardalis*), margay (*Leopardus wiedii*) and jaguar (*Panthera onca*). Of these six species, the collared peccary appears to have been the preferred target, perhaps because of their greater abundance: 5.4 million collared peccaries were killed between 1904 and 1969. During the same period, hunters killed 804,000 ocelots and margays, as well as 183,000 jaguars, which are the largest feline in the Americas. Nearly 8,000 jaguars were killed in 1969, two years after such hunting was banned in Brazil.

The estimates also include the death of 1.9 million aquatic mammals, such as manatees (*Trichechus inunguis*), and mammals that spend their time in both land and water, such as capybaras (*Hydrochoerus hydrochaeris*), giant otters (*Pteronura brasiliensis*) and neotropical otters (*Lontra longicaudis*). The population of black caimans (*Melanosuchus niger*)—one of the largest predators in the Amazon, averaging 4.5 meters in length and prized for its black hide—was reduced by 4.4 million. "The extraction of black caiman hides led to the emergence of large tanneries in Manaus and Belém," Antunes says.

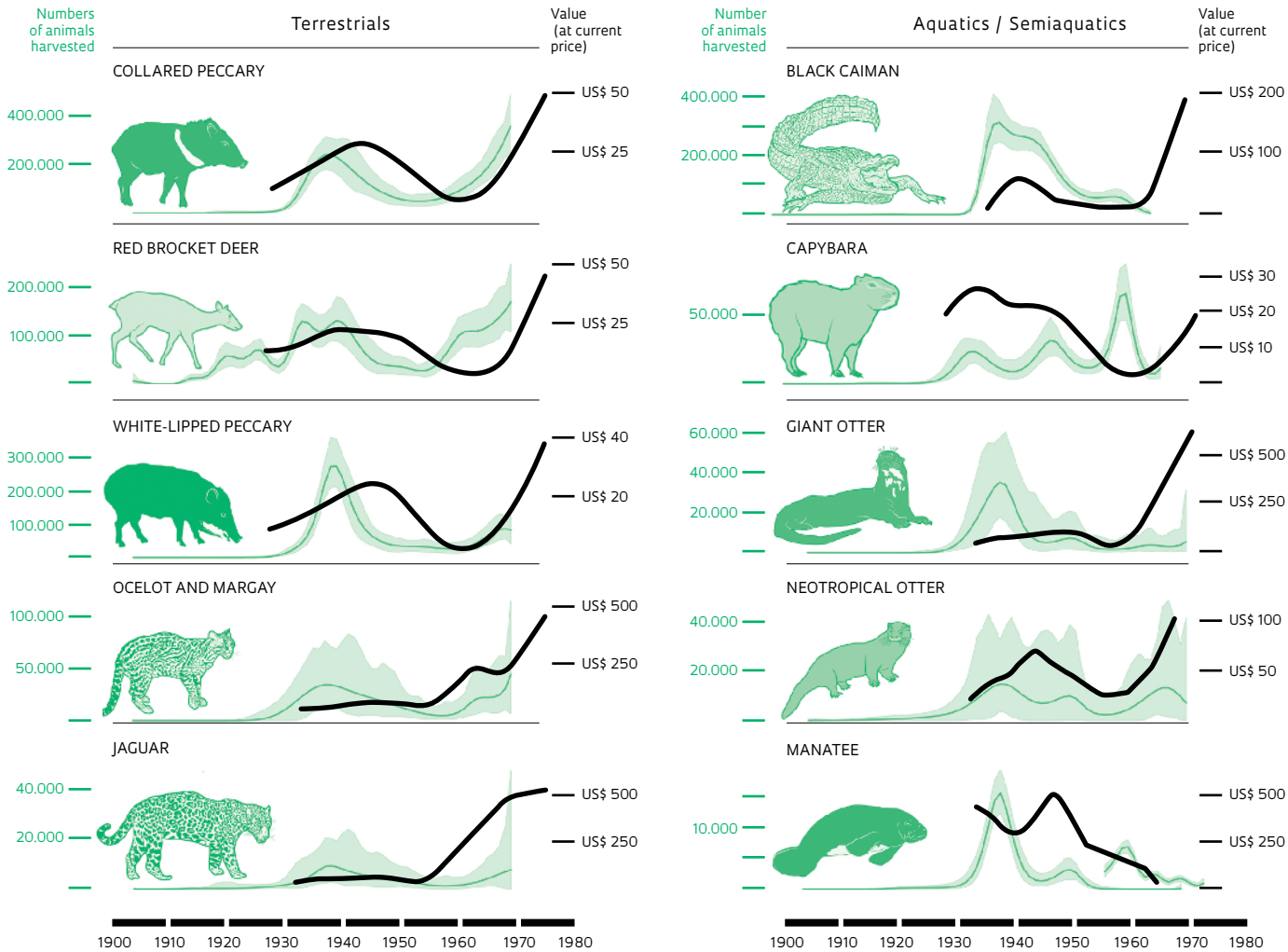
From their analysis of the evolution of hunting in the Amazon during that period, the researchers concluded that the aquatic species, described in the paper, were very close to extinction in much of the region. For a long time, none of these animals were sighted in the areas where they had usually been abundant, according to accounts given by residents. The populations of terrestrial species have now recovered reasonably well, as indicated by the stable production of hides over the past few decades. This is likely a sign of resilience in the face of pressures exerted by hunting.

Two factors help explain why aquatic animals are more vulnerable. First, some mammal species of mammals, which spend at least some of their time in the water usually have a low reproductive rate. Giant otters and manatees, for example, only produce a few offspring per gestation—and there are long intervals between gestations.

PHOTOS 1 EDUARDO CESAR **2** WING-CHI POON / WIKIPEDIA **INFOGRAPHIC** ANTUNES *ET AL.* SCIENCE ADVANCES. 2016

Most wanted

Numbers of harvested animals of the 10 most-hunted species and price variation for their hides and pelts



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Another factor is that aquatic mammals appear to be more exposed to humans. "Historically, in the Amazon, human occupations have been located along riverbanks," Antunes explains. "Access by boat makes it easy to obtain aquatic animals and transport their hides, while animals that live in forests in terra firma have more refuges and are farther from riverside communities," he notes.

By comparing harvest trends with historical events of the 20th century, the authors of the study identified the economic causes that drove commercial exploitation of wild Amazonian fauna. Around 1910, the regional economy began to collapse as latex production in Malaysia became widespread, and Brazilian rubber was unable to compete. The hide trade, which had previously been minimal and focused on the exploitation of red brocket deer, became an income-generating alternative for some of the 500,000 immigrants

Despite the ban of nearly five decades, hunting remains an ongoing practice throughout Brazil

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Vulnerable in the water: of the 113,000 manatees captured during the past century, 15,000 were harvested in 1938 alone

who had come to the region in the preceding decades, as well as for the indigenous peoples who were involved in the rubber cycle.

Between 1930 and 1960, commercial hunting became one of the principal extractivist activities in the Amazon. It was not until 1967, when the Fauna Protection Act was passed, that the practice was banned. Nevertheless, Antunes says, administrative rulings that allowed for the liquidation of stockpiles caused an escalation in the illegal hide trade in this region during the early 1970s.

SHRINKING POPULATIONS

Despite the nearly five-decade ban, hunting remains an ongoing practice throughout Brazil. One of the environments in which the damage is becoming evident is the Atlantic Forest. A study of wild mammals in the largest continuous forest remnant, in eastern São Paulo State, indicates that, in places where hunting persists, it causes the local extinction of large-bodied animals, such as the white-lipped peccary and the tapir (*Tapirus terrestris*). These large mammals play a fundamental role in seed dispersal, soil fertilization and forest renewal.

The researchers conducting the above study—which was led by biologist Mauro Galetti, a professor in the Department of Ecology at São Paulo State University (Unesp) in Rio Claro—explored approximately 4,000 kilometers in 13 areas of the Serra do Mar Mountains and recorded the density of 44 mammal species and the total biomass of eight species. "Just having a lot of mammals isn't enough," says ecologist Ricardo Bovendorp, currently a postdoctoral researcher at Unesp. "There need to be large animals, such as tapirs and white-lipped peccaries, which have no substitute for the ecological functions they perform in the ecosystem," explains Bovendorp, coauthor of the paper describing the findings in a recent issue of *Animal Conservation*.

One cause of the widespread hunting of wild animals is the lack of effective protection in environmental protection areas. "In Ilha do Cardoso State Park, on the southern coast of São Paulo State, two of the 34 white-lipped peccaries we've been tracking with radio collars have been harvested," Galetti says.

The Unesp team also observed that areas of intensive hunting can have similar numbers of mammals as regions where animals are not harvested. The difference is that, in hunting areas, practically the only animals to be found are small bodied, such as tamarins and rodents, which can result in an irreversible environmental imbalance. "Without large mammals, plants with large seeds are at risk of disappearing," says ecologist Carolina Bello, a doctoral student advised by Galetti. During late 2015, she and Galetti published a study in *Science Advances*, which shows that defaunation in the Atlantic Forest affects the forest's ability to remove carbon from the atmosphere.

The impact of hunting on populations of large mammals is not exclusive to Brazil. Galetti and Brazilian ecologist Carlos Peres, a professor at the University of East Anglia in England, were co-participants in an international study that assessed the preservation status of 301 mammal species from various regions around the world, species that are at risk of extinction because of hunting. The killing of animals for food or to extract ivory, horns or bones—the latter two are particularly valued in Asia for their medicinal properties—has been decimating some populations, according to a paper published in the *Royal Society Open Science* journal in October 2016.

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The black caiman, a predator prized for its black hide; the tapir, a seed disperser that has disappeared from some sections of the Atlantic Forest

"African elephants alone have lost half their population in the past 30 years due to hunting and loss of habitat," Peres says.

According to the survey, most of the mammals threatened by hunting live in regions that have high social inequality. In these areas, wild animals serve as sources of income and protein, and they are captured using traps, a practice that magnifies the damage. Studies conducted in Central Africa show that one-fourth of animals caught in traps rot in the wild or are consumed by other animals. Another third escape with wounds and may die hours or days later. An earlier survey, in a conservation area in Zimbabwe, confirmed that, over four years from 2005 to 2009, 1,400 large mammals rotted in traps. In addition to being wasteful, this form of hunting often results in the capture of females that may be pregnant or of young animals that would likely have a long reproductive life ahead of them—situations that are quite harmful to some species.

CONTROLLED PERMISSION

Given this scenario, the researchers argue that, in some regions, a total ban is more harmful than permitting animals to be captured under specific conditions and with rigorous surveillance. This is not a new idea. In most areas of the United States, it is permissible to hunt white-tailed deer (*Odocoileus virginianus*), and the population of these animals has remained stable. "They are one of the world's most widely studied large animals, particularly because the quotas have to be adjusted for sustainable culling," says Peres, who also collaborated on the paper in *Science Advances*.

Peres and Antunes suggest that, in Brazil, some mechanisms could allow for native peoples of Amazonia to be authorized to hunt certain anispecies of animals, for purposes of subsistence only. The Environmental Crimes Act of 1998 permits hunting in exceptional situations, such as extreme necessity; another law, which established the National System of Conservation Units in 2000, ensures that native peoples have access to natural resources, as a way of respecting their knowledge and culture. The researchers emphasize, however, that such permission could only be given in the context of very judicious and continuous management in areas of heavy forest cover without roads, preferably in conservation units. This model, they say, would only be applicable to some regions of Amazonia. "In today's Atlantic Forest, it would be unimaginable," Peres maintains.

The idea would be to develop something similar to the management of bony-tongue fish, or *pirarucu* (*Arapaima gigas*) in parts of Amazonia. Catching pirarucu, one of the largest freshwater fish in the world, is prohibited in the region. However, community-based management in a number of sustainable development reserves and indigenous territories is making sustainable fishing possible and increasing the fish population (*see* Pesquisa FAPESP Issue No. 248). The researchers propose something similar for hunting. Peres suggests the possibility of stipulating which species can be hunted—those with a high reproductive capacity, for example—or limiting capture only to adult males. "That way," Antunes suggests, "it may become possible to provide for the needs of traditional peoples and maintain a stable population of these animal species." ■

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PHOTOS 1 LÉO RAMOS CHAVES, TAKEN AT THE SÃO PAULO AQUARIUM 2 WHALDENER ENDO / WIKIPEDIA 3 CHARLESJSHARP / WIKIPEDIA