



EDGE Species
(Evolutionarily Distinct and
Globally Endangered Species)

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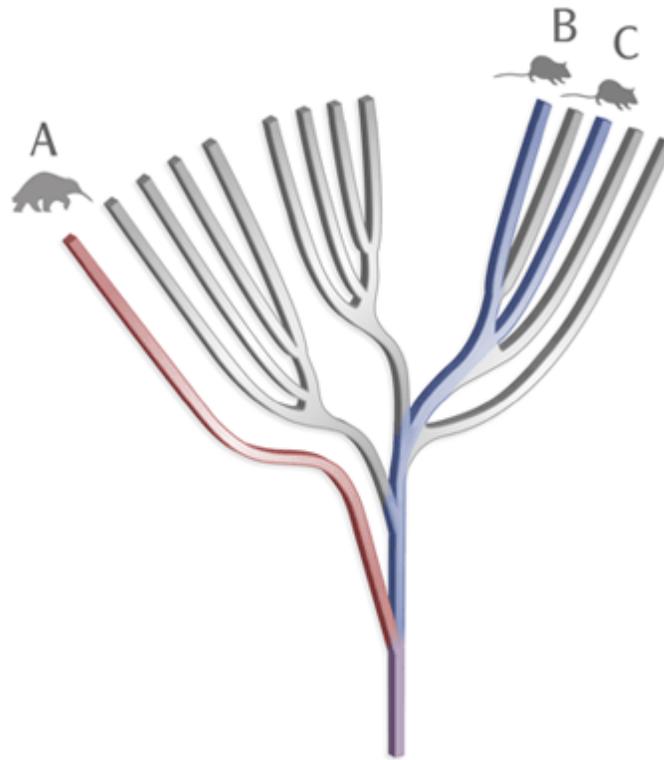
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Introduction



Evolutionarily Distinct and Globally Endangered (EDGE) Species represent a disproportionate amount of unique evolutionary history. They have few close relatives and are often extremely unusual in the way they look, live and behave. Some EDGE species, such as elephants and pandas, are well known and already receive considerable conservation attention, but many others, such as the Yangtze River dolphin (the world's rarest cetacean), the bumblebee bat (arguably the world's smallest mammal) and the egg-laying long-beaked echidnas are highly threatened yet remain poorly understood and are frequently overlooked by existing conservation frameworks. Recent research indicates that 70% of the world's most threatened and evolutionarily distinct mammal species are currently receiving little or no conservation attention. If these species are not highlighted and conserved we will not only lose many of the world's unique species and a disproportionate amount of biodiversity, but we may also greatly reduce the potential for future evolution. The Zoological Society of London (ZSL) has launched a new global conservation initiative, the EDGE of Existence Programme to raise awareness and funds for the conservation of these species.

Calculating *EDGE* Scores



Every species is given a score according to the amount of unique evolutionary history it represents, and its conservation status. These scores are used to identify *EDGE* species.

Some species are more distinct than others because they represent a larger amount of unique evolution. Species like the armadillo have few close relatives and have been evolving independently for many millions of years. Others like the domestic dog originated only recently and have many close relatives. Species uniqueness' can be measured as an 'Evolutionary Distinctiveness' (ED) score, using a phylogeny, or evolutionary tree.

In the phylogeny shown on the right, species A has a higher ED score than either species B or C - it represents a branch rather than a twig on the tree of life. If species A were to go extinct, there would be no similar species left on the planet and a disproportionate amount of unique evolutionary history would be lost forever.

Globally Endangered (GE) scores for each species are measured according to the IUCN Red List of Threatened Species, an assessment of the conservation status of the world's plant and animal species.

Summary of 2006 IUCN Red List categories.

Species which are Critically Endangered receive a higher score than less threatened species, which in turn, receive a higher score than those not currently in danger of extinction.

The two scores are then combined to produce an overall EDGE score for each species. EDGE scores are calculated by multiplying ED and GE together. In mathematical terms, EDGE scores are an estimate of the expected loss of evolutionary history per unit time.

EDGE species are species which have an above average ED score and are threatened with extinction (Critically Endangered, Endangered or Vulnerable). There are currently 564 EDGE mammal species (~12% of the total). Potential EDGE species are those with high ED scores but whose conservation status is unclear.

Focal species

Many EDGE species are not being adequately protected by existing conservation measures. This suggests that a disproportionate amount of evolutionary history is likely to be lost in the near future. To redress this balance, ten focal species are selected each year for which active research and conservation programmes will be carried out.

The focal species are the subject of research programmes aimed at establishing what the main threats are and what actions need to be taken to ensure their survival. Each study is focused on delivering a conservation action plan. These plans provide information on the conservation actions highlighted by the research programme, and identify key stakeholders that will carry out these actions.

2007/8 focal mammal species

Numbers refer to EDGE rank

1. Yangtze River dolphin (*Lipotes vexillifer*)
2. Attenborough's long-beaked echidna (*Zaglossus attenboroughi*)
5. Hispaniolan solenodon (*Solenodon paradoxus*)
8. Bactrian camel (*Camelus bactrianus*)
21. Pygmy hippopotamus (*Hexaprotodon liberiensis*)
22. Slender loris (*Loris tardigradus*)
37. Hirola antelope (*Beatragus hunteri*)
46. Golden-rumped elephant-shrew (*Rhynchocyon chrysopygus*)
49. Bumblebee bat (*Craseonycteris thonglongyai*)
81. Long-eared jerboa (*Euchoreutes naso*)

2008/9 focal amphibian species

2. Chinese giant salamander (*Andrias davidianus*)
3. Sagalla caecilian (*Boulengerula niedeni*)
4. Purple frog (*Nasikabatrachus sahyadrensis*)
15. Ghost frogs (*Heleophryne hewitti* and *Heleophryne rosei*)
18. Olm (*Proteus anguinus*)
24. Lungless Mexican salamanders (20 species from the top ranked 100 species, including *Parvimolge townsendi*, *Chiropetrotriton lavae*, *Chiropetrotriton magnipes* and *Chiropetrotriton mosaueri*)
37. Malagasy rainbow frog (*Scaphiophryne gottlebei*)
45. Chile Darwin's frog (*Rhinoderma rufum*)
55. Betic midwife toad (*Alytes dickhilleni*)
69. Seychelles frogs (*Sooglossus gardineri*, *Sooglossus pipilodryas*, *Sooglossus sechellensis* and *Sooglossus thomasseti*)

Chapter 1

African Elephant

African elephants



Loxodonta africana

Conservation status



Vulnerable (IUCN 3.1)

Scientific classification [e]

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Proboscidea
Family:	Elephantidae
Genus:	<i>Loxodonta</i> Anonymous, 1827

Species

L. adaurora †

ssp. *L. a. adaurora* †
ssp. *L. a. kararae* †

L. africana
L. atlantica †

ssp. *L. a. angammensis* †
ssp. *L. a. atlantica* †

L. cyclotis
L. exaptata †



Distribution of *Loxodonta africana* (2007)

African elephants are the species of elephants in the genus *Loxodonta* (Greek for 'oblique-sided tooth'), one of the two existing genera in Elephantidae. Although it is commonly believed that the genus was named by Georges Cuvier in 1825, Cuvier spelled it *Loxodonte*. An anonymous author romanized the spelling to *Loxodonta* and the ICZN recognizes this as the proper authority.

Fossil members of *Loxodonta* have only been found in Africa, where they developed in the middle Pliocene.

Size

African elephants are bigger than Asian elephants. Males stand 3.2–4.0 m (10–13 ft) tall at the shoulder and weigh 4,700–6,048 kg (10,000–13,330 lb), while females stand 2.2–2.6 m (7.2–8.5 ft) tall and weigh 2,160–3,232 kg (4,800–7,130 lb).

Teeth



A male African bush elephant in Namibia

Elephants have four molars; each weighs about 5 kg (11 lb) and measures about 30 cm (12 in) long. As the front pair wears down and drops out in pieces, the back pair shifts forward, and two new molars emerge in the back of the mouth. Elephants replace their teeth six times. At about 40 to 60 years of age, the elephant no longer has teeth and will likely die of starvation, a common cause of death.

Their tusks are teeth; the second set of incisors become the tusks. They are used for digging for roots and stripping the bark off trees for food, for fighting each other during mating season, and for defending themselves against predators. The tusks weigh from 23–45 kg (51–99 lb) and can be from 1.5–2.4 m (5–8 ft) long. Unlike Asian elephants, both male and female African elephants have tusks. The enamel plates of the molars are fewer in number than in Asian elephants.

Species

- African bush elephant (*Loxodonta africana*).
- African forest elephant (*Loxodonta cyclotis*).
- *Loxodonta adaurora*, extinct, presumed antecedent of the modern African elephants.
- *Loxodonta atlantica*, extinct.
- *Loxodonta exaptata*, extinct.

- North African Elephant (*Loxodonta africana pharaoensis*), extinct. Presumed subspecies north of the Sahara from the Atlas to Ethiopia.

Bush and forest elephants were formerly considered subspecies of the same species *Loxodonta africana*. As described in the entry for the forest elephant in the third edition of *Mammal Species of the World* (MSW3), there is now morphological and genetic evidence they should be considered as separate species.



Females usually live in smaller or larger herds, here *Loxodonta africana* in Tanzania

Much of the evidence cited in MSW3 is morphological. The African forest elephant has a longer and narrower mandible, rounder ears, a different number of toenails, straighter and downward tusks, and considerably smaller size. With regard to the number of toenails: the African bush elephant normally has four toenails on the front foot and three on the hind feet, the African forest elephant normally has five toenails on the front foot and four on the hind foot (like the Asian elephant), but hybrids between the two species commonly occur.

MSW3 lists the two forms as full species and does not list any subspecies in its entry for *Loxodonta africana*. However, this approach is not taken by the United Nations Environment Programme's World Conservation Monitoring Centre nor by the International Union for Conservation of Nature (IUCN), both of which list *L.cyclotis* as a synonym (not even a subspecies) of *L.africana*.

A consequence of the IUCN taking this view is that the IUCN Red List makes no independent assessment of the conservation status of the two forms of African elephant. It merely assesses the two forms taken together as a unit as vulnerable.

A study of nuclear DNA sequences published in 2010 indicated that the divergence date between forest and savanna elephants is 2.6–5.6 million years ago, which is virtually the same as the divergence date estimated between the Asian elephant and woolly mammoths (2.5–5.4 million years ago), strongly supporting their status as separate species. Forest elephants were found to have a high degree of genetic diversity, perhaps reflecting periodic fragmentation of their habitat during the climatic changes of the Pleistocene.

Intelligence

African elephants are highly intelligent, and they have a very large and highly convoluted neocortex, a trait also shared by humans, apes and certain dolphin species.

Conservation



Men with African elephant tusks, Dar es Salaam, c. 1900

Poaching significantly reduced the population of *Loxodonta* in certain regions during the 20th century. In the ten years preceding an international ban in the trade in ivory in 1990 the African elephant population was more than halved from 1.3 million to around 600,000. An example of how the ivory trade causes poaching pressure is in the eastern region of Chad—elephant herds where as recently as 1970 there was an estimated population of 400,000; however, by 2006 the number had dwindled to about 10,000. The African elephant nominally has governmental protection, but poaching for the ivory trade can devastate populations.

Human encroachment into or adjacent to natural areas where bush elephants occur has led to recent research into methods of safely driving groups of elephants away from humans, including the discovery that playback of the recorded sounds of angry honey bees is remarkably effective at prompting elephants to flee an area.

Chapter 2

Fin Whale

Fin whale



A fin whale surfaces in the Kenai Fjords, Alaska



Size compared to an average human

Conservation status



Endangered (IUCN 3.1)

Scientific classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Subclass: Eutheria
Order: Cetacea
Suborder: Mysticeti
Family: Balaenopteridae

Genus: *Balaenoptera*

Species: *B. physalus*

Binomial name

Balaenoptera physalus

(Linnaeus, 1758)



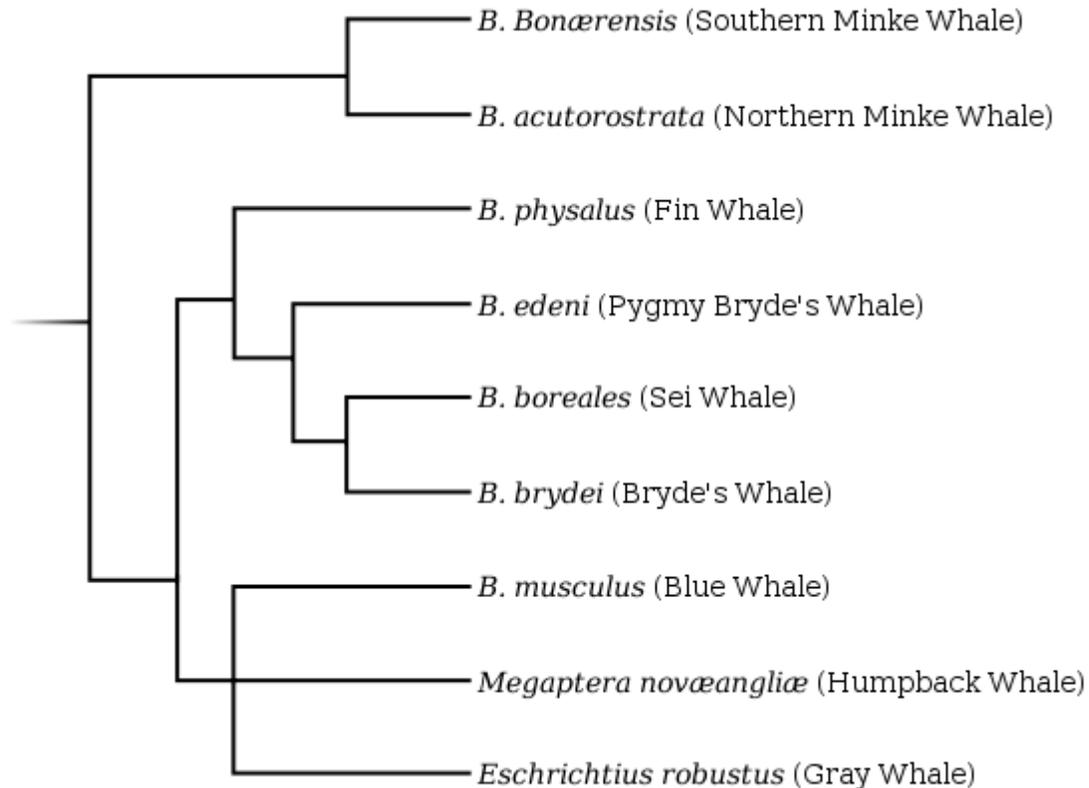
Fin whale range

The **fin whale** (*Balaenoptera physalus*), also called the **finback whale**, **razorback**, or **common rorqual**, is a marine mammal belonging to the suborder of baleen whales. It is the second largest whale and the second largest living animal after the blue whale, growing to nearly 27 meters (88 ft) long. The American naturalist Roy Chapman Andrews called the fin whale "the greyhound of the sea" because of its great speed when chased and slender build.

Long and slender, the fin whale's body is brownish-grey with a paler underside. There are at least two distinct subspecies: the Northern fin whale of the North Atlantic, and the larger Antarctic fin whale of the Southern Ocean. It is found in all the world's major oceans, from polar to tropical waters. It is absent only from waters close to the ice pack at both the north and south poles and relatively small areas of water away from the open ocean. The highest population density occurs in temperate and cool waters. Its food consists of small schooling fish, squid, and crustaceans including mysids and krill.

Like all other large whales, the fin whale was heavily hunted during the twentieth century and is an endangered species. Almost 750,000 fin whales were taken from the Southern Hemisphere alone between 1904 and 1979 and less than 3,000 currently remain in that region. The International Whaling Commission (IWC) has issued a moratorium on commercial hunting of this whale, although Iceland and Japan have resumed hunting: in 2009, Iceland took 125 fin whales during its whaling season, and Japan took 1 fin whale in its 2008-2009 Antarctic season. The species is also hunted by Greenlanders under the Aboriginal Subsistence Whaling provisions of the IWC. Collisions with ships and noise from human activity also significantly threaten recovery.

Taxonomy



A cladogram of animals related to the fin whale

The fin whale has long been known to taxonomists. It was first described by Frederick Martens in 1675 and then again by Paul Dudley in 1725. These descriptions were used as the basis of the species *Balaena physalus* by Carl Linnaeus in 1758. The Comte de Lacepede reclassified the species as *Balaenoptera physalus* early in the nineteenth century. The word "*physalus*" comes from the Greek word *physis*, meaning "blows".

Fin whales are rorquals, members of the family Balaenopteridae family, which also includes the humpback whale, the blue whale, the Bryde's whale, the sei whale and the minke whale. The family diverged from the other baleen whales in the suborder Mysticeti as long ago as the middle Miocene, although it is not known when the members of these families further evolved into their own species. Hybridization between the blue whale and the fin whale is known to occur at least occasionally in the North Atlantic and in the North Pacific. Recent DNA evidence indicates that the fin whale may be more closely related to the gray whale (*Eschrichtius robustus*) and humpback whale (*Megaptera novaeangliae*), two whales in different genera, than it is to members of its own genus, such as the minke whales. If further research confirms this theory, this taxonomy would need revision.

As of 2006, there are two named subspecies, each with distinct physical features and vocalizations. The Northern fin whale, *B. p. physalus* (Linnaeus 1758), inhabits the North Atlantic, and the Antarctic fin whale, *B. p. quoyi* (Fischer 1829), occupies the Southern Ocean. Most experts consider the fin whales of the North Pacific to be a third, as yet unnamed species. The three groups mix at most rarely.

Description and behavior

The fin whale is usually distinguished by its great length and slender build. The average size of males and females is 19 and 20 meters (62 and 66 ft), respectively. Subspecies in the Northern Hemisphere are known to reach lengths of up to 24 metres (79 ft) and the Antarctic subspecies reaches lengths of up to 26.8 metres (88 ft). A full-sized adult has never been weighed, but calculations suggest that a 25 metres (82 ft) animal could weigh as much as 70,000 kilograms (150,000 lb). Full physical maturity is attained between 25 and 30 years. Fin whales live to 94 years of age, although specimens have been found aged at an estimated 135-140 years. A newborn fin whale measures about 6.5 metres (21 ft) in length and weighs approximately 1,800 kilograms (4,000 lb). The animal's large size aids in identification, and it is usually only confused with the blue whale, the sei whale, or, in warmer waters, Bryde's whale.

The fin whale has a brownish grey top and sides and a whitish underside. It has a pointed snout, paired blowholes, and a broad, flat rostrum. Two lighter-colored chevrons begin midline behind the blowholes and slant down the sides toward the tail on a diagonal upward to the dorsal fin, sometimes recurving forward on the back. It has a large white patch on the right side of the lower jaw, while the left side of the jaw is grey or black. This type of asymmetry can be seen occasionally in minke whales, but the fin whale's asymmetry is universal and thus is unique among cetaceans and is one of the keys to making a full identification. It was hypothesized to have evolved because the whale swims on its right side when surface lunging and it often circles to the right while at the surface above a prey patch. However, the whales just as often circle to the left. There is no accepted hypothesis to explain the asymmetry.

The whale has a series of 56–100 pleats or grooves along the bottom of the body that run from the tip of the chin to the navel that allow the throat area to expand greatly during feeding. It has a curved, prominent 60 centimetres (24 in) dorsal fin about three-quarters of the way along the back. Its flippers are small and tapered, and its tail is wide, pointed at the tip, and notched in the center.

When the whale surfaces, the dorsal fin is visible soon after the spout. The spout is vertical and narrow and can reach heights of 6 metres (20 ft). The whale will blow one to several times on each visit to the surface, staying close to the surface for about one and a half minutes each time. The tail remains submerged during the surfacing sequence. It then dives to depths of up to 250 metres (820 ft) each dive lasting between 10 and 15 minutes. Fin whales have been known to leap completely out of the water.

Life history

Mating occurs in temperate, low-latitude seas during the winter, followed by an eleven months to one year gestation period. A newborn weans from its mother at 6 or 7 months of age when it is 11 or 12 metres (39 ft) in length, and the calf follows the mother to the winter feeding ground. Females reproduce every 2 to 3 years, with as many as 6 fetuses being reported, but single births are far more common. Females reach sexual maturity at between 3 and 12 years of age.

Feeding



Overhead view of a fin whale feeding

The fin whale is a filter-feeder, feeding on small schooling fish, squid, and crustaceans including mysids and krill. It feeds by opening its jaws while swimming at a relatively high speed, 11 kilometres per hour (6.8 mph) in one study, which causes it to engulf up to 70 cubic metres (18,000 US gal; 15,000 imp gal) of water in one gulp. It then closes its jaws and pushes the water back out of its mouth through its baleen, which allows the water to leave while trapping the prey. An adult has between 262 and 473 baleen plates on each side of the mouth. Each plate is made of keratin that frays out into fine hairs on the ends inside the mouth near the tongue. Each plate can measure up to 76 centimetres (30 in) in length and 30 centimetres (12 in) in width. The whale routinely dives to depths of more than 200 metres (660 ft) where it executes an average of four "lunges", where it feeds on aggregations of krill. Each gulp provides the whale with approximately 10 kilograms (22 lb) of krill. One whale can consume up to 1,800 kilograms (4,000 lb) of food a day, leading scientists to conclude that the whale spends about three hours a day feeding to meet its energy requirements, roughly the same as humans. If prey *patches* are not sufficiently dense, or are located too deep in the water, the whale has to spend a

larger portion of its day searching for food. One hunting technique is to circle schools of fish at high speed, frightening the fish into a tight ball, then turning on its side before engulfing the massed prey.

Behavior

The fin whale is one of the fastest cetaceans and can sustain speeds of 37 kilometres per hour (23 mph) and bursts in excess of 40 kilometres per hour (25 mph) have been recorded, earning the fin whale the nickname "the greyhound of the sea". Fin whales are more gregarious than other rorquals, and often live in groups of 6–10, although feeding groups may reach up to 100 animals.

Vocalizations

Like other whales, the male fin whale makes long, loud, low-frequency sounds. The vocalizations of blue and fin whales are the lowest-frequency sounds made by any animal. Most sounds are frequency-modulated (FM) down-swept infrasonic pulses from 16 to 40 hertz frequency (the range of sounds that most humans can hear falls between 20 hertz and 20 kilohertz). Each sound lasts one to two seconds, and various sound combinations occur in patterned sequences lasting 7 to 15 minutes each. The whale then repeat the sequences in bouts lasting up to many days. The vocal sequences have source levels of up to 184–186 decibels relative to 1 micropascal at a reference distance of one meter, and can be detected hundreds of miles from their source.

When fin whale sounds were first recorded by US biologists, they did not realize that these unusually loud, long, pure and regular sounds were being made by whales. They first investigated the possibilities that the sounds were due to equipment malfunction, geophysical phenomena, or even part of a Soviet Union scheme for detecting enemy submarines. Eventually, biologists demonstrated that the sounds were the vocalizations of fin whales.

Direct association of these vocalizations with the reproductive season for the species and that only males make the sounds point to these vocalizations as possible reproductive displays. Over the past 100 years, the dramatic increase in ocean noise from shipping and naval activity may have slowed the recovery of the fin whale population, by impeding communications between males and sexually receptive females.

Range and habitat



Fin whales may reach lengths of up to 26.8 metres (88 ft)

Like many large rorquals, the fin whale is a cosmopolitan species. It is found in all the world's major oceans, and in waters ranging from the polar to the tropical. It is absent only from waters close to the ice pack at both the north and south extremities and relatively small areas of water away from the large oceans, such as the Red Sea, the Persian Gulf, the eastern part of the Mediterranean, and the Baltic Sea. The highest population density occurs in temperate and cool waters. It is less densely populated in the warmest, equatorial regions. It prefers deep waters beyond the continental shelf to shallow waters.

The North Atlantic fin whale has an extensive distribution, occurring from the Gulf of Mexico and Mediterranean Sea, northward to the edges of the Arctic ice pack. In general, fin whales are more common north of approximately 30°N latitude, but considerable confusion arises about their occurrence south of 30°N latitude because of the difficulty in distinguishing fin whales from Bryde's whales. Extensive ship surveys have led researchers to conclude that the summer feeding range of fin whales in the western North Atlantic was mainly between 41°20'N and 51°00'N, from shore seaward to the 1,000 fathoms (1,800 m) contour.

Summer distribution of fin whales in the North Pacific is the immediate offshore waters from central Baja California to Japan, and as far north as the Chukchi Sea bordering the Arctic Ocean. They occur in high densities in the northern Gulf of Alaska and southeastern Bering Sea between May and October, with some movement through the Aleutian passes into and out of the Bering Sea. Several whales tagged between November and January off southern California were killed in the summer off central California, Oregon, British Columbia, and in the Gulf of Alaska. Fin whales have been observed feeding in Hawaiian waters in mid-May, and several winter sightings have been made there. Some researchers have suggested that the whales migrate into Hawaiian waters primarily in the autumn and winter.

Although fin whales are certainly migratory, moving seasonally in and out of high-latitude feeding areas, the overall migration pattern is not well understood. Acoustic readings from passive-listening hydrophone arrays indicate a southward migration of the North Atlantic fin whale occurs in the autumn from the Labrador-Newfoundland region, south past Bermuda, and into the West Indies. One or more populations of fin whales are thought to remain year-round in high latitudes, moving offshore, but not southward in late autumn. In the Pacific, migration patterns are poorly characterized. Although some fin whales are apparently present year-round in the Gulf of California, there is a significant increase in their numbers in the winter and spring. Antarctic fin whales migrate seasonally from relatively high-latitude Antarctic feeding grounds in the summer to low-latitude breeding and calving areas in the winter. The location of winter breeding areas is still unknown, since these whales tend to migrate in the open ocean.

Population and trends



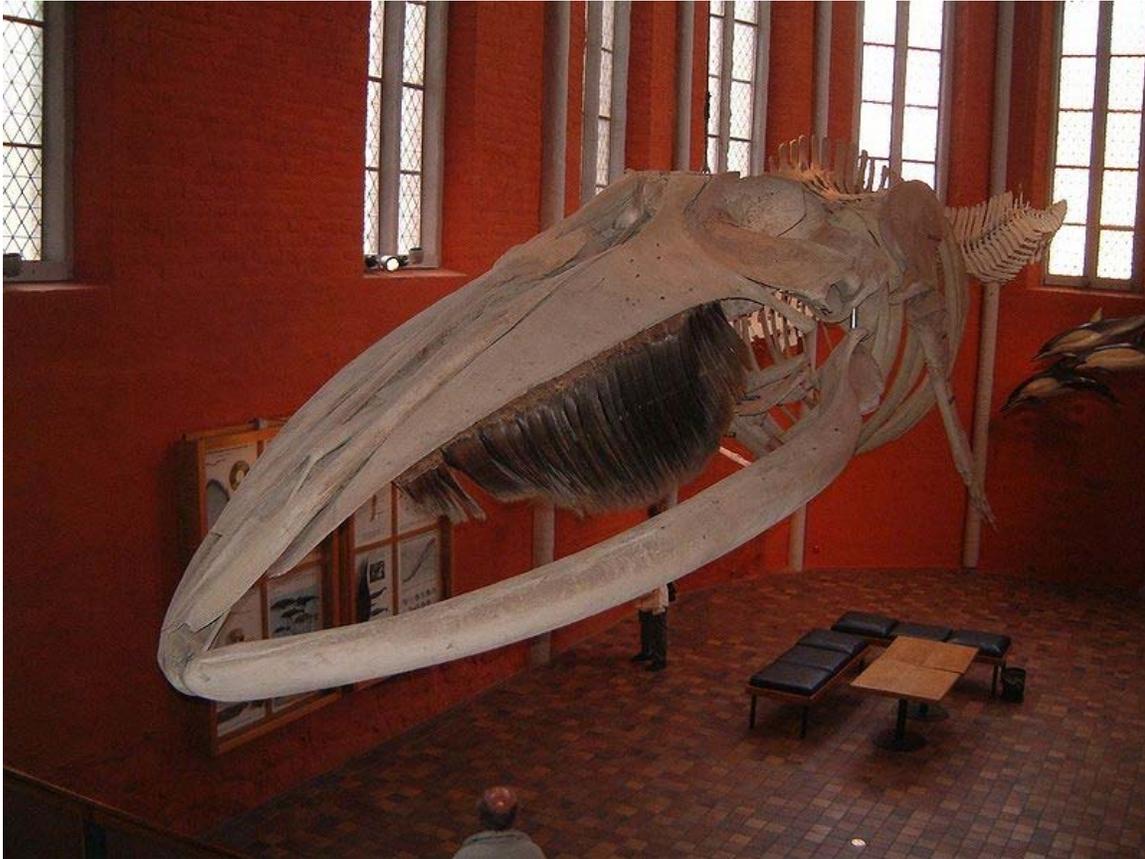
A fin whale approaching

Poor understanding of migration patterns combined with contradictory population surveys makes estimating the historical and current population levels of the whale difficult and contentious. Due to a long history of hunting this whale, pre-exploitation population levels are difficult to determine.

North Atlantic

North Atlantic fin whales are defined by the International Whaling Commission to exist in one of seven discrete population zones: Nova Scotia-New England, Newfoundland-Labrador, western Greenland, eastern Greenland-Iceland, North Norway, West Norway-Faroe Islands, and Ireland-Spain-United Kingdom-Portugal. Results of mark-and-recapture surveys have indicated that some movement occurs across the boundaries of these population zones, suggesting that each zone is not entirely discrete and that some immigration and emigration does occur. J. Sigurjónsson estimated in 1995 that total pre-exploitation population size in the entire North Atlantic ranged between 50,000 and 100,000 animals, but his research is criticized for not providing supporting data and an explanation of his reasoning. In 1977, D.E. Sergeant suggested a "primeval" aggregate total of 30,000 to 50,000 throughout the North Atlantic. Of that number, about 8,000 to 9,000 would have resided in the Newfoundland and Nova Scotia areas, with whales summering in U.S. waters south of Nova Scotia presumably omitted. J.M. Breiwick estimated that the "exploitable" (above the legal size limit of ft50) component of the Nova Scotia population was 1,500 to 1,600 animals in 1964, reduced to only about 325 in 1973. Two aerial surveys in Canadian waters since the early 1970s gave numbers of 79 to 926 whales on the eastern Newfoundland-Labrador shelf in August 1980, and a few hundred in the northern and central Gulf of Saint Lawrence in August 1995–1996. Summer estimates in the waters off western Greenland range between 500 and 2,000, and in 1974, Jonsgard considered the fin whales off Western Norway and the Faroe Islands to "have been considerably depleted in postwar years, probably by overexploitation". The population around Iceland appears to have fared much better, and in 1981, the population appeared to have undergone only a minor decline since the early 1960s. Surveys during the summers of 1987 and 1989 estimated of 10,000 to 11,000 between eastern Greenland and Norway. This shows a substantial recovery when compared to a survey in 1976 showing an estimate of 6,900, which was considered to be a "slight" decline since 1948. Summer population estimates in the British Isles-Spain-Portugal area range from 7,500 to more than 17,000. The aggregate population level is estimated to be between 40,000 and 56,000 individuals.

North Pacific



Fin whale skeleton

The total historical North Pacific population was estimated at 42,000 to 45,000 before the start of whaling. Of this, the population in the eastern portion of the North Pacific was estimated to be 25,000 to 27,000. By 1975, the estimate had declined to between 8,000 and 16,000. Surveys conducted in 1991, 1993, 1996, and 2001 produced estimates of between 1,600 and 3,200 off California and 280 to 380 off Oregon and Washington. The minimum estimate for the California-Oregon-Washington population, as defined in the *U.S. Pacific Marine Mammal Stock Assessments: 2005*, is about 2,500. Surveys in coastal waters of British Columbia in summers 2004 and 2005 produced abundance estimates of approximately 500 animals (95% confidence intervals: 201-1,220). Surveys near the Pribilof Islands in the Bering Sea indicated a substantial increase in the local abundance of Fin Whales between 1975–1978 and 1987–1989. In 1984, the entire population was estimated to be at less than 38% of its historic carrying capacity.

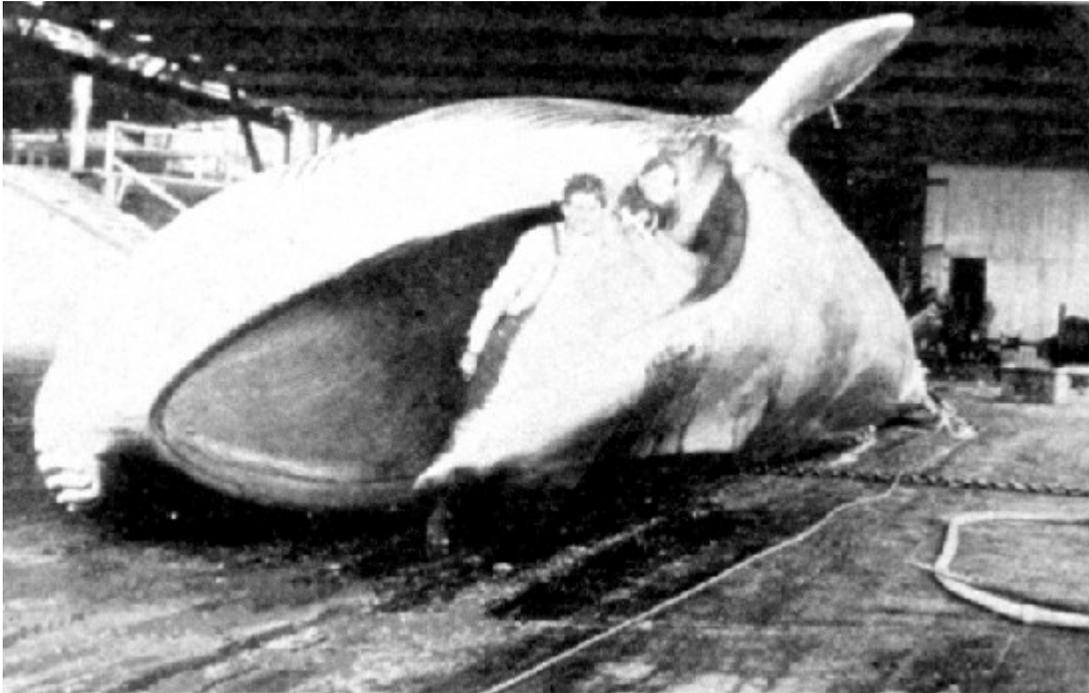
Antarctica

Relatively little is known about the historical and current population levels of the Antarctic fin whale. The IWC officially estimates that the Southern Hemisphere pre-whaling population was 400,000 whales, and that the population in 1979 (at the cessation of Antarctic large scale whaling) was 85,200. Both the current and historical estimates

should be considered as poor estimates because the methodology and data used in the study are known to be flawed. Other estimates cite current (late 1980s-early 1990s) population levels of no more than 5,000 whales and possibly as low as 2,000 to 3,000.

As of 2006, there is no scientifically accepted estimate of current population or trends in abundance.

Human interaction



A 65 long tons (66 t), 72 feet (22 m) fin whale caught at Grays Harbor circa 1912

In the 19th century, the fin whale was occasionally hunted by open-boat whalers, but it was relatively safe because of its speed and the fact that it often sank when killed. However, the later introduction of steam-powered boats and harpoons that exploded on impact made it possible to kill and secure them along with blue whales and sei whales on an industrial scale. As other whale species became over-hunted, the whaling industry turned to the still-abundant fin whale as a substitute. It was primarily hunted for its blubber, oil, and baleen. Approximately 704,000 fin whales were caught in Antarctic whaling operations alone between 1904 and 1975.

The introduction of factory ships with stern slipways in 1925 substantially increased the number of whales taken per year. In 1937 alone, over 28,000 fin whales were taken. From 1953 to 1961, the catch averaged around 25,000 per year. By 1962, sei whale catches began to increase as fin whales became scarce. By 1974, fewer than 1,000 fin whales were being caught each year. In the North Pacific, a reported total of approximately 46,000 fin whales were killed by commercial whalers between 1947 and 1987.

The IWC prohibited hunting in the southern hemisphere in 1976. The Soviet Union engaged in the illegal killing of protected whale species in the North Pacific, rendering reported catch data incomplete. The fin whale was given full protection from commercial whaling by the IWC in the North Pacific in 1976, and in the North Atlantic in 1987, with small exceptions for aboriginal catches and catches for research purposes. All populations worldwide remain listed as endangered species by the US National Marine Fisheries Service and the International Conservation Union Red List, and the fin whale is on Appendix 1 of CITES.

The IWC has set a quota of 19 fin whales per year for Greenland. Meat and other products from whales killed in these hunts are widely marketed within Greenland, but export is illegal. Iceland and Norway are not bound by the IWC's moratorium on commercial whaling because both countries filed objections to the moratorium. In October 2006, Iceland's fisheries ministry authorized the hunting of nine fin whales through August 2007.

In the southern hemisphere, Japan permits annual takes of 10 fin whales under its Antarctic Special Permit whaling program for the 2005–2006 and 2006–2007 seasons. The proposal for 2007–2008 and the subsequent 12 seasons allows taking 50 per year, but by the close of the 2007-2008 season in April 2008, no fin whales had been caught.

Collisions with ships are a major cause of mortality. In some areas, they cause a substantial portion of large whale strandings. Most serious injuries are caused by large, fast-moving ships over or near the continental shelf.

Chapter 3

Fossa (Animal)

Fossa



Conservation status



Vulnerable (IUCN 3.1)

Scientific classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Carnivora
Family: Eupleridae
Genus: *Cryptoprocta*
 Bennett, 1833
Species: *C. ferox*

Binomial name

Cryptoprocta ferox
Bennett, 1833



Distribution of the fossa
(*Cryptoprocta ferox*)

Synonyms

- *typicus* A. Smith, 1834

The **fossa** is a cat-like, carnivorous mammal that is endemic to Madagascar. It is a member of the Eupleridae, a family of carnivorans closely related to the mongoose family (Herpestidae). Its classification has been controversial because its physical traits resemble those of cats, yet other traits suggest a close relationship with viverrids (most civets and their relatives). Its classification, along with that of the other Malagasy carnivores, influenced hypotheses about how many times mammalian carnivores have colonized the island. With genetic studies demonstrating that the fossa and all other Malagasy carnivores are most closely related to each other (forming a clade, recognized as the family Eupleridae), carnivores are now thought to have colonized the island once around 18 to 20 million years ago.

The fossa is the largest mammalian carnivore on the island of Madagascar and has been compared to a small cougar. Adults have a head-body length of 70–80 cm (28–31 in) and weigh between 5.5–8.6 kg (12–19 lb), with the males larger than the females. It has semi-retractable claws and flexible ankles that allow it to climb up and down trees head-first, and also support jumping from tree-to-tree. The fossa is unique within its family for the shape of its genitalia, which share traits with those of cats and hyenas.

The species is widespread, although population densities are usually low. It is found solely in forested habitat, and actively hunts both day and night. Over 50% of its diet consists of lemurs, the endemic primates found on the island, though tenrecs, rodents, lizards, birds, and other animals are also documented as prey. Mating usually occurs in trees on horizontal limbs and can last for several hours. Litters range from one to six pups, which are born blind and toothless (altricial). Infants wean after 4.5 months and are independent after a year. Sexual maturity occurs around three to four years of age, and life expectancy in captivity is 20 years. The fossa is listed as "Vulnerable" by the

International Union for Conservation of Nature (IUCN). It is generally feared by the Malagasy people and is often protected by their taboo, known as *fady*. The greatest threat to the species is habitat destruction.

Taxonomy

The fossa was formally described in 1833 by Edward Turner Bennett. The genus name *Cryptoprocta* refers to how the animal's anus is hidden by its anal pouch, from the Ancient Greek words *crypto-* "hidden", and *procta* "anus". The species name *ferox* is the Latin adjective "fierce" or "wild." Its common name is Malagasy and can be spelled *fossa* or *fosa*. The common name is the same as the generic name of the Malagasy civet (*Fossa fossana*), but they are different species. Because of shared physical traits with civets, mongooses, and cats (Felidae), its classification has been controversial. Bennett originally placed the fossa as a type of civet in the family Viverridae, a classification that long remained popular among taxonomists. Its compact braincase, large eye sockets, retractable claws, and specialized carnivorous dentition have also led some taxonomists to associate it with the felids. In 1939, William King Gregory and Milo Hellman placed the fossa in its own subfamily within Felidae, the Cryptoproctinae. George Gaylord Simpson placed it back in Viverridae in 1945, still within its own subfamily, yet conceded it had many cat-like characteristics.



The fossa has a cat-like appearance, resembling a small cougar.

In 1993, Géraldine Veron and François Catzefflis published a DNA hybridization study suggesting that the fossa was more closely related to mongooses (family Herpestidae) than to cats or civets. However, in 1995, Veron's morphological study once again grouped it with Felidae. In 2003, molecular phylogenetic studies using nuclear and mitochondrial genes by Anne Yoder and colleagues showed that all native Malagasy carnivorans share a common ancestry that excludes other carnivores (meaning they form a clade, making them monophyletic) and are most closely related to Asian and African Herpestidae. To reflect these relationships, all Malagasy carnivorans are now placed in a single family, Eupleridae. Within Eupleridae, the fossa is placed in the subfamily Euplerinae with the falanouc (*Eupleres goudoti*) and Malagasy Civet, but its exact relationships are poorly resolved.

An extinct relative of the fossa was described in 1902 from subfossil remains and recognized as a separate species, *Cryptoprocta spelea*, in 1935. This species was much larger than the living fossa, but otherwise similar. Across Madagascar, people distinguish two kinds of fossa—a large *fosa mainty* ("black fossa") and the smaller *fosa mena* ("reddish fossa")—and a white form has been reported in the southwest. It is unclear whether this is purely folklore or individual variation—related to sex, age or instances of melanism and leucism—or whether there is indeed more than one species of living fossa.

Description

The fossa appears as a diminutive form of a large felid, such as a cougar, but with a slender body and muscular limbs, and a tail nearly as long as the rest of the body. It has a mongoose-like head, relatively longer than that of a cat, although with a muzzle that is broad and short, and with large but rounded ears. It has medium brown eyes set relatively wide apart with pupils that contract to slits. Like many carnivorans that hunt at night, its eyes reflect light; the reflected light is orange in hue. Its head-body length is 70–80 cm (28–31 in) and its tail is 65–70 cm (26–28 in) long. There is some sexual dimorphism, with adult males (weighing 6.2–8.6 kg; 14–19 lb) being larger than females (5.5–6.8 kg; 12–15 lb). Smaller individuals are typically found north and east on Madagascar, while larger ones to the south and west. Unusually large individuals weighing up to 20 kg (44 lb) have been reported, but there is some doubt as to the reliability of the measurements. The fossa can smell, hear, and see well. It is a robust animal and illnesses are rare in captive fossas.



Cranium (dorsal, ventral, and lateral views) and mandible (lateral and dorsal views)

Both males and females have short, straight fur that is relatively dense and without spots or patterns. Both sexes are generally a reddish-brown dorsally and colored a dirty cream ventrally. When in rut, they may have an orange coloration to their abdomen from a reddish substance secreted by a chest gland secretions, but this has not been consistently observed by all researchers. The tail tends to be lighter in coloration than the sides. Juveniles are either gray or nearly white.

Several of the animal's physical features are adaptations to climbing through trees. It uses its tail to aid in balance and has semi-retractable claws that it uses to climb trees in its search for prey. It has semiplantigrade feet, switching between a plantigrade-like gait (when arboreal) and a digitigrade-like one (when terrestrial). The soles of its paws are

nearly bare and covered with strong pads. The fossa has very flexible ankles that allow it to readily grasp tree trunks so as to climb up or down trees head first or to leap to another tree. Captive juveniles have been known to swing upside down by their hindfeet from knotted ropes.

The fossa has several scent glands, although the glands are less developed in females. Like herpestids it has a perianal skin gland inside an anal sac which surrounds the anus like a pocket. The pocket opens to the exterior with a horizontal slit below the tail. Other glands are located near the penis or vagina, with the penile glands emitting a strong odor. Like the herpestids, it has no prescrotal glands.

One of the more interesting physical features of this species is its external genitalia. Males have an unusually long penis and baculum (penis bone), reaching to between its forelegs when erect. The glans extends about halfway down the shaft and is spiny except at the tip. In comparison, the glans of felids is short and spiny, while that of viverrids is smooth and long. The female fossa exhibits transient masculinization, starting at about 1–2 years of age, developing an enlarged, spiny clitoris that resembles a male's penis. The enlarged clitoris is supported by an os clitoridis, which decreases in size as the animal grows. Females do not have a pseudo-scrotum, but they do secrete an orange substance that colors their underparts, much like the secretions of males. Hormone levels (testosterone, androstenedione, dihydrotestosterone) do not seem to play a part in this transient masculinization, as those levels are the same in masculinized juveniles and nonmasculinized adults. It is speculated that the transient masculinization either reduces sexual harassment of juvenile females by adult males, or reduces aggression from territorial females. While females of other mammal species (such as the spotted hyena) have a pseudo-penis, none of them are known to have theirs diminish in size as the animal grows.

Comparison with related carnivores

Overall, the fossa has features in common with three different carnivoran families, leading researchers to place it and other members of the Eupleridae alternatively in Herpestidae, Viverridae, and Felidae. Felid features are primarily those associated with eating and digestion, including teeth shape and facial portions of the skull, the tongue, and the digestive tract, typical of its exclusively carnivorous diet. The remainder of the skull most closely resembles those of genus *Viverra*, while the general body structure is most similar to that of various members of Herpestidae. The permanent dentition is 3.1.3–4.1 3.1.3–4.1 (three incisors, one canine, three or four premolars, and one molar on each side of both the upper and lower jaws), with the deciduous formula being similar but lacking the fourth premolar and the molar. The fossa has a large, prominent rhinarium similar to that of viverrids, but has comparatively larger, round ears, almost as large as those of a similarly sized felid. Its facial vibrissae (whiskers) are long, with the longest being longer than its head. Like some mongoose genera, particularly *Galidia* (which is now in the fossa's own Eupleridae family) and *Herpestes* (of Herpestidae), it has carpal vibrissae as well. Its claws are retractile, but unlike those of Felidae species, they are not hidden in skin sheaths. It has three pairs of nipples (one inguinal, one ventral, and one pectoral).

Habitat and distribution

The fossa has the most widespread geographical range of the Malagasy carnivores, and is generally found in low numbers throughout the island in remaining tracts of forest, preferring pristine undisturbed forest habitat. It is also encountered in some degraded forests, but in lower numbers. Although the fossa is found in all known forest habitats throughout Madagascar, including the western, dry deciduous forests, the eastern rainforests, and the southern spiny forests, it is seen more frequently in humid than in dry forests. This may be because the reduced canopy in dry forests provides less shade, and also because the fossa seems to travel more easily in humid forests. It is absent from areas with the heaviest habitat disturbance and, like most of Madagascar's fauna, from the central high plateau of the country.

The fossa has been found across several different elevational gradients in undisturbed portions of protected areas throughout Madagascar. In the Réserve Naturelle Intégrale d'Andringitra, evidence of the fossa has been reported at four different sites ranging from 810 to 1,625 m (2,660 to 5,331 ft). Its highest known occurrence was reported at 2,000 m (6,600 ft); its presence high on the Andringitra Massif was subsequently confirmed in 1996. Similarly, evidence has been reported of the fossa at the elevational extremes of 440 m (1,440 ft) and 1,875 m (6,152 ft) in the Andohahela National Park. The presence of the fossa at these locations indicates its ability to adapt to various elevations, consistent with its reported distribution in all Madagascar forest types.

Behavior



Fossa are active both day and night (catheMERal).

The fossa is active during both the day and the night and is considered cathemeral; activity peaks may occur early in the morning, late in the afternoon, and late in the night. The animal generally does not reuse sleeping sites, but females with young do return to the same den. The home ranges of male fossas in Kirindy Forest are up to 26 km² (10 sq mi) large, compared to 13 km² (5.0 sq mi) for females. These ranges overlap—by about 30% according to data from the eastern forests—but females usually have separated ranges. Home ranges grow during the dry season, perhaps because less food and water is available. In general, radio-collared fossas travel between 2 and 5 kilometres (1.2 and 3.1 mi) per day, although in one reported case a fossa was observed moving a straight-line distance of 7 km (4.3 mi) in 16 hours. The animal's population density appears to be low: in Kirindy Forest, where it is thought to be common, its density has been estimated at one animal per 4 km² (1.5 sq mi) in 1998. Another study in the same forest between 1994 and 1996 using the mark and recapture method indicated a population density of one animal per 3.8 km² (1.5 sq mi) and one adult per 5.6 km² (2.2 sq mi).

Except for mothers with young and occasional observations of pairs of males, animals are usually found alone, so that the species is considered solitary. A 2009 publication, however, reported a detailed observation of cooperative hunting, wherein three male fossas hunted a 3 kg (6.6 lb) sifaka (*Propithecus verreauxi*) for 45 minutes, and subsequently shared the prey. This behavior may be a vestige of cooperative hunting that would have been required to take down larger recently extinct lemurs.

Fossas communicate using sounds, scents, and visual signals. Vocalizations include purring, a threatening call, and a call of fear, consisting of "repeated loud, coarse inhalations and gasps of breath". A long, high yelp may function to attract other fossas. Females mew during mating and males produce a sigh when they have found a female. Throughout the year, animals produce long-lasting scent marks on rocks, trees, and the ground using glands in the anal region and on the chest. They also communicate using face and body expression, but the significance of these signals is uncertain. The animal is aggressive only during mating, and males in particular fight boldly. After a short fight, the loser flees and is followed by the winner for a short distance. In captivity, fossas are usually not aggressive and sometimes even allow themselves to be stroked by a zookeeper, but adult males in particular may try to bite.

Diet

The fossa is a carnivore that hunts small to medium-sized animals. One of eight carnivorous species endemic to Madagascar, the fossa is the island's largest surviving endemic terrestrial mammal and the only predator capable of preying upon adults of all extant lemur species, the largest of which can weigh as much as 90% of the weight of the average fossa. Although it is the predominant predator of lemurs, reports of its dietary habits demonstrate a wide variety of prey selectivity and specialization depending on habitat and season; diet does not vary by sex. While the fossa is thought to be a lemur specialist in Ranomafana National Park, its diet is more variable in other rain forest habitats.



The fossa's diet includes small- (Gray Mouse Lemur, above) to medium-sized (Diademed Sifaka, below) mammals.

The diet of the fossa in the wild has been studied by analyzing their distinctive scats, which resemble gray cylinders with twisted ends and measure 10–14 cm (3.9–5.5 in) long by 1.5–2.5 cm (0.6–1.0 in) thick. Scat collected and analyzed from both Andohahela and Andringitra contained lemur matter and rodents. Eastern populations in Andringitra incorporate the widest recorded variety of prey, including both vertebrates and invertebrates. Vertebrates consumed ranged from reptiles to a wide variety of birds, including both understory and ground birds, and mammals, including insectivores, rodents, and lemurs. Invertebrates eaten by the fossa in the high mountain zone of Andringitra include insects and crabs. One study found that vertebrates comprised 94% of the diet of fossas, with lemurs comprising over 50%, followed by tenrecs (9%), lizards (9%), and birds (2%). Seeds, which comprised 5% of the diet, may have been in the stomachs of the lemurs eaten, or may have been consumed with fruit taken for water, as seeds were more common in the stomach in the dry season. The average prey size varies geographically; it is only 40 grams (1.4 oz) in the high mountains of Andringitra, in contrast to 480 grams (17 oz) in humid forests and over 1,000 grams (35 oz) in dry deciduous forests. In a study of fossa diet in the dry deciduous forest of western Madagascar, more than 90% of prey items were vertebrates, and more than 50% were lemurs. The primary diet consisted of approximately six lemur species and two or three spiny tenrec species, along with snakes and small mammals. Generally, the fossa preys upon larger lemurs and rodents in preference to smaller ones.

Prey is obtained by hunting either on the ground or in the trees. During the non-breeding season the fossa hunts individually, but during the breeding season hunting parties may be seen, and these may be pairs or later on mothers and young. One member of the group scales a tree and chases the lemurs from tree to tree, forcing them down to the ground where the other is easily able to capture them. The fossa is known to eviscerate its larger lemur prey, a trait that, along with its distinct scat, helps identify its kills. Long-term observations of the fossa's predation patterns on rainforest sifakas suggest that the fossa hunts in a subsection of their range until prey density is increased, then moves on. The fossa has been reported to prey on domestic animals, such as goats and small calves, and especially chickens. In captivity, the fossa consumes between 800 and 1,000 grams (28 and 35 oz) of meat a day. Food taken in captivity includes amphibians, birds, insects, reptiles, and small- to medium-sized mammals.

This wide variety of prey items taken in various rainforest habitats is similar to the varied dietary composition noted occurring in the dry forests of western Madagascar, as well. As the largest endemic predator on Madagascar, this dietary flexibility combined with a flexible activity pattern has allowed it to exploit a wide variety of niches available throughout the island, making it a potential keystone species for the Madagascar ecosystems.

Breeding



Fossa illustration circa 1927

Most of the details of reproduction in wild populations are from the western dry deciduous forests; whether certain of these details are applicable to eastern populations will require further field research. Mating typically occurs during September and October, although there are reports of it occurring as late as December, and can be highly conspicuous. In captivity in the Northern Hemisphere, fossas instead mate in the northern Spring, from March to July. Intromission usually occurs in trees on horizontal limbs about 20 m (66 ft) off the ground. Frequently the same tree is used year after year, with remarkable precision as to the date the season commences. Trees are often near a water source, and have limbs strong enough and wide enough to support the mating pair, about 20 cm (7.9 in) wide. Some mating has been reported on the ground as well.

As many as eight males will be at a mating site, staying in close vicinity to the receptive female. The female seems to choose the male she mates with, and the males compete for the attention of the female with a significant amount of vocalization and antagonistic interactions. The female may choose to mate with several of the males, and her choice of mate does not seem to have any correlation to the physical appearance of the males. To stimulate the male to mount her, she gives a series of mewling vocalizations. The male mounts from behind, resting his body on her slightly off-center, a position requiring delicate balance; if the female were to stand, the male would have significant difficulty continuing. He places his paws on her shoulders or grasps her around the waist and often licks her neck. Mating may last for nearly three hours. This unusually lengthy mating is due to the physical nature of the male's erect penis, which has backwards-pointing spines along most of its length. Fossa mating includes a copulatory tie, which may be enforced by the male's spiny penis. The tie is difficult to break if the mating session is interrupted. Copulation with a single male may be repeated several times, with a total mating time of

up to fourteen hours, while the male may remain with the female for up to an hour after the mating. A single female may occupy the tree for up to a week, mating with multiple males over that time. Also, other females may take her place, mating with some of the same males as well as others. This mating strategy, whereby the females monopolize a site and maximize the available number of mates, seems to be unique among carnivores. Recent research suggests that this system helps the fossa overcome factors which would normally impede mate-finding, such as low population density and lack of den use.

The birthing of the litter of one to six (typically two to four) takes place in a concealed location, such as an underground den, a termite mound, a rock crevice, or in the hollow of a large tree (particularly those of the *Commiphora* genus). Contrary to older research, litters are of mixed sexes. Young are born in December or January, making the gestation period 90 days, with the late mating reports indicating a gestational period of about six to seven weeks. The newborns are blind and toothless, and weigh no more than 100 g (3.5 oz). The fur is thin and has been described as gray-brown or nearly white. After about two weeks the cubs' eyes open, they become more active, and their fur darkens to a pearl gray. The cubs do not take solid food until three months old, and do not leave the den until they are 4.5 months old; they are weaned shortly after that. After the first year, the juveniles are independent of their mother. Permanent teeth appear at 18 to 20 months. Physical maturity is reached by about two years old, but sexual maturity does not happen for another year or two, and the young may stay with their mother until they are fully mature. Lifespan in captivity is up to or past 20 years of age, possibly due to the slow juvenile development.

Human interactions

The fossa has been assessed as "Vulnerable" by the IUCN Red List since 2008, as its population size has probably declined by at least 30% over the last 21 years; previous assessments have included "Endangered" (2000) and "Insufficiently Known" (1988, 1990, 1994). The species is dependent on forest and thus threatened by the widespread destruction of Madagascar's native forest, but is also able to persist in disturbed areas. A suite of microsatellite markers (short segments of DNA that have a repeated sequence) have been developed to help aid in studies of genetic health and population dynamics of both captive and wild fossas. Several pathogens have been isolated from the fossa, some of which, such as anthrax and canine distemper, are thought to have been transmitted by feral dogs or cats.

Although the species is widely distributed, it is locally rare in all regions, making them particularly vulnerable to extinction. The effects of habitat fragmentation increase the risk. For its size, the fossa has a lower than predicted population density, which is further threatened by Madagascar's rapidly disappearing forests and dwindling lemur populations, which make up a high proportion of its diet. The loss of the fossa, either locally or completely, could significantly impact ecosystem dynamics, possibly leading to over-grazing by some of its prey species. The total population of the fossa living within protected areas is estimated at less than 2,500 adults, but this may be an overestimate. Only two protected areas are thought to contain 500 or more adult fossas: Masoala

National Park and Midongy-Sud National Park, although these are also thought to be overestimated. Too little population information has been collected for a formal population viability analysis, but estimates suggest that none of the protected areas support a viable population. If this is correct, the extinction of the fossa may take as much as 100 years to occur as the species gradually declines. In order for the species to survive, it is estimated that at least 555 km² (214 sq mi) is needed to maintain smaller, short-term viable populations, and at least 2,000 km² (770 sq mi) for populations of 500 adults.

Taboo, known in Madagascar as *fady*, offers protection for the fossa and other carnivores. In the Marolambo District (part of the Atsinanana region in Toamasina Province), the fossa has traditionally been hated and feared as a dangerous animal. It has been described as "greedy and aggressive", known for taking fowl and piglets, and believed to "take little children who walk alone into the forest". Some do not eat it for fear that it will transfer its undesirable qualities to anyone who consumes it. However, the animal is also taken for bushmeat; a study published in 2009 reported that 57% of villages (8 of 14 sampled) in the Makira forest consume fossa meat. The animals were typically hunted using slingshots, with dogs, or most commonly, by placing snare traps on animal paths. Near Ranomafana National Park, the fossa, along with several of its smaller cousins and the introduced small Indian civet (*Viverricula indica*), are known to "scavenge on the bodies of ancestors", which are buried in shallow graves in the forest. For this reason, eating these animals is strictly prohibited by *fady*. However, if they wander into villages in search of domestic fowl, they may be killed or trapped. Small carnivore traps have been observed near chicken runs in the village of Vohiparara.

Fossas are occasionally held in captivity in zoos. They first bred in captivity in 1974 in the zoo of Montpellier. The next year, at a time when there were only eight fossas in the world's zoos, the Duisburg Zoo acquired one; this zoo later started a successful breeding program, and most zoo fossas now descend from the Duisburg population. Research on the Duisburg fossas has provided much data about their biology.

Chapter 4

Giant Panda

Giant panda



Giant panda at Ocean Park, Hong Kong

Conservation status



Endangered (IUCN 3.1)

Scientific classification [e]

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Carnivora
Family:	Ursidae
Genus:	<i>Ailuropoda</i>
Species:	<i>A. melanoleuca</i>

Binomial name

Ailuropoda melanoleuca
(David, 1869)

Subspecies

- *A. melanoleuca melanoleuca*
- *A. melanoleuca qinlingensis*



Giant panda range

The **giant panda**, or **panda** (*Ailuropoda melanoleuca*, literally meaning "black and white cat-foot") is a bear native to central-western and south western China. It is easily recognized by its large, distinctive black patches around the eyes, over the ears, and across its round body. Though it belongs to the order Carnivora, the panda's diet is 99% bamboo. Pandas in the wild will occasionally eat other grasses, wild tubers, or even meat in the form of birds, rodents or carrion. In captivity they may receive honey, eggs, fish, yams, shrub leaves, oranges, or bananas along with specially prepared feed.

The giant panda lives in a few mountain ranges in central China, mainly in Sichuan province, but also in the Shaanxi and Gansu provinces. Due to farming, deforestation and other development, the panda has been driven out of the lowland areas where it once lived.

The panda is a conservation reliant endangered species. A 2007 report shows 239 pandas living in captivity inside China and another 27 outside the country. Wild population estimates vary; one estimate shows that there are about 1,590 individuals living in the wild, while a 2006 study via DNA analysis estimated that this figure could be as high as 2,000 to 3,000. Some reports also show that the number of pandas in the wild is on the rise. However, the IUCN does not believe there is enough certainty yet to reclassify the species from Endangered to Vulnerable.

While the dragon has historically served as China's national emblem, in recent decades the panda has also served as an emblem for the country. Its image appears on a large number of modern Chinese commemorative silver, gold, and platinum coins. Though the

panda is often assumed to be docile, it has been known to attack humans, presumably out of irritation rather than predation.

Description

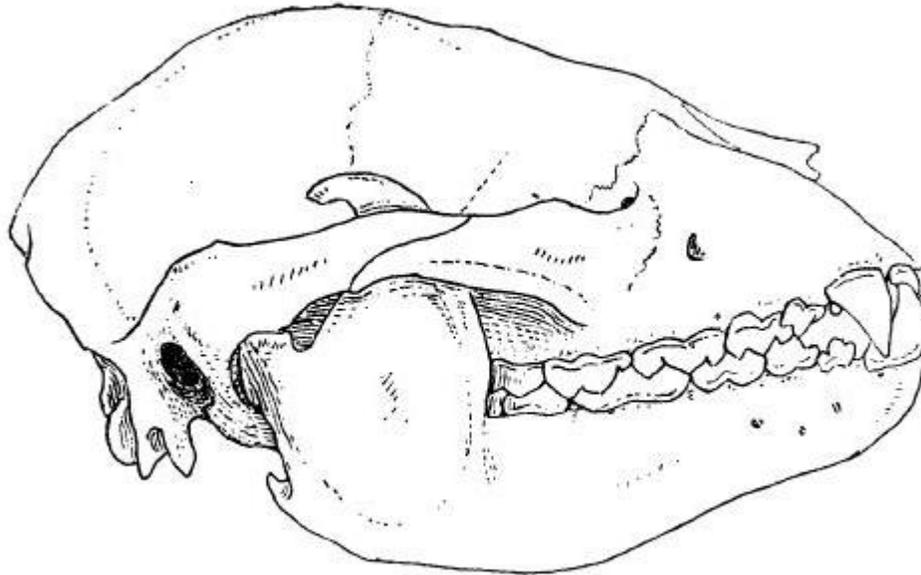


Fig. 53.—Side view of the skull of the Giant Panda (*Ailuropoda melanoleuca*).

Skull, as illustrated in Pocock's *The Fauna of British India, including Ceylon and Burma*
- *Mammalia* Vol 2



A giant panda cub. At birth, the giant panda typically weighs 100 to 200 grams (3 ½ to 7 oz) and measures 15 to 17 centimeters (6 to 7 in) long.

The giant panda has a black-and-white coat. Adults measure around 1.5 meters (5 ft) long and around 75 centimeters (2 ft 6 in) tall at the shoulder. Males can weigh up to 150 kilograms (330 lb). Females (generally 10–20% smaller than males) can weigh up to 125 kilograms (280 lb).

The giant panda has a body shape typical of bears. It has black fur on its ears, eye patches, muzzle, legs, arms and shoulders. The rest of the animal's coat is white. Although scientists do not know why these unusual bears are black and white, some speculate that the bold coloring provides effective camouflage in its shade-dappled snowy and rocky surroundings. The giant panda's thick, wooly coat keeps it warm in the cool forests of its habitat. The giant panda has large molar teeth and strong jaw muscles for crushing tough bamboo.

The giant panda's paw has a "thumb" and five fingers; the "thumb" is actually a modified sesamoid bone, which helps the giant panda to hold bamboo while eating. Stephen Jay Gould discusses this feature in his book of essays on evolution and biology, *The Panda's Thumb*.

The giant panda's tail, measuring 10 to 15 centimeters (4 to 6 in), is the second longest in the bear family. The longest belongs to the Sloth Bear.

The giant panda usually lives around 20 years in the wild and up to 30 years in captivity.

Behavior

In the wild, the giant panda is a terrestrial animal and primarily spends its life roaming and feeding in the bamboo forests of the Qinling Mountains and in the hilly Sichuan Province. Though generally alone, each adult has a defined territory and females are not tolerant of other females in their range. Pandas communicate through vocalization and scent marking such as clawing trees or spraying urine. The giant panda is able to climb and take shelter in hollow trees or rock crevices but does not establish permanent dens. For this reason, pandas do not hibernate, which is similar to other subtropical mammals, and will instead move to elevations with warmer temperatures. Pandas rely primarily on spatial memory rather than visual memory.

Social encounters occur primarily during the brief breeding season in which pandas in proximity to one another will gather. After mating, the male leaves the female alone to raise the cub.

Diet

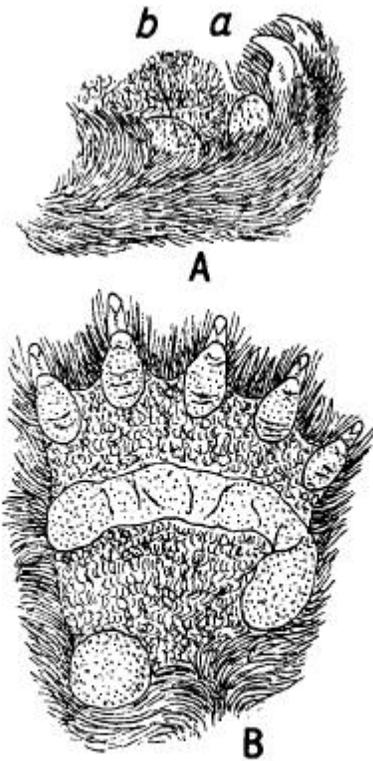


Fig. 51.

- A. Inner view of right fore foot of the Giant Panda (*Ailuropoda melanoleuca*), showing the method of folding the pad (a) of the first digit on the accessory lobe, (b) of the plantar pad to constitute the grasping organ.
- B. Lower view of right fore foot of the same, with the long hairs clipped or turned aside and the digits spread to show the webbing; also shown are the accessory lobe on the plantar pad and the carpal pad.

Forefeet



Pandas eating bamboo at the National Zoo in Washington, D.C.



Panda eating, standing, playing

Despite its taxonomic classification as a carnivoran, the giant panda's diet is primarily herbivorous, consisting almost exclusively of bamboo. However, the giant panda still has the digestive system of a carnivore, as well as carnivore-specific genes, and thus derives little energy and little protein from consumption of bamboo. Its ability to digest cellulose is ascribed to the microbes in its gut. The average giant panda eats as much as 9 to 14 kg (20 to 30 pounds) of bamboo shoots a day. Because the giant panda consumes a diet low in nutrition, it is important for it to keep its digestive tract full. The limited energy input imposed on it by its diet has affected the panda's behavior. The giant panda tends to limit its social interactions and avoids steeply sloping terrain in order to limit its energy expenditures.

Two of the panda's most distinctive features, its large size and its round face, are adaptations to its bamboo diet. Panda researcher Russell Ciochon observed that: “[much] like the vegetarian gorilla, the low body surface area to body volume [of the giant panda] is indicative of a lower metabolic rate. This lower metabolic rate and a more sedentary lifestyle allow the giant panda to subsist on nutrient poor resources such as bamboo.” Similarly, the giant panda's round face is the result of powerful jaw muscles, which attach from the top of the head to the jaw. Large molars crush and grind fibrous plant material.

Pandas eat any of twenty-five bamboo species in the wild, such as *Fargesia dracocephala* and *Fargesia rufa*. Only a few bamboo species are widespread at the high altitudes pandas now inhabit. Bamboo leaves contain the highest protein levels; stems have less. Given this large diet, the giant panda can defecate up to 40 times a day.

Because of the synchronous flowering, death, and regeneration of all bamboo within a species, the giant panda must have at least two different species available in its range to avoid starvation. While primarily herbivorous, the giant panda still retains decidedly ursine teeth, and will eat meat, fish, and eggs when available. In captivity, zoos typically maintain the giant panda's bamboo diet, though some will provide specially-formulated biscuits or other dietary supplements.

Genomics

The giant panda genome was sequenced in 2009 using a next-generation sequencing technology. Its genome contains 20 pairs of autosomes and one pair of sex chromosomes.

Classification

For many decades the precise taxonomic classification of the giant panda was under debate because it shares characteristics of both bears and raccoons. However, molecular studies suggest that the giant panda is a true bear and part of the Ursidae family, though it differentiated early in history from the main ursine stock. The giant panda's closest ursine relative is the spectacled bear of South America. The giant panda has been referred to as a living fossil.

Despite the shared name, habitat type, and diet, as well as a unique enlarged bone called the *pseudo thumb* (which helps them grip the bamboo shoots they eat), the giant panda and red panda are only distantly related. Molecular studies have placed the red panda in its own family Ailuridae, and not under Ursidae.



Hua Mei, the baby panda born at the San Diego Zoo in 1999.

Subspecies

Two subspecies of giant panda have been recognized on the basis of distinct cranial measurements, color patterns, and population genetics (Wan et al., 2005).

- The nominate subspecies *Ailuropoda melanoleuca melanoleuca* consists of most extant populations of panda. These animals are principally found in Sichuan and display the typical stark black and white contrasting colors.
- The Qinling Panda, *Ailuropoda melanoleuca qinlingensis* is restricted to the Qinling Mountains in Shaanxi at elevations of 1300–3000 m. The typical black and white pattern of Sichuan giant pandas is replaced with a dark brown versus light brown pattern. The skull of *A. m. qinlingensis* is smaller than its relatives, and it has larger molars.

Uses and human interaction

Early references

In the past, pandas were thought to be rare and noble creatures – the mother of Emperor Wen of Han was buried with a panda skull in her vault. The grandson of Emperor Taizong of Tang is said to have given Japan two pandas and a sheet of panda skin as a sign of goodwill. Unlike many other animals in Ancient China, pandas were rarely thought to have medical uses. The few known uses include the Sichuan tribal peoples' use of panda urine to melt accidentally swallowed needles, and the use of panda pelts to control menses as described in the Qin Dynasty encyclopedia *Erya*.

The creature named *mo* (貘) mentioned in some ancient books has been interpreted as giant panda. The dictionary *Shuowen Jiezi* (Eastern Han Dynasty) says that the *mo*, from Shu (Sichuan), is bear-like, but yellow-and-black, although the older *Erya* describes *mo* simply as a "white leopard". The interpretation of the legendary fierce creature *pixiu* (貔貅) as referring to the giant panda are also common.

The comparative obscurity of the giant panda throughout most of China's history is illustrated by the fact that, despite there being a number of depictions of bears in Chinese art starting from its most ancient times, and the bamboo being one of the favorite subjects for Chinese painters, there are no known pre-20th-century artistic representations of giant pandas.

Modern "discovery"

The West first learned of the giant panda in 1869 because the French missionary Armand David received a skin from a hunter on March 11, 1869. The first Westerner known to have seen a living giant panda is the German zoologist Hugo Weigold, who purchased a cub in 1916. Kermit and Theodore Roosevelt, Jr., became the first Westerners to shoot a panda, on an expedition funded by the Field Museum of Natural History in the 1920s. In 1936, Ruth Harkness became the first Westerner to bring back a live giant panda, a cub named Su Lin who went to live at the Brookfield Zoo in Chicago. In 1938, five giant pandas were sent to London; these activities were later halted because of wars and for the next half of the century, the West knew little of pandas.



Gao Gao, an adult male giant panda at San Diego Zoo.

Panda diplomacy

Loans of giant pandas to American and Japanese zoos formed an important part of the diplomacy of the People's Republic of China in the 1970s, as it marked some of the first cultural exchanges between the People's Republic and the West. This practice has been termed "Panda diplomacy".

By 1984, however, pandas were no longer used as agents of diplomacy. Instead, China began to offer pandas to other nations only on 10-year loans. The standard loan terms include a fee of up to US\$1,000,000 per year and a provision that any cubs born during the loan are the property of the People's Republic of China. Since 1998, due to a WWF lawsuit, the United States Fish and Wildlife Service only allows a U.S. zoo to import a panda if the zoo can ensure that China will channel more than half of its loan fee into conservation efforts for the giant panda and its habitat.

In May 2005, China offered a breeding pair to Taiwan. The issue became embroiled in cross-Strait relations—both over the underlying symbolism, and over technical issues such as whether the transfer would be considered "domestic" or "international," or whether any true conservation purpose would be served by the exchange. China's offer was initially rejected by President Chen of Taiwan. However when the presidency changed hands China's offer was accepted at the beginning of Ma Ying-jeou's presidency in 2008, and the pandas themselves arrived in December of that year. A contest to name

the pandas was held in China, resulting in the politically charged names "Tuan Tuan" and "Yuan Yuan" (from *tuanyuan*, meaning "reunion", i.e. "reunification").

Conservation

The giant panda is an endangered species, threatened by continued habitat loss and by a very low birthrate, both in the wild and in captivity.

The giant panda has been a target for poaching by locals since ancient times and by foreigners since it was introduced to the West. Starting in the 1930s, foreigners were unable to poach giant pandas in China because of the Second Sino-Japanese War and the Chinese Civil War, but pandas remained a source of soft furs for the locals. The population boom in China after 1949 created stress on the pandas' habitat, and the subsequent famines led to the increased hunting of wildlife, including pandas. During the Cultural Revolution, all studies and conservation activities on the pandas were stopped. After the Chinese economic reform, demand for panda skins from Hong Kong and Japan led to illegal poaching for the black market, acts generally ignored by the local officials at the time.



Close up of a baby seven-month-old panda cub in the Wolong Nature Reserve in Sichuan, China.

Though the Wolong National Nature Reserve was set up by the PRC government in 1958 to save the declining panda population, few advances in the conservation of pandas were

made, due to inexperience and insufficient knowledge of ecology. Many believed that the best way to save the pandas was to cage them. As a result, pandas were caged at any sign of decline, and suffered from terrible conditions. Because of pollution and destruction of their natural habitat, along with segregation due to caging, reproduction of wild pandas was severely limited. In the 1990s, however, several laws (including gun control and the removal of resident humans from the reserves) helped the chances of survival for pandas. With these renewed efforts and improved conservation methods, wild pandas have started to increase in numbers in some areas, even though they still are classified as a rare species.

In 2006, scientists reported that the number of pandas living in the wild may have been underestimated at about 1,000. Previous population surveys had used conventional methods to estimate the size of the wild panda population, but using a new method that analyzes DNA from panda droppings, scientists believe that the wild panda population may be as large as 3,000. Although the species is still endangered, it is thought that the conservation efforts are working. In 2006, there were 40 panda reserves in China, compared to just 13 reserves two decades ago.

The giant panda is among the world's most adored and protected rare animals, and is one of the few in the world whose natural inhabitant status was able to gain a UNESCO World Heritage Site designation. The Sichuan Giant Panda Sanctuaries, located in the southwest Sichuan province and covering seven natural reserves, were inscribed onto the World Heritage List in 2006.

Not all conservationists agree that the money spent on conserving pandas is money well spent. Chris Packham has argued that breeding pandas in captivity is "pointless" because "there is not enough habitat left to sustain them". Packham argues that the money spent on pandas would be better spent elsewhere, and has said that he would "eat the last panda if I could have all the money we have spent on panda conservation put back on the table for me to do more sensible things with," though he has apologized for upsetting people who like pandas. He points out that "The panda is possibly one of the grossest wastes of conservation money in the last half century."

Reproduction



Panda Research and Breeding Centre in Chengdu.

Initially the primary method of breeding giant pandas in captivity was by artificial insemination, as they seemed to lose their interest in mating once they were captured. This led some scientists to try extreme methods such as showing them videos of giant Pandas mating and giving the males Viagra. Only recently have researchers started having success with captive breeding programs, and they have now determined that giant pandas have comparable breeding to some populations of the American black bear, a thriving bear family. The current reproductive rate is considered one young every two years.

Giant pandas reach sexual maturity between the ages of four and eight, and may be reproductive until age 20. The mating season is between March and May, when a female goes into her estrous cycle which lasts for two or three days and only occurs once a year. When mating, the female is in a crouching, head-down position as the male mounts her from behind. Copulation time is short, ranging from thirty seconds to five minutes, but the male may mount her repeatedly to ensure successful fertilization. The gestation period ranges from 95 to 160 days. Cubs weigh only 90 to 130 grams (3.2 to 4.6 ounces), which is about 1/800 of the mother's weight.

If twins are born, usually only one survives in the wild. The mother will select the stronger of the cubs, and the weaker will die. It is thought that the mother cannot produce

enough milk for two cubs since she does not store fat. The father has no part in helping raise the cub.

When the cub is first born, it is pink, blind, and toothless. A giant panda cub is also extremely small, and it is difficult for the mother to protect it because of the baby's size. It nurses from its mother's breast 6 to 14 times a day for up to 30 minutes at a time. For three to four hours, the mother may leave the den to feed, which leaves the cub defenseless. One to two weeks after birth, the cub's skin turns gray where its hair will eventually become black. A slight pink color may appear on cub's fur, as a result of a chemical reaction between the fur and its mother's saliva. A month after birth, the color pattern of the cub's fur is fully developed. A cub's fur is very soft and coarsens with age. The cub begins to crawl at 75 to 80 days; mothers play with their cubs by rolling and wrestling with them. The cubs are able to eat small quantities of bamboo after six months, though mother's milk remains the primary food source for most of the first year. Giant panda cubs weigh 45 kg (100 pounds) at one year, and live with their mothers until they are 18 months to two years old. The interval between births in the wild is generally two years.

In July 2009, Chinese scientists confirmed the birth of the first cub to be successfully conceived through artificial insemination using frozen sperm. The cub was born at 07:41 on 23 July that year in Sichuan as the third cub of You You, an 11-year-old. The technique for freezing the sperm in liquid nitrogen was first developed in 1980 and the first birth was hailed as a solution to the problem of lessening giant panda semen availability which had led to in-breeding. It has been suggested that panda semen, which can be frozen for decades, could be shared between different zoos to save the species. It is expected that zoos in destinations such as San Diego in the United States and Mexico City will now be able to provide their own semen to inseminate more giant pandas.

Attempts have also been made to reproduce giant pandas by interspecific pregnancy by implanting cloned panda embryos into the uterus of an animal of another species. This has resulted in panda fetuses, but no live births.

Name

There is no conclusive explanation of the origin of the word "panda". The closest candidate is the Nepali word *ponya*, possibly referring to the adapted wrist bone. The Western world originally applied this name to the red panda. Until 1901, when it was erroneously stated that it was related to the red panda, the giant panda was known as "mottled bear" (*Ailuropus melanoleucus*) or "particolored bear".

In most encyclopedic sources, the name "panda" or "common panda" originally referred to the lesser-known red panda, thus necessitating the inclusion of "giant" and "lesser/red" prefixes in front of the names. Even in 2010, the *Encyclopædia Britannica* still used "giant panda" or "panda bear" for the bear and simply "panda" for the Ailuridae, despite the popular usage of the word "panda".

Since the earliest collection of Chinese writings, the Chinese language has given the bear 20 different names, such as 花熊 (hua xiong) "spotted bear" and 竹熊 (zhu xiong) "bamboo bear". The most popular names in China today are 大熊貓 (dà xióng māo), literally "large bear cat", or just 熊貓 (xióng māo), "bear cat". The name may have been inspired by the giant panda's eyes, which have pupils that are cat-like vertical slits - unlike other bear species, which have round pupils.

In Taiwan, the popular name for panda is the inverted 貓熊 (māo xióng) "cat bear," even though many encyclopedia and dictionaries in Taiwan still use "bear cat" as the correct name. Some linguists argue that, in this construction, "bear" instead of "cat" is the base noun, making this name more grammatically and logically correct, which may have led to the popular choice despite official writings.

In zoos

Pandas have been kept in zoos as early as the Western Han Dynasty in China, where the writer Sima Xiangru notes that the panda was the most treasured animal in the emperor's garden of exotic animals in Xi'an. Not until the 1950s were pandas again recorded to have been exhibited in China's zoos.

A 2006 *New York Times* article outlined the economics of keeping pandas, which costs five times more than that of the next most expensive animal, an elephant. American zoos generally pay the Chinese government \$1 million a year in fees, as part of a typical ten-year contract. San Diego's contract with China was to expire in 2008 but got a five-year extension at about half of the previous yearly cost. The last contract, with the Memphis Zoo in Memphis, Tennessee, ends in 2013.

Asia

China



Tai Shan in June 2007

Many zoos and breeding centers in China house giant pandas. These include:

- Beijing Zoo – home of the internationally notorious Gu Gu.
- Bifengxia Panda Base, Ya'an, Sichuan – home to U.S. born giant pandas Mei Sheng (M), Hua Mei (F), Tai Shan (M), Su Lin (F), and Zhen Zhen (F). It is also home to the Austrian-born Fu Long.
- Chengdu Research Base of Giant Panda Breeding, Chengdu, Sichuan – Twelve cubs were born here in 2006. It is also home to Japanese-born Xiong Bang (M) and U.S.-born Mei Lan (F).
- China Conservation and Research Center for the Giant Panda at the Wolong National Nature Reserve, Sichuan – Seventeen cubs were born here in 2006.
- Ocean Park, Hong Kong – home to Jia Jia (F), An An (M), Le Le (M), and Ying Ying (F).

Other places in Asia

- Taipei Zoo, Taipei, Taiwan – home to Tuan Tuan (M) and Yuan Yuan (F).
- Chiang Mai Zoo, Chiang Mai, Thailand – home to Chuang Chuang (M), Lin Hui (F), and Lin Bing, a female cub born May 27, 2009

- Adventure World, Shirahama, Wakayama – Until recently, home to Ei Mei (M), Mei Mei (F), Rau Hin (F), Ryu Hin and Syu Hin (male twins), and Kou Hin (M). In December 2006, twin cubs were born to Ei Mei and Mei Mei. Two cubs, Eiihin (M) and Meihin (F), were born to Rau Hin on September 13, 2008. Mei Mei, a mother of ten cubs, died on October 15, 2008.
- Oji Zoo, Kobe, Hyōgo – home of Kou Kou (M), Tan Tan (F)
- River Safari, a new park under Wildlife Reserves Singapore, Singapore – to receive two pandas in 2012.

Australia

- Adelaide Zoo, Adelaide – home to Wang Wang (M) and Funi (F). They arrived on November 28, 2009, and went on display on December 14. They are expected to stay for a minimum of 10 years, and are the only giant pandas living in the Southern Hemisphere.

Europe



Giant panda in Vienna's zoo Tiergarten Schönbrunn

- Zoologischer Garten Berlin, Berlin, Germany – home of Bao Bao, age 32, the oldest male panda living in captivity; he has been in Berlin for 25 years and has never reproduced.
- Tiergarten Schönbrunn, Vienna, Austria – home to Yang Yang (F) and Long Hui (M), born in Wolong, China in 2000. They gave birth to Fu Long (M) in 2007, and Fu Hu (M) in 2010. Fu Long, who has been relocated to China, was the first to be born in Europe in 25 years.
- Zoo Aquarium, Madrid, Spain – home of Bing Xing (M) and Hua Zuiba (F) since 2007. They gave birth to twin cubs on September 7, 2010. The zoo was also the site of the first giant panda birth in Europe, back in 1982. That giant panda cub was named Chu-lin.
- The Edinburgh Zoo signed an agreement with the Wolong Nature Preserve on 10 January 2011 to obtain two giant pandas, Tian Tian (F) and Yang Guang (M).

North America



Bai Yun at San Diego Zoo, has given birth to 5 cubs in captivity and is considered one of the most successfully reproductive captive pandas

- Chapultepec Zoo, Mexico City – home of Xiu Hua, born on June 25, 1985, Shuan Shuan, born on June 15, 1987, and Xin Xin, born on July 1, 1990 from Tohui (Tohui born on Chapultepec Zoo on July 21, 1981 and died on November 16, 1993), all females.
- San Diego Zoo, San Diego, California – home of Bai Yun (F), Gao Gao (M), and Yun Zi (M).
- US National Zoo, Washington, D.C. – home of Mei Xiang (F) and Tian Tian (M).
- Zoo Atlanta, Atlanta, Georgia – home of Lun Lun (F), Yang Yang (M), Xi Lan (M), and Po (M), born 3 November 2010.

- Memphis Zoo, Memphis, Tennessee – home of Ya Ya (F) and Le Le (M)

Notable North American–born pandas

- Tohui (Nahuatl word for kid), born July 21, 1981, died November 16, 1993; female. Chapultepec Zoo, Mexico City. Was the first giant panda that was born and survived in captivity outside China. Her parents were Ying Ying and Pe Pe.
- Hua Mei, born 1999 in the San Diego Zoo and sent to China 2004.
- Mei Sheng, born 2003 at the San Diego Zoo, sent to China 2007.
- Tai Shan, born July 9, 2005 at the National Zoo in Washington, sent to China 2010.
- Su Lin, born August 2, 2005 at the San Diego Zoo and moved to China 2010.
- Mei Lan, born September 6, 2006 at Zoo Atlanta, sent to China 2010.
- Zhen Zhen, born August 3, 2007 at the San Diego Zoo and moved to China 2010.
- Xi Lan, born August 30, 2008 at Zoo Atlanta.
- Yun Zi, born August 5, 2009 at the San Diego Zoo.

Chapter 5

Tiger

Tiger



A Bengal Tiger (*P. tigris tigris*) in India's Ranthambhore National Park.

Conservation status



Endangered (IUCN 3.1)

Scientific classification

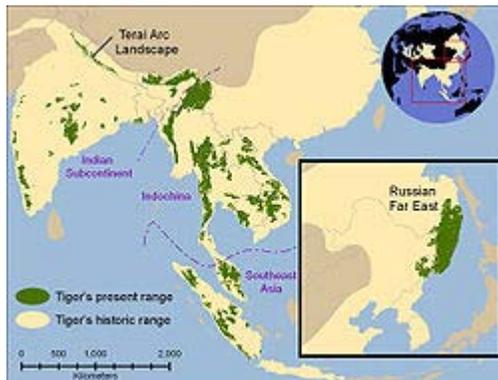
Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Carnivora
Family:	Felidae
Genus:	<i>Panthera</i>
Species:	<i>P. tigris</i>

Binomial name

Panthera tigris
(Linnaeus, 1758)

Subspecies

- P. t. tigris*
- P. t. corbetti*
- P. t. jacksoni*
- P. t. sumatrae*
- P. t. altaica*
- P. t. amoyensis*
- †*P. t. virgata*
- †*P. t. balica*
- †*P. t. sondaica*



Historical distribution of tigers (pale yellow) and 2006 (green).

Synonyms

Felis tigris Linnaeus, 1758

Tigris striatus Severtzov, 1858

Tigris regalis Gray, 1867

The **tiger** (*Panthera tigris*), a member of the Felidae family, is the largest of the four "big cats" in the genus *Panthera*. The tiger is native to much of eastern and southern Asia, and is an apex predator and an obligate carnivore. The larger tiger subspecies are comparable in size to the biggest extinct felids, reaching up to 3.3 metres (11 ft) in total length, weighing up to 300 kilograms (660 pounds), and having canines up to 4 inches long. Aside from their great bulk and power, their most recognisable feature is a pattern of dark vertical stripes that overlays near-white to reddish-orange fur, with lighter underparts. The most numerous tiger subspecies is the Bengal tiger, while the largest is the Siberian tiger.

Tigers have a lifespan of 10–15 years in the wild, but can live longer than 20 years in captivity. They are highly adaptable and range from the Siberian taiga to open grasslands and tropical mangrove swamps.

They are territorial and generally solitary animals, often requiring large contiguous areas of habitat that support their prey demands. This, coupled with the fact that they are indigenous to some of the more densely populated places on earth, has caused significant conflicts with humans. Three of the nine subspecies of modern tiger have gone extinct, and the remaining six are classified as endangered, some critically so. The primary direct causes are habitat destruction, fragmentation, and hunting.

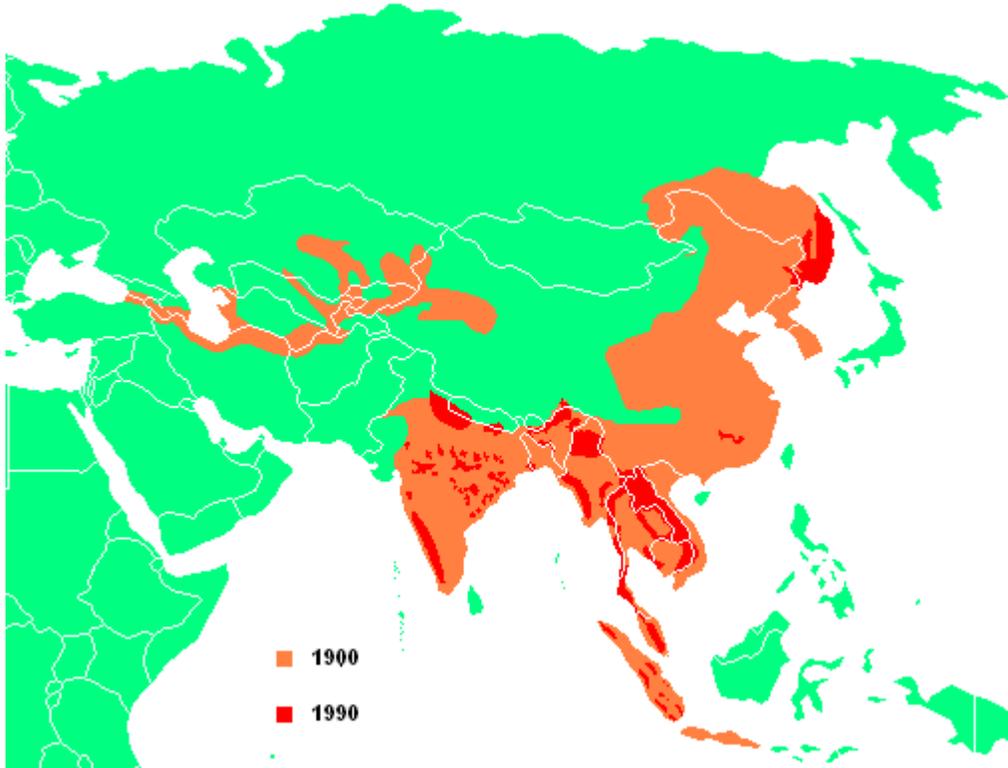
Historically, tigers have existed from Mesopotamia and the Caucasus throughout most of South and East Asia. Today, the range of the species is radically reduced. All surviving species are under formal protection, yet poaching, habitat destruction, and inbreeding depression continue to threaten the tigers.

Tigers are among the most recognisable and popular of the world's charismatic megafauna. They have featured prominently in ancient mythology and folklore, and continue to be depicted in modern films and literature. Tigers appear on many flags and coats of arms, as mascots for sporting teams, and as the national animal of several Asian nations, including India.

Naming and etymology

The word "tiger" is taken from the Greek word "*tigris*", which is possibly derived from a Persian source meaning "arrow", a reference to the animal's speed and also the origin for the name of the Tigris river. In American English, "tigress" was first recorded in 1611. It was one of the many species originally described by Linnaeus in his 18th century work, *Systema Naturae*: he called it *Felis tigris*. The generic component of its scientific designation, *Panthera tigris*, is often presumed to derive from Greek *pan-* ("all") and *theron* ("beast"), but this may be a folk etymology. Although it came into English through the classical languages, *panthera* is probably of Indian origin, meaning "the yellowish animal", or "whitish-yellow".

Tigers rarely form groups (see below), but collective nouns sometimes used when they do are "streak".



Range of the tiger including the western part 1900 and 1990

Range and habitat

In the past, tigers were found throughout Asia, from the Caucasus and the Caspian Sea to Siberia and Indonesia. Today the range of the tiger is only 7% of what it used to be. Furthermore, within the past decade alone, the estimated area known to be occupied by tigers has declined by 41%.

During the 19th century, the tiger completely vanished from western Asia and became restricted to isolated pockets in the remaining parts of their range. Today, their range is fragmented, and certain parts degraded, and extends from India in the west to China and Southeast Asia in the east. The northern limit is close to the Amur River in south eastern Siberia. The only large island inhabited by tigers today is Sumatra. Tigers vanished from Java and Bali during the 20th century. In Borneo they are known only from fossil remains.

Tiger habitats will usually include sufficient cover, proximity to water, and an abundance of prey. Bengal Tigers live in many types of forests, including wet; evergreen; the semi-evergreen of Assam and eastern Bengal; the mangrove forest of the Ganges Delta; the deciduous forest of Nepal, and the thorn forests of the Western Ghats. Compared to the lion, the tiger prefers denser vegetation, for which its camouflage colouring is ideally suited, and where a single predator is not at a disadvantage compared with the multiple felines in a pride.

Among the big cats, only the tiger and jaguar are strong swimmers; tigers are often found bathing in ponds, lakes, and rivers. During the extreme heat of the day, they often cool off in pools. Tigers are excellent swimmers, and are able to carry prey through the water.

Physical characteristics, taxonomy and evolution

The oldest remains of a tiger-like cat, called *Panthera palaeosinensis*, have been found in China and Java. This species lived about 2 million years ago, at the beginning of the Pleistocene, and was smaller than a modern tiger. The earliest fossils of true tigers are known from Java, and are between 1.6 and 1.8 million years old. Distinct fossils from the early and middle Pleistocene were also discovered in deposits from China, and Sumatra. A subspecies called the **Trinil tiger** (*Panthera tigris trinilensis*) lived about 1.2 million years ago and is known from fossils found at Trinil in Java.

Tigers first reached India and northern Asia in the late Pleistocene, reaching eastern Beringia (but not the American Continent), Japan, and Sakhalin. Fossils found in Japan indicate that the local tigers were, like the surviving island subspecies, smaller than the mainland forms. This may be due to the phenomenon in which body size is related to environmental space, or perhaps the availability of prey. Until the Holocene, tigers also lived in Borneo, as well as on the island of Palawan in the Philippines.

Physical characteristics

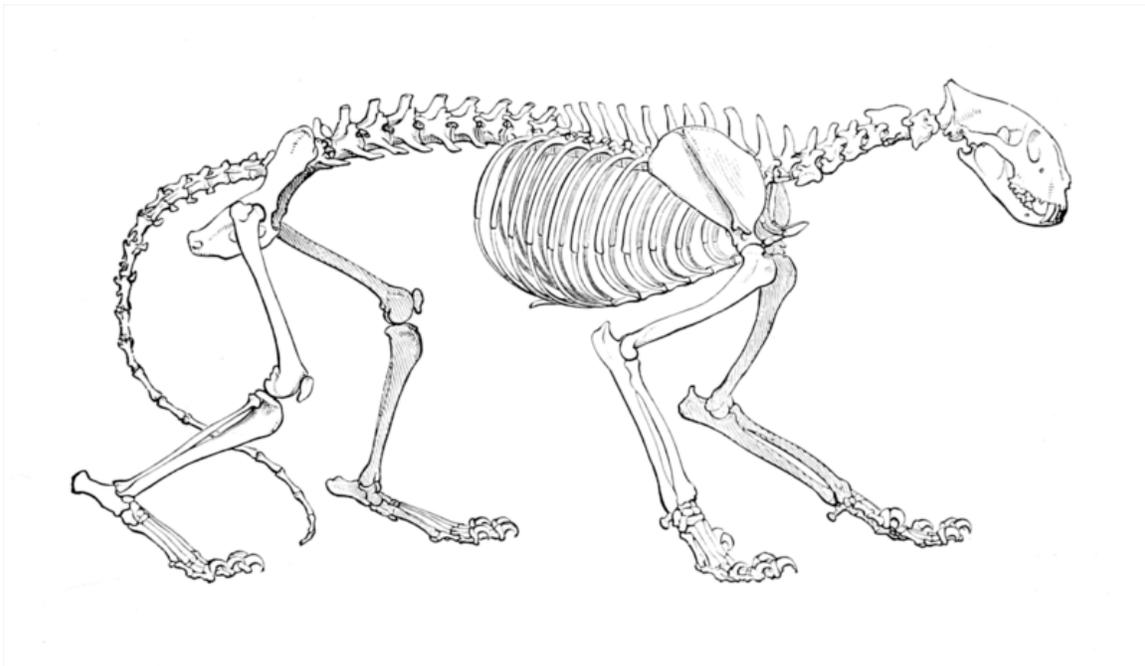


Siberian tiger

Tigers typically have rusty-reddish to brown-rusty coats, a whitish medial and ventral area, a white "fringe" that surrounds the face, and stripes that vary from brown or gray to pure black. The form and density of stripes differs between subspecies (as well as the ground coloration of the fur; for instance, Siberian tigers are usually paler than other tiger subspecies), but most tigers have over 100 stripes.

The pattern of stripes is unique to each animal, these unique markings can be used by researchers to identify individuals (both in the wild and captivity), much in the same way that fingerprints are used to identify humans. It seems likely that the function of stripes is camouflage, serving to help tigers conceal themselves amongst the dappled shadows and long grass of their environment as they stalk their prey. The stripe pattern is also found on the skin of the tiger. If a tiger were to be shaved, its distinctive camouflage pattern would be preserved.

Like other big cats, tigers have a white spot on the backs of their ears. These spots, called ocelli, serve a social function, by communicating the animal's mental state to conspecifics in the gloom of dense forest or in tall grass.



Skeleton

Tigers have the additional distinction of being the heaviest cats found in the wild. They also have powerfully built legs and shoulders, with the result that they, like lions, have the ability to pull down prey substantially heavier than themselves. However, the subspecies differ markedly in size, tending to increase proportionally with latitude, as predicted by Bergmann's Rule.

Large male Siberian Tigers (*Panthera tigris altaica*) can reach a total length of 3.5 m "over curves" (3.3 m. "between pegs") and a weight of 306 kilograms,. This is considerably larger than the sizes reached by island-dwelling tigers such as the Sumatran, the smallest living subspecies, with a body weight of only 75–140 kg.

Tigresses are smaller than the males in each subspecies, although the size difference between male and female tigers tends to be more pronounced in the larger subspecies of tiger, with males weighing up to 1.7 times more than the females. In addition, male tigers have wider forepaw pads than females. Biologists use this difference to determine gender based on tiger tracks. The skull of the tiger is very similar to that of the lion, though the frontal region is usually not as depressed or flattened, with a slightly longer postorbital region. The skull of a lion has broader nasal openings. However, due to the amount of skull variation in the two species, usually, only the structure of the lower jaw can be used as a reliable indicator of species.

Tigers have round pupils and yellow irises (except for the blue eyes of white tigers). Due to a retinal adaptation that reflects light back to the retina, the night vision of tigers is six times better than that of humans.

Subspecies



A Bengal tigress with her cub.

There are nine recent subspecies of tiger, three of which are extinct. Their historical range (severely diminished today) ran through Bangladesh, Siberia, Iran, Afghanistan, India, China, and southeast Asia, including some Indonesian islands. The surviving subspecies, in descending order of wild population, are:

- The **Bengal tiger** or the **Royal Bengal tiger** (*Panthera tigris tigris*) is the most common subspecies of tiger and is found primarily in India and Bangladesh. It lives in varied habitats: grasslands, subtropical and tropical rainforests, scrub forests, wet and dry deciduous forests, and mangroves. Males in the wild usually weigh 205 to 227 kg (450 to 500 lb), while the average female will weigh about 141 kg. However, the northern Indian and the Nepalese Bengal tigers are somewhat bulkier than those found in the south of the Indian Subcontinent, with males averaging around 235 kilograms (520 lb). While conservationists already believed the population to be below 2,000, the most recent audit by the Indian Government's National Tiger Conservation Authority has estimated the number at just 1,411 wild tigers (1165–1657 allowing for statistical error), a drop of 60% in the past decade. Since 1972, there has been a massive wildlife conservation project, known as Project Tiger, to protect the Bengal tiger. Despite increased efforts by Indian officials, poaching remains rampant and at least one Tiger Reserve (Sariska Tiger Reserve) has lost its entire tiger population to poaching. The passing of the Forest Rights Act by the Indian government in 2006 has worsened the situation as evidence has shown that human habitats and tigers cannot co-exist and has pushed the Indian tiger on the brink of extinction.



Indochinese tiger

- The **Indochinese Tiger** (*Panthera tigris corbetti*), also called *Corbett's tiger*, is found in Cambodia, China, Laos, Burma, Thailand, and Vietnam. These tigers are smaller and darker than Bengal tigers: Males weigh from 150–190 kg (330–420

lb) while females are smaller at 110–140 kg (240–310 lb). Their preferred habitat is forests in mountainous or hilly regions. Estimates of the Indochinese tiger population vary between 1,200 to 1,800, with only several hundred left in the wild. All existing populations are at extreme risk from poaching, prey depletion as a result of poaching of primary prey species such as deer and wild pigs, habitat fragmentation and inbreeding. In Vietnam, almost three-quarters of the tigers killed provide stock for Chinese pharmacies.



Malayan tiger

- The **Malayan Tiger** (*Panthera tigris jacksoni*), exclusively found in the southern part of the Malay Peninsula, was not considered a subspecies in its own right until 2004. The new classification came about after a study by Luo et al. from the Laboratory of Genomic Diversity Study, part of the National Cancer Institute of the United States. Recent counts showed there are 600–800 tigers in the wild, making it the third largest tiger population, behind the Bengal tiger and the Indochinese tiger. The Malayan tiger is the smallest of the mainland tiger subspecies, and the second smallest living subspecies, with males averaging about 120 kg and females about 100 kg in weight. The Malayan tiger is a national icon in Malaysia, appearing on its coat of arms and in logos of Malaysian institutions, such as Maybank.



Sumatran tiger

- The **Sumatran Tiger** (*Panthera tigris sumatrae*) is found only on the Indonesian island of Sumatra, and is critically endangered. It is the smallest of all living tiger subspecies, with adult males weighing between 100–140 kg (220–310 lb) and females 75–110 kg (170–240 lb). Their small size is an adaptation to the thick, dense forests of the island of Sumatra where they reside, as well as the smaller-sized prey. The wild population is estimated at between 400 and 500, seen chiefly in the island's national parks. Recent genetic testing has revealed the presence of unique genetic markers, indicating that it may develop into a separate species, if it does not go extinct. This has led to suggestions that Sumatran tigers should have greater priority for conservation than any other subspecies. While habitat destruction is the main threat to existing tiger population (logging continues even in the supposedly protected national parks), 66 tigers were recorded as being shot and killed between 1998 and 2000, or nearly 20% of the total population.



Siberian tiger

- The **Siberian tiger** (*Panthera tigris altaica*), also known as the *Amur*, *Manchurian*, *Altaic*, *Korean* or *North China* tiger, which is the most northernmost subspecies, is confined to the Amur-Ussuri region of Primorsky Krai and Khabarovsk Krai in far eastern Siberia, where it is now protected. The largest subspecies of tiger, it has a head and body length of 160–180 cm for females and 190–230+ cm for males, plus a tail of about 60–110 cm long (about 270–330 cm in total length) and an average weight of around 227 kilograms (500 lb) for males, the Amur tiger is also noted for its thick coat, distinguished by a paler golden hue and fewer stripes. The heaviest wild Siberian tiger on record weighed in at 384 kg, but according to Mazak these giants are not confirmed via reliable references. Even so, a six-month old Siberian tiger can be as big as a fully grown leopard. The last two censuses (1996 and 2005) found 450–500 Amur tigers within their single, and more or less continuous, range making it one of the largest undivided tiger populations in the world. Genetic research in 2009 demonstrated that the Siberian tiger, and the western "Caspian tiger" (once thought to have been a separate subspecies that became extinct in the wild in the late 1950s) are actually the same subspecies, since the separation of the two populations may have occurred as recently as the past century due to human intervention.



South China tiger

- The **South China Tiger** (*Panthera tigris amoyensis*), also known as the *Amoy* or *Xiamen* tiger, is the most critically endangered subspecies of tiger and is listed as one of the 10 most endangered animals in the world. One of the smaller tiger subspecies, the length of the South China tiger ranges from 2.2–2.6 m (87–100 in) for both males and females. Males weigh between 127 and 177 kg (280 and 390 lb) while females weigh between 100 and 118 kg (220 and 260 lb). From 1983 to 2007, no South China tigers were sighted. In 2007 a farmer spotted a tiger and handed in photographs to the authorities as proof. The photographs in question, however, were later exposed as fake, copied from a Chinese calendar and digitally altered, and the “sighting” turned into a massive scandal. In 1977, the Chinese government passed a law banning the killing of wild tigers, but this may have been too late to save the subspecies, since it is possibly already extinct in the wild. There are currently 59 known captive South China tigers, all within China, but these are known to be descended from only six animals. Thus, the genetic diversity required to maintain the subspecies may no longer exist. Currently, there are breeding efforts to reintroduce these tigers to the wild.

Extinct subspecies



A hunted down Balinese tiger

- The **Bali Tiger** (*Panthera tigris balica*) was limited to the island of Bali. They were the smallest of all tiger subspecies, with a weight of 90–100 kg in males and 65–80 kg in females. These tigers were hunted to extinction—the last Balinese tiger is thought to have been killed at Sumbar Kima, West Bali on 27 September 1937; this was an adult female. No Balinese tiger was ever held in captivity. The tiger still plays an important role in Balinese Hinduism.



A photograph of a Javan tiger.

- The **Javan tiger** (*Panthera tigris sondaica*) was limited to the Indonesian island of Java. It now seems likely that this subspecies became extinct in the 1980s, as a result of hunting and habitat destruction, but the extinction of this subspecies was extremely probable from the 1950s onwards (when it is thought that fewer than 25 tigers remained in the wild). The last confirmed specimen was sighted in 1979, but there were a few reported sightings during the 1990s. With a weight of 100–141 kg for males and 75–115 kg for females, the Javan tiger was one of the smaller subspecies, approximately the same size as the Sumatran tiger.



A captive Caspian Tiger, Berlin Zoo 1899

- The **Caspian Tiger** (formerly *Panthera tigris virgata*), also known as the **Persian tiger** or **Turanian tiger** was the westernmost population of Siberian tiger, found in Iran, Iraq, Afghanistan, Turkey, Mongolia, Kazakhstan, the Caucasus, Tajikistan, Turkmenistan, and Uzbekistan until it apparently became extinct in the late 1950s, though there have been several alleged more recent sightings of the tiger. Though originally thought to have been a distinct subspecies, genetic research in 2009 suggest that the animal was largely identical to the Siberian tiger.

Hybrids

Hybridisation among the big cats, including the tiger, was first conceptualised in the 19th century, when zoos were particularly interested in the pursuit of finding oddities to display for financial gain. Lions have been known to breed with tigers (most often the Amur and Bengal subspecies) to create hybrids called ligers and tigons. Such hybrids were once commonly bred in zoos, but this is now discouraged due to the emphasis on conserving species and subspecies. Hybrids are still bred in private menageries and in zoos in China.

The liger is a cross between a male lion and a tigress. Because the lion sire passes on a growth-promoting gene, but the corresponding growth-inhibiting gene from the female tiger is absent, ligers grow far larger than either parent. They share physical and behavioural qualities of both parent species (spots and stripes on a sandy background). Male ligers are sterile, but female ligers are often fertile. Males have about a 50% chance of having a mane, but, even if they do, their manes will be only around half the size of that of a pure lion. Ligers are typically between 10 to 12 feet in length, and can be between 800 and 1,000 pounds or more.

The less common tigon is a cross between the lioness and the male tiger.

Colour variations

White tigers



A Bengal white tiger in Bannerghatta National Park in Bangalore



A pair of white tigers at the Singapore Zoo.

There is a well-known mutation that produces the white tiger, technically known as *chinchilla albinistic*, an animal which is rare in the wild, but widely bred in zoos due to its popularity. Breeding of white tigers will often lead to inbreeding (as the trait is recessive). Many initiatives have taken place in white and orange tiger mating in an attempt to remedy the issue, often mixing subspecies in the process. Such inbreeding has led to white tigers having a greater likelihood of being born with physical defects, such as cleft palates and scoliosis (curvature of the spine). Furthermore, white tigers are prone to having crossed eyes (a condition known as strabismus). Even apparently healthy white tigers generally do not live as long as their orange counterparts. Recordings of white tigers were first made in the early 19th century. They can only occur when both parents carry the rare gene found in white tigers; this gene has been calculated to occur in only one in every 10,000 births. The white tiger is not a separate sub-species, but only a colour variation; since the only white tigers that have been observed in the wild have been Bengal tigers (and all white tigers in captivity are at least part Bengal), it is commonly thought that the recessive gene that causes the white colouring is probably carried only by Bengal tigers, although the reasons for this are not known. Nor are they in any way more endangered than tigers are generally, this being a common misconception. Another misconception is that white tigers are albinos, despite the fact that pigment is evident in the white tiger's stripes. They are distinct not only because of their white hue; they also have blue eyes.

Golden tabby tigers



A rare golden tabby/strawberry tiger at the Buffalo Zoo.

In addition, another recessive gene may create a very unusual "golden tabby" colour variation, sometimes known as "strawberry." Golden tabby tigers have light gold fur, pale legs and faint orange stripes. Their fur tends to be much thicker than normal. There are extremely few golden tabby tigers in captivity, around 30 in all. Like white tigers, strawberry tigers are invariably at least part Bengal. Some golden tabby tigers, called heterozygous tigers, carry the white tiger gene, and when two such tigers are mated, can produce some stripeless white offspring. Both white and golden tabby tigers tend to be larger than average Bengal tigers.

Other colour variations

There are also unconfirmed reports of a "blue" or slate-coloured tiger, the Maltese Tiger, and largely or totally black tigers, and these are assumed, if real, to be intermittent mutations rather than distinct species.

Biology and behaviour

Territorial behaviour

Tigers are essentially solitary and territorial animals. The size of a tiger's home range mainly depends on prey abundance, and, in the case of male tigers, on access to females. A tigress may have a territory of 20 square kilometres, while the territories of males are much larger, covering 60–100 km². The range of a male tends to overlap those of several females.



Tigers for the most part are solitary animals

The relationships between individuals can be quite complex, and it appears that there is no set "rule" that tigers follow with regards to territorial rights and infringing territories.

For instance, although for the most part tigers avoid each other, both male and female tigers have been documented sharing kills. George Schaller observed a male tiger share a kill with two females and four cubs. Females are often reluctant to let males near their cubs, but Schaller saw that these females made no effort to protect or keep their cubs from the male, suggesting that the male might have been the father of the cubs. In contrast to male lions, male tigers will allow the females and cubs to feed on the kill first. Furthermore, tigers seem to behave relatively amicably when sharing kills, in contrast to lions, which tend to squabble and fight. Unrelated tigers have also been observed feeding on prey together. The following quotation is from Stephen Mills' book *Tiger*, as he describes an event witnessed by Valmik Thapar and Fateh Singh Rathore in Ranthambhore:

A dominant tigress they called Padmini killed a 250 kg (550-lb) male nilgai – a very large antelope. They found her at the kill just after dawn with her three 14-month-old cubs and they watched uninterrupted for the next ten hours. During this period the family was joined by two adult females and one adult male – all offspring from Padmini's previous litters and by two unrelated tigers, one female the other unidentified. By three o'clock there were no fewer than nine tigers round the kill.

When young female tigers first establish a territory, they tend to do so fairly close to their mother's area. The overlap between the female and her mother's territory tends to wane with increasing time. Males, however, wander further than their female counterparts, and set out at a younger age to mark out their own area. A young male will acquire territory either by seeking out a range devoid of other male tigers, or by living as a transient in another male's territory until he is old and strong enough to challenge the resident male. The highest mortality rate (30–35% per year) amongst adult tigers occurs for young male tigers who have just left their natal area, seeking out territories of their own.



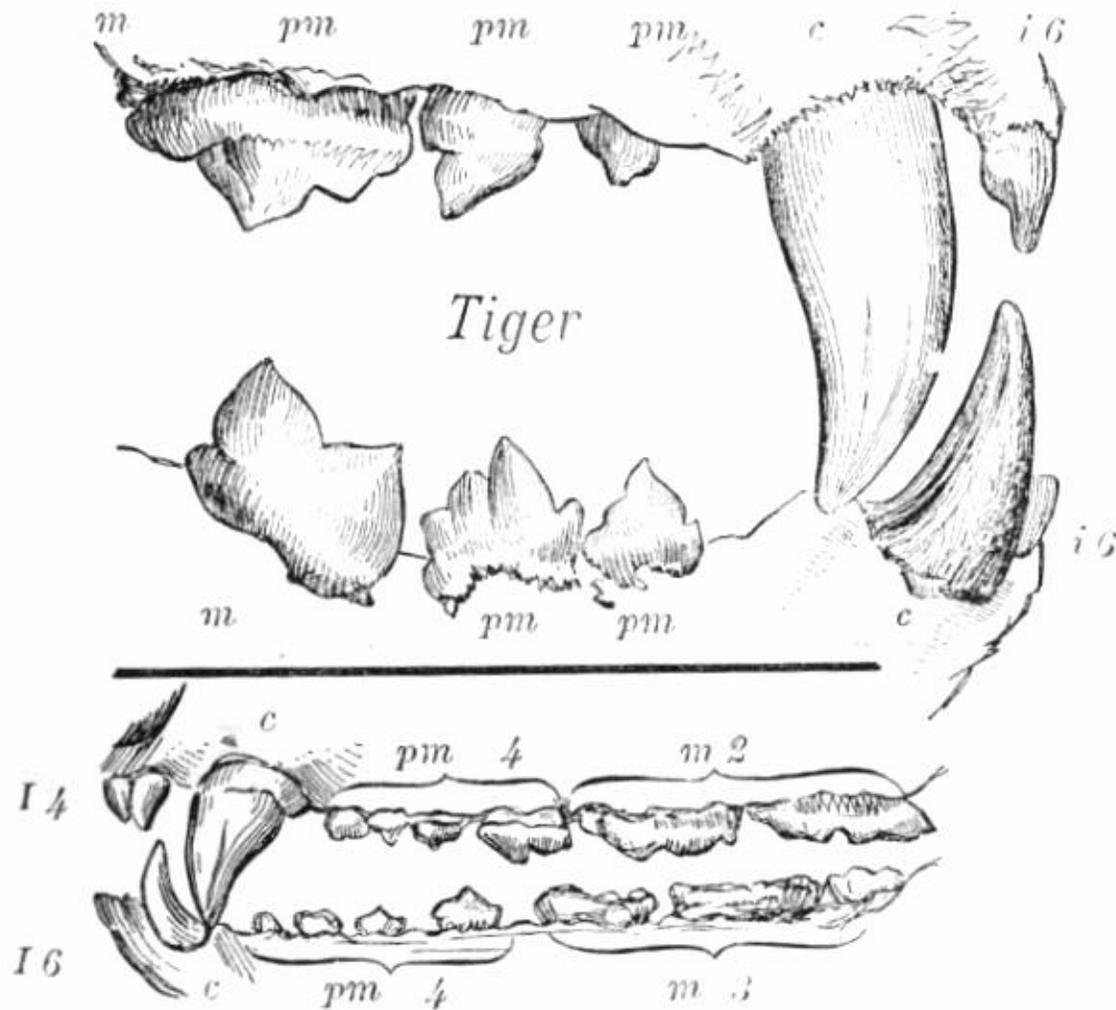
Two male Bengal tiger siblings play with each other in the Pilibhit Tiger Reserve, India.

Male tigers are generally more intolerant of other males within their territory than females are of other females. For the most part, however, territorial disputes are usually solved by displays of intimidation, rather than outright aggression. Several such incidents have been observed, in which the subordinate tiger yielded defeat by rolling onto its back, showing its belly in a submissive posture. Once dominance has been established, a male may actually tolerate a subordinate within his range, as long as they do not live in too close quarters. The most violent disputes tend to occur between two males when a female is in oestrus, and may result in the death of one of the males, although this is a rare occurrence.

To identify his territory, the male marks trees by spraying of urine and anal gland secretions, as well as marking trails with scat. Males show a grimacing face, called the Flehmen response, when identifying a female's reproductive condition by sniffing their urine markings. Like the other *Panthera* cats, tigers can roar. Tigers will roar for both aggressive and non-aggressive reasons. Other tiger vocal communications include moans, hisses, growls and chuffs.

Tigers have been studied in the wild using a variety of techniques. The populations of tigers were estimated in the past using plaster casts of their pugmarks. This method was found faulty and attempts were made to use camera trapping instead. Newer techniques based on DNA from their scat are also being evaluated. Radio collaring has also been a popular approach to tracking them for study in the wild.

Hunting and diet



Tiger dentition(above), compared with that of an Asian black bear (below). The large canines are used to make the killing bite, but they tear meat when feeding using the carnassial teeth.

In the wild, tigers mostly feed on larger and medium sized animals. Sambar, gaur, chital, barasingha, wild boar, nilgai and both water buffalo and domestic buffalo are the tiger's favoured prey in India. Sometimes, they also prey on leopards, pythons, sloth bears and crocodiles. In Siberia the main prey species are manchurian wapiti, wild boar, sika deer, moose, roe deer, and musk deer. In Sumatra, sambar, muntjac, wild boar, and malayan tapir are preyed on. In the former Caspian tiger's range, prey included saiga antelope, camels, caucasian wisent, yak, and wild horses. Like many predators, they are opportunistic and will eat much smaller prey, such as monkeys, peafowls, hares, and fish.

Adult elephants are too large to serve as common prey, but conflicts between tigers and elephants do sometimes take place. A case where a tiger killed an adult Indian Rhinoceros has been observed. Young elephant and rhino calves are occasionally taken.

Tigers also sometimes prey on domestic animals such as dogs, cows, horses, and donkeys. These individuals are termed cattle-lifters or cattle-killers in contrast to typical game-killers.

Old tigers, or those wounded and rendered incapable of catching their natural prey, have turned into man-eaters; this pattern has recurred frequently across India. An exceptional case is that of the Sundarbans, where healthy tigers prey upon fishermen and villagers in search of forest produce, humans thereby forming a minor part of the tiger's diet. Tigers will occasionally eat vegetation for dietary fiber, the fruit of the Slow Match Tree being favoured.



Tigers' extremely strong jaws and sharp teeth make them superb predators.

Tigers are thought to be nocturnal predators, hunting at night. However, in areas where humans are absent, they have been observed via remote controlled, hidden cameras hunting during the daylight hours. They generally hunt alone and ambush their prey as most other cats do, overpowering them from any angle, using their body size and strength to knock large prey off balance. Even with their great masses, tigers can reach speeds of about 49–65 kilometres per hour (35–40 miles per hour), although they can only do so in short bursts, since they have relatively little stamina; consequently, tigers must be relatively close to their prey before they break their cover. Tigers have great leaping ability; horizontal leaps of up to 10 metres have been reported, although leaps of around half this amount are more typical. However, only one in twenty hunts ends in a successful kill.

When hunting large prey, tigers prefer to bite the throat and use their forelimbs to hold onto the prey, bringing it to the ground. The tiger remains latched onto the neck until its prey dies of strangulation. By this method, gaurs and water buffalos weighing over a ton have been killed by tigers weighing about a sixth as much. With small prey, the tiger bites the nape, often breaking the spinal cord, piercing the windpipe, or severing the jugular vein or common carotid artery. Though rarely observed, some tigers have been recorded to kill prey by swiping with their paws, which are powerful enough to smash the skulls of domestic cattle, and break the backs of sloth bears.

During the 1980s, a tiger named "Genghis" in Ranthambhore National Park was observed frequently hunting prey through deep lake water, a pattern of behaviour that had not been previously witnessed in over 200 years of observations. Moreover, he appeared to be extraordinarily successful for a tiger, with as many as 20% of hunts ending in a kill.

Reproduction



A tigress with her cubs in the Kanha Tiger Reserve, India.

Mating can occur all year round, but is generally more common between November and April. A female is only receptive for a few days and mating is frequent during that time period. A pair will copulate frequently and noisily, like other cats. The gestation period is 16 weeks. The litter size usually consists of around 3–4 cubs of about 1 kilogram (2.2 lb) each, which are born blind and helpless. The females rear them alone, sheltering them in dens such as thickets and rocky crevices. The father of the cubs generally takes no part in rearing them. Unrelated wandering male tigers may even kill cubs to make the female receptive, since the tigress may give birth to another litter within 5 months if the cubs of the previous litter are lost. The mortality rate of tiger cubs is fairly high – approximately half do not survive to be more than two years old.

There is generally a dominant cub in each litter, which tends to be male but may be of either sex. This cub generally dominates its siblings during play and tends to be more active, leaving its mother earlier than usual. At 8 weeks, the cubs are ready to follow their mother out of the den, although they do not travel with her as she roams her territory until they are older. The cubs become independent around 18 months of age, but it is not until they are around 2–2½ years old that they leave their mother. Females reach sexual maturity at 3–4 years, whereas males reach sexual maturity at 4–5 years.

Over the course of her life, a female tiger will give birth to an approximately equal number of male and female cubs. Tigers breed well in captivity, and the captive population in the United States may rival the wild population of the world.

Interspecific predatory relationships



Tiger hunted by wild dogs (dhool) as illustrated in Samuel Howett & Edward Orme, Hand Coloured, Aquatint Engravings, Published London 1807.

Tigers may kill such formidable predators as leopards, pythons and even crocodiles on occasion, although predators typically avoid one another. When seized by a crocodile, a tiger will strike at the reptile's eyes with its paws. Eighteenth century Physician Oliver Goldsmith described the frequent conflicts between mugger crocodiles and tigers that occurred during that time. When the tigers impelled by thirst, frequently descended to the rivers to drink and, on these occasions tigers were seized and killed by the muggers, though more often the tiger escaped and the reptile was disabled. Leopards dodge competition from tigers by hunting in different times of the day and hunting different prey. With relatively abundant prey, tigers and leopards were seen to successfully coexist without competitive exclusion or inter-species dominance hierarchies that may be more common to the savanna. Tigers have been known to suppress wolf populations in areas where the two species coexist. Dhole packs have been observed to attack and kill tigers in disputes over food, though not usually without heavy losses. Lone golden jackals

expelled from their pack have been known to form commensal relationships with tigers. These solitary jackals, known as *kol-bahl*, will attach themselves to a particular tiger, trailing it at a safe distance in order to feed on the big cat's kills. A *kol-bahl* will even alert a tiger to a kill with a loud *pheal*. Tigers have been known to tolerate these jackals: one report describes how a jackal confidently walked in and out between three tigers walking together a few feet away from each other. Siberian tigers and brown bears can be competitors and usually avoid confrontation; however, tigers will kill bear cubs and even some adults on occasion. Bears (Asiatic black bears and brown bears) make up 5–8% of the tiger's diet in the Russian Far East. There are also a few records of brown bears killing tigers, either in self defense or in disputes over kills. Some bears emerging from hibernation will try to steal tigers' kills, although the tiger will sometimes defend its kill. Sloth bears are quite aggressive and will sometimes drive young tigers away from their kills, although it is more common for Bengal tigers to prey on sloth bears.

Conservation efforts

Poaching for fur and destruction of habitat have greatly reduced tiger populations in the wild. At the start of the 20th century, it is estimated there were over 100,000 tigers in the world but the population has dwindled to between 1,500 and 3,500 in the wild. Some estimates suggest that there are less than 2,500 mature breeding individuals, with no subpopulation containing more than 250 mature breeding individuals.

India



A Bengal tiger in a national park in southern India. Indian officials successfully reintroduced two Bengal tigers in the Sariska Tiger Reserve in July 2008.

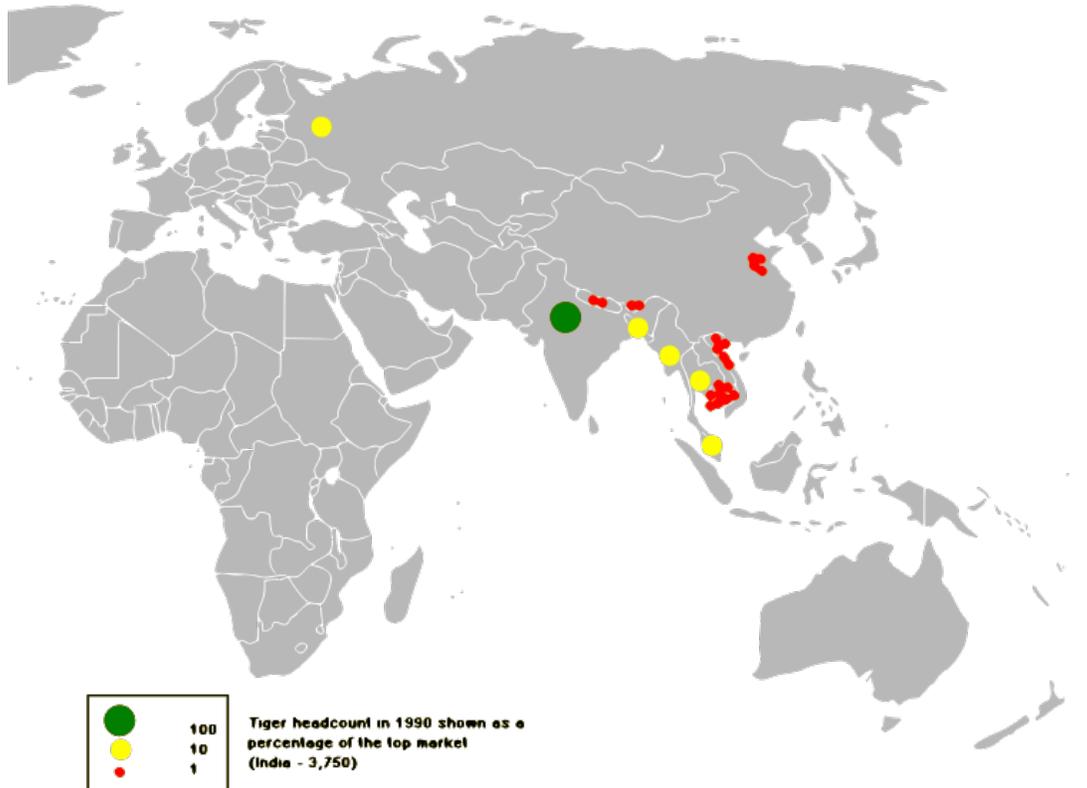
India is home to the world's largest population of tigers in the wild. According to the World Wildlife Fund, of the 3,500 tigers around the world, 1,400 are found in India. Only 11% of original Indian tiger habitat remains, and it is becoming significantly fragmented and often degraded.

A major concerted conservation effort, known as *Project Tiger*, has been underway since 1973, initially spearheaded by Indira Gandhi. The fundamental accomplishment has been the establishment of over 25 well-monitored tiger reserves in reclaimed land where human development is categorically forbidden. The program has been credited with tripling the number of wild Bengal tigers from roughly 1,200 in 1973 to over 3,500 in the 1990s. However, a tiger census carried out in 2007, whose report was published on February 12, 2008, stated that the wild tiger population in India declined by 60% to approximately 1,411. It is noted in the report that the decrease of tiger population can be attributed directly to poaching.

Following the release of the report, the Indian government pledged \$153 million to further fund the Project Tiger initiative, set-up a Tiger Protection Force to combat poachers, and fund the relocation of up to 200,000 villagers to minimise human-tiger interaction. Additionally, eight new tiger reserves in India are being set up. Indian officials successfully started a project to reintroduce the tigers into the Sariska Tiger Reserve. The Ranthambore National Park is often cited as a major success by Indian officials against poaching.

Tigers Forever is a collaboration between the Wildlife Conservation Society and Panthera Corporation to serve as both a science-based action plan and a business model to ensure that tigers live in the wild forever. Initial field sites of *Tigers Forever* include the world's largest tiger reserve, the 21,756 km² Hukaung Valley in Myanmar, the Western Ghats in India, Thailand's Huai Khai Khaeng-Thung Yai protected areas, and other sites in Laos PDR, Cambodia, the Russian Far East and China covering approximately 260,000 km² of critical tiger habitat.

Russia



Tiger headcount in 1990

The Siberian tiger was on the brink of extinction with only about 40 animals in the wild in the 1940s. Under the Soviet Union, anti-poaching controls were strict and a network of protected zones (zapovedniks) were instituted, leading to a rise in the population to several hundred. Poaching again became a problem in the 1990s, when the economy of Russia collapsed, local hunters had access to a formerly sealed off lucrative Chinese market, and logging in the region increased. While an improvement in the local economy has led to greater resources being invested in conservation efforts, an increase of economic activity has led to an increased rate of development and deforestation. The major obstacle in preserving the species is the enormous territory individual tigers require (up to 450 km² needed by a single female and more for a single male). Current conservation efforts are led by local governments and NGO's in consort with international organisations, such as the World Wide Fund and the Wildlife Conservation Society. The competitive exclusion of wolves by tigers has been used by Russian conservationists to convince hunters in the Far East to tolerate the big cats, as they limit ungulate populations less than wolves, and are effective in controlling the latter's numbers. Currently, there are about 400–550 animals in the wild.

Tibet

The trade in tiger skins is illegal in the People's Republic of China, of which Tibet is a part. However, the law banning the trade in endangered animal parts is not enforced in Tibet. An undercover investigation in 2000 by the Wildlife Protection Society of India produced much news about the tiger skin trade and pictures of Tibetans wearing tiger skins. The tigers poached for their skins, subsequent investigations found, originated in India, in a "highly sophisticated" smuggling operation that crossed through Nepal, that "had less to do with old customs than new money" and even attracted European tourists for the tiger skin products of Lhasa. When in 2005, officials in Tibet intercepted "32 tiger, 579 leopard and 665 otter skins", the 14th Dalai Lama called on exiled Tibetans, who are involved in the trade, to cease their activity. The 14th Dalai Lama had spoken out about wearing furs before, but he repeated his condemnation during the 2006 Kalachakra festival in India to expatriate Tibetans. Afterwards, the Dalai Lama issued a press release claiming to have received video of Tibetans burning their animal skin coats, and reports of arrests of eight Tibetans involved for conspiring with the Dalai Lama's government.

Rewilding

Although the term "rewilding" was used in conservation in other contexts since at least 1990, it was first applied to the restoration of a single species of carnivores by conservationist and ex-carnivore manager of Pilanesberg National Park, Gus Van Dyk in 2003. In an effort to find the most appropriate translation of the Chinese term “野化” Van Dyk chose to adopt the term "rewilding" to describe the Save China's Tigers rewilding project of the South China Tiger.



A South China tiger of the Save China's Tigers project with his blesbuck kill

One attempt at rewilding was by Indian conservationist Billy Arjan Singh, who reared a zoo-born tigress named Tara, and released her in the wilds of Dudhwa National Park in 1978. This was soon followed by a large number of people being eaten by a tigress who was later shot. Government officials claim that this tigress was Tara, an assertion hotly contested by Singh and conservationists. Later on, this rewilding gained further disrepute when it was found that the local gene pool had been sullied by Tara's introduction as she was partly Siberian tiger, a fact not known at the time of release, ostensibly due to poor record-keeping at Twycross Zoo, where she had been raised.

Another organisation, Save China's Tigers, working with the Wildlife Research Centre of the State Forestry Administration of China and the Chinese Tigers South Africa Trust, secured an agreement on the reintroduction of Chinese tigers into the wild. The agreement, which was signed in Beijing on 26 November 2002, calls for the establishment of a Chinese tiger conservation model through the creation of a pilot reserve in China where indigenous wildlife, including the South China Tiger, will be reintroduced. Save China's Tigers aims to rewild the critically endangered South China Tiger by bringing a few captive-bred individuals to South Africa for rehabilitation training for them to regain their hunting instincts. At the same time, a pilot reserve in China is being set-up and the Tigers will be relocated and release back in China when the reserve in China is ready. The offspring of the trained tigers will be released into the pilot reserves in China, while the original animals will stay in South Africa to continue breeding.

Traditional Asian medicine

Many people in China have a belief that various tiger parts have medicinal properties, including as pain killers and aphrodisiacs. There is no scientific evidence to support these beliefs. The use of tiger parts in pharmaceutical drugs in China is already banned, and the government has made some offenses in connection with tiger poaching punishable by death. Furthermore, all trade in tiger parts is illegal under the Convention on International Trade in Endangered Species of Wild Fauna and Flora and a domestic trade ban has been in place in China since 1993. Still, there are a number of tiger farms in the country specialising in breeding the cats for profit. It is estimated that between 5,000 and 10,000 captive-bred, semi-tame animals live in these farms today.

As pets

The Association of Zoos and Aquariums estimates that up to 12,000 tigers are being kept as private pets in the US, significantly more than the world's entire wild population, 4,000 are believed to be in captivity in Texas alone. Part of the reason for America's enormous tiger population relates to legislation. Only nineteen states have banned private ownership of tigers, fifteen require only a license, and sixteen states have no regulations at all. The success of breeding programmes at American zoos and circuses led to an overabundance of cubs in the 1980s and 1990s, which drove down prices for the animals. The SPCA estimate there are now 500 lions, tigers and other big cats in private ownership just in the Houston area.

World's favourite animal

In a poll conducted by Animal Planet, the tiger was voted the world's favourite animal, narrowly beating the dog. More than 50,000 viewers from 73 countries voted in the poll. Tigers received 21% of the vote, dogs 20%, dolphins 13%, horses 10%, lions 9%, snakes 8%, followed by elephants, chimpanzees, orangutans and whales.

Animal behaviourist Candy d'Sa, who worked with Animal Planet on the list, said: "We can relate to the tiger, as it is fierce and commanding on the outside, but noble and discerning on the inside".

Callum Rankine, international species officer at the World Wildlife Federation conservation charity, said the result gave him hope. "If people are voting tigers as their favourite animal, it means they recognise their importance, and hopefully the need to ensure their survival," he said.

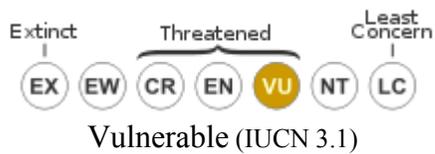
Chapter 6

Dugong

Dugong
Temporal range: Early Eocene–Recent



Conservation status



Vulnerable (IUCN 3.1)

Scientific classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Sirenia
Family: Dugongidae
 Gray, 1821
Subfamily: **Dugonginae**
 Simpson, 1932
Genus: ***Dugong***
 Lacépède, 1799
Species: ***D. dugon***

Binomial name

Dugong dugon
(Müller, 1776)



Dugong range

The **dugong** (*Dugong dugon*) is a large marine mammal which, together with the manatees, is one of four living species of the order Sirenia. It is the only living representative of the once-diverse family Dugongidae; its closest modern relative, Steller's Sea Cow (*Hydrodamalis gigas*), was hunted to extinction in the 18th century. It is also the only sirenian in its range, which spans the waters of at least 37 countries throughout the Indo-Pacific, though the majority of dugongs live in the northern waters of Australia between Shark Bay and Moreton Bay. The dugong is the only strictly-marine herbivorous mammal, as all species of manatee utilize fresh water to some degree.

Like all modern sirenians, the dugong has a fusiform body with no dorsal fin or hind limbs, instead possessing paddle-like forelimbs used to maneuver itself. It is easily distinguished from the manatees by its fluked, dolphin-like tail, but also possesses a unique skull and teeth. The dugong is heavily dependent on seagrasses for subsistence and is thus restricted to the coastal habitats where they grow, with the largest dugong concentrations typically occurring in wide, shallow, protected areas such as bays, mangrove channels and the lee sides of large inshore islands. Its snout is sharply downturned, an adaptation for grazing and uprooting benthic seagrasses.

The dugong has been hunted for thousands of years for its meat and oil, although dugong hunting also has great cultural significance throughout its range. The dugong's current distribution is reduced and disjunct, and many populations are close to extinction. The IUCN lists the dugong as a species vulnerable to extinction, while the Convention on International Trade in Endangered Species limits or bans the trade of derived products based on the population involved. Despite being legally protected in many countries throughout their range, the main causes of population decline remain anthropogenic and include hunting, habitat degradation, and fishing-related fatalities. With its long lifespan of 70 years or more, and slow rate of reproduction, the dugong is especially vulnerable to these types of exploitation. Dugongs are also threatened by storms, parasites, and their natural predators, sharks, killer whales, and crocodiles.

Etymology and taxonomy

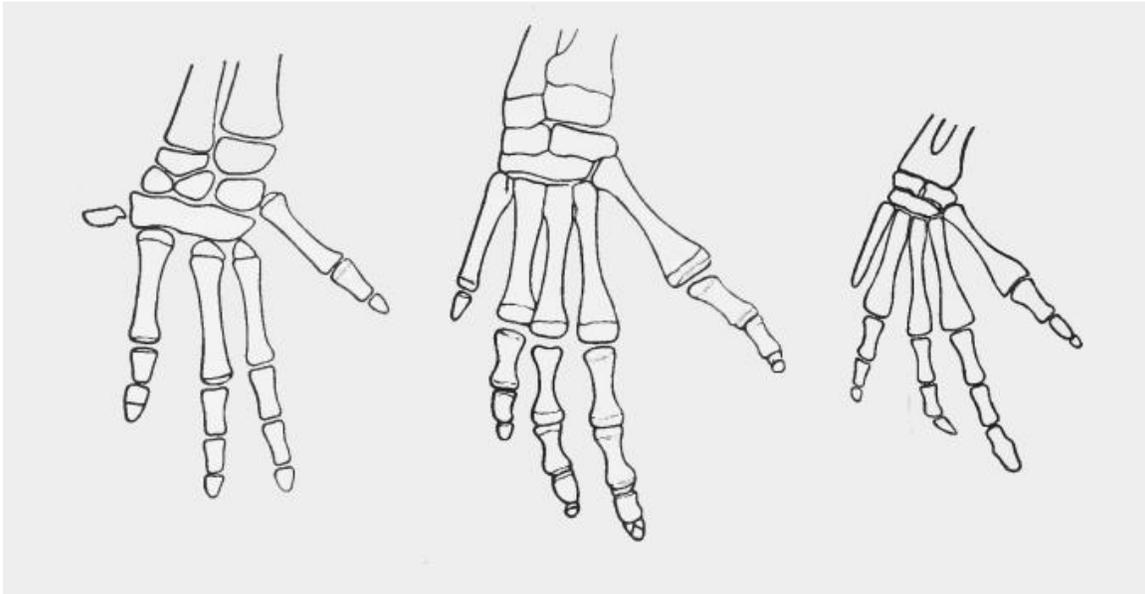
Dugong dugon is the only extant species of the Dugongidae family, and one of only four extant species of the Sirenia order, the others being manatees. It was first classified by Müller in 1776 as *Trichechus dugon*, a member of the manatee genus previously defined by Linnaeus. It was later assigned as the type species of *Dugong* by Lacépède and further classified within its own family by Gray and subfamily by Simpson.

Dugongs and other Sirenians are not closely related to other marine mammals, being more related to elephants. Dugongs and elephants share a monophyletic group with hyraxes and the Aardvark, one of the earliest offshoots of eutherians. The fossil record shows Sirenians appearing in the Eocene, where they most likely lived in the Tethys Ocean. The two extant families of Sirenians are thought to have diverged in the mid-Eocene, after which the dugong's and its closest relative, the Steller's Sea Cow, split off from a common ancestor in the Miocene. The Steller's Sea Cow became extinct in the 18th century. No fossils exist of other members of the Dugongidae.

Molecular studies have been made on dugong populations using mitochondrial DNA. The results have suggested that the population of Southeast Asia are distinct from the others. Australia has two distinct maternal lineages, one of which also contains the dugongs from Africa and Arabia. Limited genetic mixing has taken place between those in Southeast Asia and those in Australia, mostly around Timor. One of the lineages stretches all the way from Moreton Bay to Western Australia, while the other only stretches from Moreton Bay to the Northern Territory. Genetic information however, is still not clear enough to make clear boundaries between distinct groups.

The word "dugong" derives from the Tagalog term *dugong* which was in turn adopted from the Malay *duyung*, both meaning "lady of the sea." Other common local names include "sea cow," "sea pig" and "sea camel."

Anatomy and morphology



Bones in the forelimb can fuse variously with age

The dugong's body is large and fusiform, with thick, smooth skin that is a pale cream color at birth but darkens dorsally and laterally to a brownish to dark gray with age. The body is sparsely covered in short hair, a common feature among sirenians which may allow for tactile interpretation of their environment. These hairs are most developed around the mouth, which has a large horse-shoe shaped upper lip forming a highly mobile muzzle that can be used in feeding.

The dugong's tail flukes and flippers are similar to those of dolphins. These flukes are raised up and down in long strokes to move the animal forward, and can be twisted to cause turning. Their forelimbs are paddle-like flippers which aid in turning while swimming as well as providing brakes. The dugong lacks nails on its flippers, which are only 15% of a dugong's body length. The tail has deep notches.

A dugong's brain can reach only 300g, about 0.1% of the entire animal's body weight. They have limited vision, but acute hearing within narrow sound thresholds. Their ears, which lack pinna, are located on the sides of their head. The nostrils are located on top of the head, and can be closed using valves. Dugongs have two teats, one located behind each flipper. A male dugong's testes are not externally located, so usually the main difference between males and females is the location of the genital aperture in relation to the umbilicus and the anus. The lungs in a dugong are very long, extending almost as far as the kidneys, which are also highly elongated in order to cope with the saltwater environment.

The skull is enlarged with a sharply downturned premaxilla, which are stronger in males. The spine has between 57 and 60 vertebrae. Unlike in manatees, the dugong's teeth do not continually grow back via horizontal tooth replacement. The dugong has two incisors

(tusks) which grow posteriorly until puberty, after which they first erupt in males. The female's tusks continue to grow posteriorly, sometimes erupting later in life after reaching the base of the premaxilla. The number of growth layer groups in a tusk indicates the age of a dugong, and the cheekteeth move forward with age. The full dental formula of

2.0.3.3
dugongs is: 3.1.3.3 Like other sirenians, the dugong experiences pachyostosis, a condition in which the ribs and other long bones are unusually solid and contain little or no marrow. These heavy bones, which are among the densest in the animal kingdom, may act as a ballast to help keep sirenians suspended slightly below the water's surface.

Dugongs are generally smaller than manatees (with the exception of the Amazonian Manatee), reaching an average adult length of 2.7 metres (8.9 ft) and weight of 150 to 300 kilograms (330 to 660 lb). An adult's length rarely exceeds 3 metres (9.8 ft), and females tend to be larger than males. The largest known dugong was a female landed off the Saurashtra coast of west India, measuring 4.03 metres (13.2 ft) and weighing 1,018 kilograms (2,240 lb).

Distribution and habitat



Dugong on the sea floor at Marsa Alam, Egypt

Dugongs are found in warm coastal waters from the Pacific Ocean to the coast of Africa, along an estimated 140,000 kilometres (86,992 mi) of coastline between 26° and 27° degrees to the north and south of the equator. Their historic range is believed to correspond to that of seagrasses from the Potamogetonaceae and Hydrocharitaceae families. It is believed that the remaining dugong populations are relics of a previous range. The numbers and the full size of the former range is unknown, although it is believed that the current populations represent the historical limits of the range. Recorded numbers of dugongs are generally believed to be lower than actual numbers, due to the lack of accurate surveys in many areas. Despite this, the dugong population is thought to be shrinking, with a worldwide decline of 20 per cent in the last 90 years. They have disappeared from the waters of Hong Kong, Mauritius, and Taiwan, as well as parts of Cambodia, Japan, the Philippines and Vietnam. Further disappearances are likely.

Populations of dugong exist in the water of 37 countries and territories. In the late 1960s, herds of up to 500 dugongs were observed off the coast of East Africa and nearby islands. However, current knowledge of dugong numbers is mostly based on anecdotal evidence and the numbers throughout the area are believed to be in decline. Current populations are extremely small, numbering 50 and below, and it is likely they become extinct in most of these areas. The eastern side of the Red Sea is the home of large populations numbering in the hundreds, and similar populations are thought to exist in the western side. In the 1980s, it was estimated the population could be as high as 4,000. The Persian Gulf has the second-largest dugong population in the world, with dugong inhabiting most of the southern coast. The current population is believed to be around 7,500. Palau also has a small population.

A highly isolated breeding population exists in the Gulf of Kutch, the only population remaining in western India. It is 1,500 kilometres (932 mi) from the population in the Persian Gulf, and 1,700 kilometres (1,056 mi) from the nearest population in India. Former populations in this area, centred on the Maldives and the Laccadive Islands are presumed to be extinct. A population exists in the Gulf of Mannar and the Palk Strait between India and Sri Lanka, but it is seriously depleted. A small population exists around the Nansei Shoto islands, and a population formerly existed off Taiwan. An endangered population of 50 or fewer dugongs survives around Okinawa.



Dugong with attached remora off Lamén Island, Vanuatu.

A small population exists off Southern China, centred around the island of Hainan. The population around the Andaman and Nicobar Islands are known only from a few records, and although during British rule the population was large it is now believed to be small and scattered. All the islands of the Philippines are believed to have once provided habitat for dugongs, which were common until the 1970s. The gulf of Thailand used to have a large population, although they haven't been recently recorded in the west of the gulf and the population in the east is believed to be very small. Dugongs are believed to exist in the Straits of Johor, although in very small numbers. The waters around Borneo support a small population, with more scattered throughout the Malay archipelago. Populations exist around the Solomon Islands archipelago and New Caledonia, stretching to the westernmost population in Vanuatu. A highly isolated population lives around the islands of Palau.

Australia is home to the largest population, stretching from Shark Bay in Western Australia to Moreton Bay in Queensland. The population of Shark Bay is thought to be stable with over 10,000 dugongs. Distribution within the day varies seasonally. Smaller populations exist up the coast, including one in Ashmore reef. A population of thousands exists off the north of the Northern Territory, with a population of over 20,000 in the gulf of Carpentaria. A population of over 25,000 exists in the Torres strait, although there is significant migration between the strait and the waters of New Guinea. The Great Barrier Reef houses a stable population of around 10,000, although the population concentration has shifted over time. Large bays facing north on the Queensland coast provide

significant habitats for dugong, with the southernmost bays being Hervey Bay and Moreton Bay.

Dugongs are generally found in warm waters around the coast with large numbers concentrated in wide and shallow protected bays. Large numbers also exist in wide and shallow mangrove channels and around large inshore islands, where seagrass beds are common. In areas where the continental shelf remains shallow, Dugongs have been known to travel more than 10 kilometres (6 mi) from the shore, descending to as far as 37 metres (121 ft), where deepwater seagrasses such as *Halophila spinulosa* are found. Special habitats are used for different activities. It has been observed that shallow waters are used as sites for calving, minimising the risk of predation. Deep waters may provide a thermal refuge from cooler waters closer to the shore during winter.

Ecology and life history



A mother and calf in shallow water

Dugongs are long lived, and the oldest dugong recorded was 73 upon death. They are usually solitary or found in pairs, although gatherings of hundreds of dugongs do happen. They can go six minutes without breathing (though about 2 1/2 minutes is more typical, and have been known to rest on their tail to breathe with their heads above water. They can dive to a maximum depth of 39 metres (128 ft), although they spend most of their lives at a maximum depth of 10 metres (33 ft). They have few natural predators, although animals such as crocodiles, killer whales, and sharks do pose a threat to the young.

Dugongs often move over long distances in search of food, with large numbers often moving from one area to another. It is thought that these movements are caused by changes in seagrass availability. Their memory allows them to return to specific points after long travels. Dugong movements mostly occur within a localised area of seagrass beds, and animals in the same region show individualistic patterns of movement. Daily movement is affected by the tides. In areas where there is a large tidal range, dugongs travel with the tide in order to access shallower feeding areas. In Moreton Bay, dugongs often travel between foraging grounds inside the bay and warmer oceanic waters. At higher latitudes dugongs make seasonal travels to reach warmer water during the winter. Occasionally individual dugong make long-distance travels over many days, and can travel over deep ocean waters.

Although they are marine creatures, dugongs have been known to travel up to 2.7 kilometres (1.7 mi) up creeks, although in one case a dugong was caught 15 kilometres (9.3 mi) up a creek near Cooktown. Lone animals have been known to travel great distances, being seen as far south as Sydney.

Feeding



Typical dugong Feeding area in Moreton Bay

Dugongs, with other Sirenians, are referred to as "sea cows" because their diet consists mainly of sea-grass. When eating they ingest the whole plant, including the roots, although when this is impossible they will feed on just the leaves. A wide variety of seagrass have been found in dugong stomach contents, and evidence exists they will eat algae when seagrass is scarce. They occasionally will eat invertebrates such as jellyfish, sea squirts, and shellfish. Most dugong do not feed from lush areas, but where the seagrass is more sparse. However, additional factors such as protein concentration and regenerative ability also affect the value of a seagrass bed. The chemical structures and composition of the seagrass is important, and the grass species most often eaten are low in fibre, high in nitrogen, and easily digestible.

In the Great Barrier Reef, dugongs feed on low-fibre high-nitrogen seagrass such as *Halophila* and *Halodule*, so as to maximize nutrient intake instead of bulk eating. Seagrasses of a lower seral are preferred, where the area has not fully vegetated. Only certain seagrass meadows are suitable for dugong consumption, due to the dugong's highly specialised diet. There is evidence dugongs actively alter seagrass species compositions at local levels. In some areas dugongs may search out deeper seagrass. Feeding trails have been observed as deep as 33 metres (108 ft), and dugongs have been seen feeding as deep as 37 metres (121 ft). Dugongs are relatively slow moving, swimming at around 10kph. When moving along the seabed to feed they walk on their pectoral fins.

When eating, a dugong will dig up an entire plant and then shake it to remove the sand before eating it. They have been known to collect a pile of plants in one area before eating them. They are particular about their diets, with certain "fields" of sea-grass being

regularly cropped. Unlike manatees, dugongs are exclusively benthic, or bottom feeders. Their primary feeding mechanism is uprooting sea-grass by digging furrows in the seafloor with their snouts. Reflecting this, the muscular snouts of dugongs are more dramatically tapered than those of manatees.

Dugongs in Moreton Bay, Australia, are omnivorous, feeding on invertebrates such as polychaetes or marine algae when the supply of their choice grasses decreases. In other southern areas of both western and eastern Australia, there is evidence dugongs actively seek out large invertebrates. This does not apply to dugongs in tropical areas, from which faecal evidence indicates that invertebrates are not eaten.

Reproduction and parental care



Dugong mother and offspring from East Timor

Different mating behaviours have been observed among dugong; in some populations males will establish a territory which females in heat will visit to mate, while in others many males will attempt to mate with the same female sometimes inflicting injuries to the female or each other. Dugongs give birth after a 13-15 month gestation, usually to just one calf. The calf nurses for 14-18 months, although it begins to eat seagrasses soon after birth. A dugong reaches sexual maturity between the ages of 8-18, longer than in most other mammals. However, the age when a female first gives birth has come under

dispute, with some studies placing the age between 10 and 17 years, while others place it as early as 6 years. Evidence exists that male dugongs lose fertility at older ages.

Despite the longevity of the dugong, which may live for fifty years or more, females give birth only a few times during their life and invest considerable parental care in their young. The time between births is unclear, with estimates ranging from 2.4 to 7 years. Birth occurs in very shallow water, with occasions known where the mothers were almost on the shore. As soon as the young is born the mother pushes it to the surface to take a breath. Newborns are already 1.2 metres (4 ft) long and 30 kilograms (66 lb) heavy. Once born, they swim close to their mothers, possibly to make swimming easier.

Importance to humans



Ipoh's Gua Tambun - Dugong Neolithic Wall Painting

Dugongs have historically provided easy targets for hunters, killed for their meat, oil, skin, and bones. They are often considered as the inspiration of mermaids, and several groups around the world developed cultures around dugong hunting. In some areas it remains an animal of great significance.

There is a 5,000-year old wall painting of a dugong, apparently drawn by neolithic peoples, found in Tambun Cave of Ipoh city in the state of Perak, Malaysia. This was discovered by Lt.R.L Rawlings in 1959 while on a routine patrol. During the Renaissance and the Baroque eras, dugongs were often exhibited in wunderkammers. They were also presented as Fiji mermaids in sideshows.

Dugong meat and oil have traditionally been some of the most valuable foods of Australian aborigines and Torres Strait Islanders. Some aborigines regard dugongs as part of their Aboriginality. Dugongs have also played a role in many legends in Kenya, and the animal is known there as the "Queen of the Sea". Body parts are used as food, medicine, and decorations. In the Gulf states, dugongs served not only as a source of food, but their tusks were used as sword handles. Dugong oil is important to people in India, and its meat is believed to be an aphrodisiac. Dugong ribs were used to make carving in Japan. In Southern China dugongs were traditionally regarded as a "miraculous fish", and it was bad luck to catch them. However, a wave of immigration beginning at

the end of the 1950's resulted in dugong being hunted for food. In the Philippines dugongs are thought to bring bad luck, and parts of them are used to ward against evil spirits. In areas of Thailand it is believed that the dugongs tears form a powerful love potion, while in areas of Indonesia they are considered reincarnations of women. In Papua New Guinea they are seen as a symbol of strength.

Dugongs' or sea cows' hides have been thought by many to have been used as coverings in the building of the Old Testament's portable worship tent known as the Tabernacle, as referenced in the Holy Bible's book of Exodus, although the book of Leviticus (11:12) says that "everything in the waters that has not fins and scales is an abomination" for the Israelites.

Dugong in captivity

Worldwide, only six dugongs are held in captivity. A male and female live at Toba Aquarium in Toba, Mie, Japan, although both are from the Philippines. Another, named Gracie, is at Underwater World, Singapore; a fourth is in Sea World Indonesia which was saved after being caught by a local fisherman; and the last two (Pig, a 10-year-old male, and Wuru, a four-year-old female) formerly lived at Sea World on the Gold Coast, Queensland, Australia, but in December, 2008, they were relocated to Sydney Aquarium.

Conservation

Dugong numbers have decreased in recent times. For a population to remain stable, 95 per cent of adults must survive in the span of one year. The estimated percentage of females humans can kill without depleting the population is 1-2%. This number is reduced in areas where calving is minimal due to food shortages. Even in the best conditions a population is unlikely to increase more than 5% a year, leaving dugong vulnerable to overexploitation. The fact that they live in shallow waters puts them under great pressure from human activity. Research on dugongs and the effects of human activity on them has been limited, with most research taking place in Australia. In many countries, the number of dugongs has not even been surveyed. As such the trends in dugong abundance are uncertain, with more data needed for comprehensive management. The only data stretching back long enough to mention population trend changes comes from the urban coast of Queensland, Australia. The last major worldwide study, made in 2002, concluded that the dugong was declining and possibly extinct in a third of its range, with unknown status in another half.

The IUCN Red List lists the dugong as vulnerable, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora regulates and in some areas has banned international trade. Regional cooperation is important due to the widespread distribution of the animal, and in 1998 there was strong support for Southeast Asian cooperation to protect dugongs. Kenya has passed legislation banning the hunting of dugongs and restricting trawling, but are not yet listed under Kenya's Wildlife Act for endangered species. Mozambique has had legislation to protect dugongs since 1955, but this has not been able to be enforced. Many marine parks have been established on the

African coast of the Red Sea, and the Egyptian Gulf of Aqaba is fully protected. The United Arab Emirates has banned all hunting within its waters, as has Bahrain. The UAE has additionally banned drift net fishing. India and Sri Lanka ban the hunting and selling of dugongs and their products. Japan has listed Dugongs as endangered and has banned intentional kills and harassment. Hunting, catching, and harassment is banned by the People's Republic of China. The first marine mammal to be protected in the Philippines was the dugong, although monitoring this is difficult. Palau has legislated to protect dugongs, although it is not well enforced and poaching persists. The dugong is a national animal of Papua New Guinea, banning all except traditional hunting. Vanuatu and New Caledonia ban hunting of dugongs. Dugongs are protected throughout Australia, although the rules vary per state. In some areas indigenous hunting is allowed.

Human activity

Entanglement in fishing nets has caused many deaths, although the exact effects have not been calculated. Most issues with industrial fishing occur in deeper waters where dugong populations are low, with local fishing being the main risk in shallower waters. The use of Shark Nets have historically caused large numbers of deaths, and they have been eliminated in most areas and replaced with baited hooks. Hunting has historically been a problem, although in most areas they are no longer hunted. However, indigenous communities sometimes still hunt them, and products produced from by-catch remain valuable. In areas such as northern Australia, hunting is the greatest impactor of dugong population.

Vessel strikes have proved an issue for Manatees, however the relevance of this to dugongs are unknown. Increasing boat traffic has had increased danger, especially in shallow waters. Ecotourism has increased in some countries, although effects remain undocumented. It has been seen to cause issues in areas such as Hainan due to environmental degradation. Modern farming practise and increased land clearing has also had an impact, and much of the coastline along dugong habitat is undergoing industrialisation with increasing populations. Dugongs accumulate heavy metal ions in their tissues throughout their lives, more than other marine mammals. The effects are unknown. Socio-political needs are an impediment to dugong conservation in many developing countries. The shallow waters are often used as a source of food and income, problems exacerbated by aid used to improve fishing. In many countries, legislation does not exist to protect dugongs, and if it does it is not enforced.

Oil spills are a danger to dugongs in some areas, as is land reclamation. In Okinawa the small dugong population is threatened by United States military activity. Plans exist to build a military base close to Henoko, and military activity also adds the threats of noise pollution, chemical pollution, soil erosion, and exposure to depleted uranium. The U.S. and Japanese governments want to build a new military base on a coral reef close to Henoko, in Nago county, Okinawa. This plan has generated strong protests from Okinawans who are concerned that the local environment, home to the dugong, would be ruined. Greenpeace stepped up its campaign protesting the Okinawa base expansion in the summer of 2007, as authorities recommenced their airbase development plans.

Environmental degradation

If dugongs do not get enough to eat, they may calve later and produce fewer young. Food shortages can be caused by many factors, such as a loss of habitat, death and decline in quality of seagrass, and a disturbance of feeding caused by human activity. Sewage, detergents, heavy metal, hypersaline water, herbicides, and other waste products all negatively affect seagrass meadows. Human activity such as mining, trawling, dredging, land-reclamation, and boat propeller scarring also cause an increase in sedimentation which smothers seagrass and prevents light from reaching it. Most damage is caused by such sedimentation and the consequent loss of light intensity. One of the dugong's preferred species of seagrass for feeding on, *Halophila ovalis*, declines rapidly due to lack of light, dying completely after 30 days. Extreme weather such as cyclones and floods can destroy hundreds of square kilometres of seagrass meadows, as well as washing dugongs ashore. Recovery of seagrass meadows and the recolonization of areas where seagrass has been destroyed can take over a decade. Most measures for protection involve restricting activities such as trawling in areas containing seagrass meadows, with little to no action on pollutant that originate from land. In some areas water salinity is increased due to wastewater, and it is unknown how much salinity seagrass can withstand.

A large number of infections and parasitic diseases affect dugongs. Detected pathogens include helminths, cryptosporidium, different types of bacterial infections, and other unidentified parasites. 30% of dugong deaths in Queensland since 1996 are thought to be because of disease. A dugong has also been recorded to have died from trauma, in this case after being impaled by a sting ray barb.

Capture and captivity

Dugongs have been listed under the Nature Conservation Act in Queensland as vulnerable. Most currently live in established marine parks, where boats must travel at a restricted speed and mesh net fishing is restricted. There are 16 dugong protection parks, and some preservation zones have been established where even aborigines are not allowed to hunt. Capturing animals for research has caused only one or two deaths however dugongs are expensive to keep in captivity due to the long time mother and child spend together and the inability to grow the seagrass that dugongs eat in an aquarium.

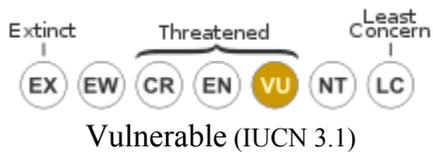
Chapter 7

Red Panda

Red panda



Conservation status



Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Carnivora
Suborder:	Caniformia
Infraorder:	Arctoidea
Superfamily:	Musteloidea

Family: Ailuridae
Genus: *Ailurus*
F. Cuvier, 1825
Species: *A. fulgens*

Binomial name

Ailurus fulgens
F. Cuvier, 1825

Subspecies

A. f. fulgens
A. f. styani



Red panda range

Synonyms

A. ochraceus Hodgson, 1847

The **red panda** (*Ailurus fulgens*, or *shining-cat*), is a small arboreal mammal native to the eastern Himalayas and southwestern China. It is the only species of the genus *Ailurus*. Slightly larger than a domestic cat, it has reddish-brown fur, a long, shaggy tail, and a waddling gait due to its shorter front legs. It feeds mainly on bamboo, but is omnivorous and may also eat eggs, birds, insects, and small mammals. It is a solitary animal, mainly active from dusk to dawn, and is largely sedentary during the day. It is only distantly related to the giant panda.

The red panda has been classified as Vulnerable by IUCN because its population is estimated at fewer than 10,000 mature individuals. Although red pandas are protected by national laws in their range countries, their numbers in the wild continue to decline mainly due to habitat loss and fragmentation, poaching, and inbreeding depression.

It has been previously classified in the families Procyonidae (raccoons) and Ursidae (bears), but recent research has placed it in its own family Ailuridae, in superfamily Musteloidea along with Mustelidae and Procyonidae. Two subspecies are recognized.

Physical characteristics



Red panda descending head first

Head and body of red pandas are 56 to 63 cm (22 to 25 in) long, and their tail about 37 to 47 cm (15 to 19 in). Males weigh 3.7 to 6.2 kg (8.2 to 14 lb) and females 4.2 to 6.0 kg (9.3 to 13 lb). They have long, soft reddish-brown fur on the upper parts, blackish fur on the lower parts, and a light face with tear markings and robust cranial-dental features. The light face has white badges similar to those of a raccoon, but each individual can have distinctive markings. Their roundish head has medium-sized upright ears, a black nose, and very dark eyes: almost pitch black. Their long bushy tail with six alternating yellowish red transverse ochre rings provides balance and excellent camouflage against its habitat of moss- and lichen-covered trees. The legs are black and short with thick fur

on the soles of the paws. This fur serves as thermal insulation on snow-covered or ice surfaces and conceals scent glands which are also present on the anus.

The red panda is specialized as a bamboo feeder with strong, curved and sharp semi-retractile claws standing inward for grasping of narrow tree branches, leaves and fruit. Like the giant panda, it has a “false thumb” that is an extension of the wrist bone. When descending a tree headfirst, the red panda rotates its ankle to control its descent, one of the few climbing species to do so.

Distribution and habitat



Red panda sleeping

The red panda is endemic to the temperate forests of the Himalayas, and ranges from the foothills of western Nepal to China in the east. Its easternmost limit is the Qinling Mountains of the Shaanxi Province in China. It is found in southern Tibet, Sikkim, Assam and Bhutan, in the northern mountains of Myanmar, and in southwestern China in the Hengduan Mountains of Sichuan and Gongshan Mountains in Yunnan. It may also live in southwest Tibet and northern Arunachal Pradesh, but this has not been documented. Locations with the highest density of red pandas include an area in the Himalayas that has been proposed as having been a refuge for a variety of endemic species in the Pleistocene. The distribution range of the red panda should be considered

disjunct, rather than continuous. A disjunct population inhabits the Meghalaya Plateau of northeastern India.

During a survey in the 1970s, signs of red pandas were found in Nepal's Dhorpatan Hunting Reserve. Their presence was confirmed in spring 2007 when four red pandas were sighted at elevations ranging from 3,220 to 3,610 m (10,560 to 11,840 ft). The species' westernmost limit is in Rara National Park located farther west of the Dhorpatan Hunting Reserve. Their presence was confirmed in 2008.

The red panda lives between 2,200 and 4,800 meters (7,200 and 15,700 ft) altitude, inhabiting areas of moderate temperature between 10 and 25 °C / 50 and 77 °F with little annual change. It prefers mountainous mixed deciduous and conifer forests, especially with old trees and dense understories of bamboo.

The effective population size of the Sichuan population is larger and more stable than that of the Yunnan population, implying a southward expansion from Sichuan to Yunnan.

In August 2010, archaeologists uncovered red panda fossil remains in Washington County in the US state of Tennessee. Although none are known to exist in the wild in North America today, it is believed the red panda thrived in the mountains of eastern Tennessee approximately 4.5 million years ago.

The red panda has become extirpated from the Chinese provinces of Guizhou, Gansu, Shaanxi and Qinghai.

Distribution of subspecies

Distribution of the red panda is disjointed, and there are two extant subspecies:

- Western red panda *Ailurus fulgens fulgens* (Cuvier, 1825) — lives in the western part of its range: in Nepal, Assam, Sikkim and Bhutan;
- Styan's red panda *Ailurus fulgens styani* — lives in the east-northeastern part of its range: in southern China and northern Myanmar.

Ailurus fulgens styani has been described by Thomas in 1902 based on one skull from a specimen collected in Szechwan. Pocock distinguished *styani* from *fulgens* by its longer winter coat and more abundant blackness in the pelage, bigger skull, more strongly curved forehead, and more robust teeth. His description is based on skulls and skins collected in Szechwan, Myitkyina close to the border of Yunnan, and Upper Burma.

The Styan's red panda is supposedly larger and darker in color than its Western cousin, but there is considerable variation in both subspecies, and some individuals may be brown or yellowish brown rather than red.

The Brahmaputra river is often considered the natural division between the two subspecies, where it makes a curve around the eastern end of the Himalayas. Although some authors suggest that *A. f. fulgens* extends farther eastward, into China.

Biology and behavior

Behavior

Red pandas are territorial. Adults are solitary except during mating season. They are generally quiet except for some twittering and whistling communication sounds. They have been reported to be both nocturnal and crepuscular, sleeping on tree branches or in tree hollows during the day and increasing their activity in the late afternoon and early evening hours. They sleep stretched out on a branch with legs dangling when it is hot, and curled up with its tail over the face when it is cold. They are very heat sensitive, with an optimal “well-being” temperature between 17 and 25 °C (63 and 77 °F), and cannot tolerate temperatures over 25 °C (77 °F).



Red panda standing

Shortly after waking, red pandas clean their fur like a cat, licking their front paws and then rubbing their back, stomach and sides. They also rub their back and belly along the

sides of trees or rocks. Then they patrol their territory, marking it with urine and a weak musk-smelling secretion from their anal gland. They search for food running along the ground or through the trees. They use their front paws to place the food into the mouth, and drink by plunging a paw into the water and then licking the paw.

Predators of the red panda include the snow leopard, martens (Mustelidae), and people. If they feel threatened or sense danger, they may try to escape by climbing a rock column or tree. If they can no longer flee, they stand on their hind legs to make themselves appear larger and use the sharp claws on their front paws to defend themselves.

Diet



Red panda gnawing

Red pandas are excellent climbers, and forage largely in trees. They eat mostly bamboo, and may eat small mammals, birds, eggs, blossoms, and berries. In captivity, they were observed to eat birds, blossoms, Acer and Morus leaves, bark and the fruits of Acer, Fagus and Morus.

Like the Giant Panda, they cannot digest cellulose, so they must consume a large volume of bamboo to survive. Their diet consists of about two-thirds bamboo, but they also eat mushrooms, roots, acorns, lichen, and grasses. Occasionally, they supplement their diet with fish and insects. They do little more than eat and sleep due to their low-calorie diet.

Bamboo shoots are more easily digested than leaves, exhibiting the highest digestibility in summer and autumn, intermediate digestibility in the spring, and lowest digestibility in the winter. These variations correlate with the nutrient contents in the bamboo. Red pandas process bamboo poorly, especially the cellulose and cell wall components. This

implies that microbial digestion plays only a minor role in their digestive strategy. In order to survive on this poor-quality diet, they have to eat the high-quality sections of the bamboo plant such as the tender leaves and shoots in large quantities, over 1.5 kilograms / 3.3 pounds of fresh leaves and 4 kilograms / 8.8 pounds of fresh shoots daily. This food passes through the digestive tract fairly rapidly (~2–4 hours) so as to maximize nutrient intake. Red pandas can taste artificial sweeteners such as aspartame, the only known non-primate to be able to do so.

Reproduction



Red panda cubs playing

Red pandas are able to reproduce from around 18 months of age, and are fully mature at 2–3 years. Adults rarely interact in the wild except to mate. Both sexes may mate with more than one partner during the mating season from mid-January to early March. A few days before birth, females begin to collect material, such as brushwood, grass, and leaves, to build a nest, which is normally located in a hollow tree or a rock crevice. After a gestation period of 112 to 158 days, the female gives birth in mid-June to late July to about one to four blind and deaf cubs weighing 110 to 130 grams (3.9 to 4.6 oz) each.

After birth, the mother cleans the cubs and can then recognize each by their smell. At first, she spends 60% to 90% of her time with the cubs. After the first week, the mother

starts spending more time outside the nest, returning every few hours to nurse and groom the cubs. She moves the young frequently among several nests, all of which she keeps clean. The cubs start to open their eyes at about 18 days of age. By about 90 days, they have achieved full adult fur and coloring, and begin to venture out of the nest. They also start eating solid foods at this point, weaning at around 6–8 months of age. The cubs stay with their mother until the next litter is born in the following summer. Males rarely help raise the young, and only if they live in pairs or in small groups.

The average lifespan is 8–10 years, but individuals have been known to reach 15 years.

Threats



A red panda in the Parco Natura Viva, Bussolengo near Verona, Italy

The primary threats to red pandas are direct harvest from the wild, live or dead, competition with domestic livestock resulting in habitat degradation, and deforestation resulting in habitat loss or fragmentation. The relative importance of these factors is different in each region, and is not well understood. For instance, in India the biggest threat seems to be habitat loss followed by poaching, while in China the biggest threat seems to be hunting and poaching. A 40% decrease in red panda populations has been reported in China over the last 50 years, and populations in western Himalayan areas are considered to be lower.

Deforestation can inhibit the spread of red pandas and exacerbate the natural population subdivision by topography and ecology, leading to severe fragmentation of the remaining

wild population. Fewer than 40 animals in 4 separate groups share resources with humans in Nepal's Langtang National Park, where only 6% of 1,710 square kilometres (660 sq mi) is preferred red panda habitat. Although direct competition for food with domestic livestock is not significant, livestock can depress bamboo growth by trampling.

Small groups of animals with little opportunity for exchange between them face the risk of inbreeding, decreased genetic diversity, and even extinction. In addition, clearcutting for firewood or agriculture, including hillside terracing, removes old trees that provide maternal dens and decreases the ability of some species of bamboo to regenerate.

In Southwest China, red pandas are hunted for their fur, especially for the highly-valued bushy tails from which hats are produced. In these areas, the fur is often used for local cultural ceremonies, and in weddings the bridegroom traditionally carries the hide. The "good-luck charm" red panda-tail hats are also used by Chinese newlyweds.

In the past, red pandas were captured and sold to zoos. Glatston reports that "in *International Zoo News*, Munro (1969) reported he personally had handled 350 red pandas in seventeen years."

Thanks to CITES this number has decreased substantially in recent years, but poaching continues, and red pandas are often sold to private collectors at exorbitant prices. In some parts of Nepal and India, red pandas are kept as pets.

The red panda has a naturally low birth rate (usually single or twin births per year), and a high death rate in the wild.

Conservation



The red panda has been confused with other animals

The red panda is listed in CITES Appendix I. The species has been classified as vulnerable in the IUCN Red List since 2008 because the global population is estimated at about 10,000 individuals, with a decreasing population trend; only about half of the total area of potential habitat of 142,000 km² (55,000 sq mi) is actually being used by the species. Due to their shy and secretive nature, and their largely nocturnal habits, observation of red pandas is difficult. Therefore, population figures in the wild are determined by population density estimates and not direct counts.

Worldwide population estimates range from fewer than 2,500 individuals to between 16,000 and 20,000 individuals. In 1999, the total population in China was estimated at between 3,000 and 7,000 individuals. In 2001, the wild population in India was estimated at between 5,000 and 6,000 individuals. Estimates for Nepal indicate only a few hundred individuals. There are no records from Bhutan or Myanmar.

Reliable population numbers are hard to find, partly because other animals have been mistaken for the red panda. For instance, one report from Myanmar stated that red pandas were still fairly common in some areas, and was accompanied by a photograph of a “red panda” as proof. The photograph in question depicted a species of civet.

The red panda is protected in all range countries, and hunting is illegal. Beyond this, conservation efforts are highly variable between countries:

- China has 35 protected areas covering about 42.4% of red panda habitat.
- India has 20 protected areas with known or possible red panda populations in Sikkim, Arunachal Pradesh and West Bengal such as Khangchendzonga National Park, Namdapha National Park and Singalila National Park, and a coordinated conservation policy for the red panda.
- In Nepal, known populations occur in Langtang National Park, Sagarmatha National Park, Makalu Barun National Park, Rara National Park, Annapurna Conservation Area, Kanchenjunga Conservation Area, and in Dhorpatan Hunting Reserve.
- Bhutan has 5 protected areas that support red panda populations.
- Myanmar has 26 protected areas, of which at least one or more host red panda populations.

In situ initiatives

A community-managed forest in Ilam District of eastern Nepal is home to 15 red pandas who generate household income through tourism activities including home stay. Villagers in the high - altitude areas of Arunachal Pradesh have formed the *Pangchen Red Panda Conservation Alliance* comprising five villages with a community - conserved forest area of 200 km² (77 sq mi) at an altitude of 2,500 m (8,200 ft) to over 4,000 m (13,000 ft).

In captivity

The red panda is quite adaptable to living in captivity, and is common in zoos worldwide. By 1992, there had been more than 300 births in captivity, and there were more than 300 individuals living in 85 institutions worldwide. By 2001, there were 182 individuals in North American zoos alone. As of 2006, the international studbook listed more than 800 individuals in zoos and parks around the world. Out of these, 511 individuals of subspecies *fulgens* were kept in 173 institutions. And 306 individuals of subspecies *styani* were kept in 81 institutions.

The International Studbook is currently managed at the Rotterdam Zoo in the Netherlands. In cooperation with the International Red Panda Management Group, they coordinate the Species Survival Plan in North America, the European Endangered Species Programme in Europe and other captive breeding programs in Australia, India, Japan and China. In 2009, Sarah Glass, Curator of red pandas and Special Exhibits at the Knoxville Zoo in Knoxville, Tennessee, was appointed as coordinator for the North American Red Panda Species Survival Plan. The Knoxville Zoo has the largest number of captive red panda births in the Western Hemisphere (93 as of September 2009). Only the Rotterdam Zoo in the Netherlands has had more captive births worldwide.

Successes in red panda captive breeding includes:

- The Padmaja Naidu Himalayan Zoological Park in Darjeeling, India, successfully released four captive bred red pandas to the wild in August and November 2003.
- At the Valley Zoo in Edmonton, Alberta, Canada, twins were born in 2007 and 2008, a single birth in 2009, and twins in 2010 (one died 9 September 2010)
- At the Denver Zoo in Denver, Colorado, twins were born in 2008 and quadruplets in 2009.
- At the Red River Zoo in Fargo, North Dakota, twins were born in 2008 and triplets in 2009.
- Triplets in September 2009 at the Cleveland Metroparks Zoo in Cleveland, Ohio.
- Twins in June 2010 at the Kristiansand Zoo and Amusement Park in Kristiansand, Norway
- Twins in June 2010 at the Zagreb Zoo in Zagreb, Croatia
- Twins in May 2010 at the Calgary Zoo in Calgary, Alberta

Because the red panda is considered a very attractive or cute animal, and is not much larger than a house cat, it would seem to be ideal for a pet. Despite this, and despite reports that Indira Gandhi kept red pandas as pets when she was a child, there does not seem to have ever been widespread adoption of these animals as pets. Due to its listing in CITES Appendix I, getting a red panda as a pet would now be quite difficult.

Phylogenetics

The taxonomic classification of the red panda has been controversial since it was discovered. French zoologist Frédéric Cuvier initially described the red panda in 1825, and classified it as a close relative of the Raccoon (Procyonidae), even though he gave it the genus name *Ailurus* "cat" based on superficial similarities with domestic cats. The specific epithet is the Latin adjective *fulgens* "shining". At various times it has been placed in Procyonidae, Ursidae, with *Ailuropoda* in Ailuridae, and in its own family, Ailuridae. This uncertainty comes from difficulty determining whether certain characteristics of *Ailurus* are phylogenetically conservative or are derived and convergent with species of similar ecological habits.



A Red panda gnawing on an exfoliated bamboo bush.

Evidence based on the fossil record, serology, karyology, behavior, anatomy, and reproduction reflect closer affinities with Procyonidae than Ursidae. However, ecological and foraging specializations and distinct geographical distribution in relation to modern Procyonids support classification in the separate family Ailuridae.

Recent molecular-systematic DNA research also places the red panda into its own family Ailuridae, which is in turn part of the broad superfamily *Musteloidea* that also includes skunk, raccoon, and weasel families.

It is not a bear, nor closely related to the giant panda, nor a raccoon, nor a lineage of uncertain affinities. Rather it is a basal lineage of musteloid, with a long history of independence from its closest relatives (skunks, raccoons, and otters/weasels/badgers).
—Flynn et al., *Whence the Red Panda*, p197

The name *Ailurus fulgens refulgens* is sometimes incorrectly used for *A. f. styani*. This stems from a lapsus made by Henri Milne-Edwards in his 1874 paper "Recherches pour servir à l'histoire naturelle des mammifères comprenant des considérations sur la classification de ces animaux", making *A. f. refulgens* a nomen nudum. The most recent edition of "Mammal Species of the World" still shows the subspecies as *A. f. refulgens*.

This has been corrected in more recent works including "A guide to the mammals of China" and "Handbook of the Mammals of the World, Volume 1: Carnivores."

Evolutionary history

The red panda is considered a living fossil and only distantly related to the Giant Panda (*Ailuropoda melanoleuca*). Their common ancestor can be traced back to the Early Tertiary Period tens of millions of years ago, with a wide distribution across Eurasia. Fossils of the red panda *Parailurus anglicus* have been unearthed from China in the east to Britain in the west.

In 1977, a single tooth of the extinct panda *Parailurus* was discovered in the Pliocene Ringold Formation of Washington State. This first North American record is almost identical to European specimens and indicates the immigration of this species from Asia. In 2004, a tooth from a red panda species never before recorded in North America was discovered at the Gray Fossil Site in Tennessee. The tooth dates from 4.5-7 million years ago. This species described as *Pristinailurus bristolii* indicates that a second, more primitive ailurine lineage inhabited North America during the Miocene. Cladistic analysis suggests that *Parailurus* and *Ailurus* are sister-taxa.

The discovery in Spain of the postcranial remains of *Simocyon batalleri*, a Miocene relative to the red panda, supports a sister-group relationship between red pandas and giant pandas. The discovery suggests that the red panda's "false thumb" was an adaptation to arboreal locomotion — independent of the giant panda's adaptation to manipulate bamboo — one of the most dramatic cases of convergent evolution among vertebrates.

Taxonomic history



Red panda at Munich Zoo, Germany

The first known written record of the red panda occurs in a 13th-century Chou Dynasty scroll depicting a hunting scene between hunters and the red panda.

Major General Thomas Hardwicke's 1821 presentation of an article titled "Description of a new Genus of the Class Mammalia, from the Himalaya Chain of Hills Between Nepal and the Snowy Mountains" at the Linnean Society in London is usually regarded as the moment the red panda became a bona fide species in Western science. Hardwicke proposed the name "Wha" and explained: "It is frequently discovered by its loud cry or call, resembling the word 'Wha,' often repeating the same : hence is derived one of the local names by which it is known. It is also called *Chitwa*." Hardwicke's paper was not published until 1827, by which time Frédéric Cuvier had published his description and a figure. Hardwicke's originally proposed taxonomic name was removed from the 1827 publication of his paper with his permission, and naming credit is now given to Cuvier.

Frédéric Cuvier had received the specimen he described from his brother's stepson Alfred Duvaucel who had sent it "from the mountains north of India". He was the first who used both the binomial *Ailurus fulgens* and the vernacular name *Panda* in reference to the species in his description published in 1825 in *Histoire Naturelle des Mammifères*. *Ailurus* is adopted from the ancient Greek word αἴλουρος meaning *cat*. *Fulgens* is Latin for *shining, bright*. *Panda* is the French name for the Roman goddess of peace and travelers, who was called upon before starting a difficult journey. Whether this is the

origin of the French vernacular name *Panda* remains uncertain. In later publications, the name is claimed to be adopted from a Himalayan language.

Local names

The red panda's local names differ from place to place. The Lepcha people call it *sak nam*. In Nepal, the species is called *bhalu biralo* (bear-cat) and *habre*. The Sherpa people of Nepal and Sikkim call it *ye niglva ponva* and *wah donka*. The word *wâ:* is Sunuwari meaning *bear*; in Tamang language, a small, red bear is called *tāwām*. In the Kanchenjunga region of eastern Nepal, the Limbus know red pandas as *Kaala*, which literally means dark because of their underside pelage; villagers of Tibetan origin call them *Hoptongar*.

Additionally, Pocock lists the vernacular names *Ye* and *Nigálya ponya* (Nepal); *Thokya* and *Thongwa* (Limbu); *Oakdonga* or *Wakdonka* and *Woker* (Bhotia); *Saknam Sunam* (Lepcha). *Nigálya* may originate from the Nepali a particular kind of small bamboo, namely *Arundinaria intermedia*, but also refers to a kind of small leopard, or cat-bear. The word *pónya* may originate from the Nepali paw of an animal. *Nigálya pónya* may translate to 'bamboo claw' or 'bamboo paw'.

Nigálya pónya, *nyala ponga*, and *poonya* are said to mean *eater of bamboo*. It could be that the name *panda* originates from *panjā*.

According to Chinese dictionaries, the red panda is called 小熊猫/小熊猫 (*xiǎo xióng māo*, "small bear cat) or 红熊猫/红熊猫 (*hóng xióng māo*, "red bear cat"). The English name *firefox* is often claimed by English sources to be a literal translation of the Chinese name for the red panda, but "firefox" (火狐, or *huǒ hú*) in Chinese refers to the Firefox web browser. The Giant Panda is called 熊猫/熊猫 (*xióng māo*, or "bear cat").

In English, the red panda is also called *lesser panda*, though due to the pejorative implications of this name, "red" is generally preferred. Many other languages use red panda, or variations of shining/gold or lesser/small in their names for this species. For instance, *червена панда* in Bulgarian, *panda roux* in French, and *panda rojo* in Spanish all mean red panda. Since at least as far back as 1855, one of its French names has been *panda éclatant* (shining panda). In Finnish, it is called *kultapanda* ("gold panda"). Variations of *lesser panda* occur in French *petit panda* ("small panda"), in Spanish *panda menor* ("lesser panda"), in Dutch *kleine panda* ("small panda"), in Russian «малая панда» (*malaya panda*, "small panda"), in Korean 아기판다 (*aeki panda*, "baby panda"), in Japanese *ressā panda* (レッサーパンダ *transliteration of English "lesser panda"*).

Other names attributed to this species include fire cat, bright panda and common panda.

Cultural depictions

The red panda was recognized as the state animal of Sikkim in the early 1990s, and was the mascot of the Darjeeling Tea Festival.

In southwest China, red pandas are hunted for their fur, especially for the highly-valued bushy tails from which hats are produced. In these areas, the fur is often used for local cultural ceremonies, and in weddings the bridegroom traditionally carries the hide. The "good-luck charm" red panda-tail hats are also used by Chinese newlyweds. This practice may be quite old, as the red panda seems to be depicted in a 13th century Chinese pen and ink scroll showing a hunting scene. There is little or no mention of the red panda in the culture and folklore of Nepal.

The Firefox browser is said to have been named after a Chinese name for red panda: 火狐, or "fire fox." However, Mozilla claims different motivations for the naming in its branding statements, saying:

It's similar to Firebird. It's easy to remember. It sounds good. It's unique. We like it. And we weren't able to find any other project or company even remotely similar to a web browser that uses the same name.

—Mozilla.org, *Why change the name?*

In addition, an article on its branding by the artist says that although Firefox is a red panda, the logo design is a red fox. Despite these statements, Mozilla says that firefox is another name for Red Panda and in 2010 the Firefox Web site started linking to a "live feed of firefox cubs" (red pandas).

An anthropomorphic red panda was featured as Master Shifu, the Kung Fu teacher, in the 2008 movie *Kung Fu Panda*. Some of the comments about this film indicate the lack of awareness about the red panda in the United States at this time. Although most of the reviewers got the species correct, some nevertheless mistook it for a tiny wolf, a rodent, and a lemur. In an interview, Dustin Hoffman also indicated that he did not know much about the animal when he first agreed to voice the character.

In 2005, *Babu*, a male red panda at Birmingham Nature Centre, in Birmingham, England, escaped and briefly became a media celebrity, before being recaptured. He was subsequently voted *Brummie of the year* (A Brummie is a person from Birmingham).

Chapter 8

Orangutan

Orangutans



Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Primates
Family:	Hominidae
Subfamily:	Ponginae
Genus:	<i>Pongo</i> Lacépède, 1799

Type species

Pongo borneo

Lacépède, 1799 (= *Simia pygmaeus*)
Linnaeus, 1760)

Species

Pongo pygmaeus

Pongo abelii



Orangutan distribution

Orangutans are the only exclusively Asian genus of extant great ape. The largest living arboreal animals, they have longer arms than the other, more terrestrial, great apes. They are among the most intelligent primates and use a variety of sophisticated tools, also making sleeping nests each night from branches and foliage. Most of their lives are spent foraging for food in solitude; they are generally not aggressive. Their hair is typically reddish-brown, instead of the brown or black hair typical of other great apes.

Native to Indonesia and Malaysia, orangutans are currently found only in rainforests on the islands of Borneo and Sumatra, though fossils have been found in Java, the Thai-Malay Peninsula, Vietnam and Mainland China. There are only two surviving species, both of which are endangered: the Bornean Orangutan (*Pongo pygmaeus*) and the critically endangered Sumatran Orangutan (*Pongo abelii*). The subfamily Ponginae also includes the extinct genera *Gigantopithecus* and *Sivapithecus*. The word "orangutan" comes from the Malay words "orang" (man) and "(h)utan" (forest); hence, "man of the forest".

Taxonomic classification

- **Genus *Pongo***
 - Bornean Orangutan (*Pongo pygmaeus*)
 - *Pongo pygmaeus pygmaeus* - northwest populations
 - *Pongo pygmaeus morio* - east populations
 - *Pongo pygmaeus wurmbii* - southwest populations
 - Sumatran Orangutan (*Pongo abelii*)

The populations on the two islands were classified as subspecies until recently, when they were elevated to full specific level, and the three distinct populations on Borneo were elevated to subspecies. The population currently listed as *P. p. wurmbii* may be closer to the Sumatran Orangutan than the Bornean Orangutan. If confirmed, *abelii* would be a subspecies of *P. wurmbii* (Tiedeman, 1808). Regardless, the type locality of *pygmaeus* has not been established beyond doubts, and may be from the population currently listed as *wurmbii* (in which case *wurmbii* would be a junior synonym of *pygmaeus*, while one of the names currently considered a junior synonym of *pygmaeus* would take precedence for the northwest Bornean taxon). To further confuse, the name *morio*, as well as various

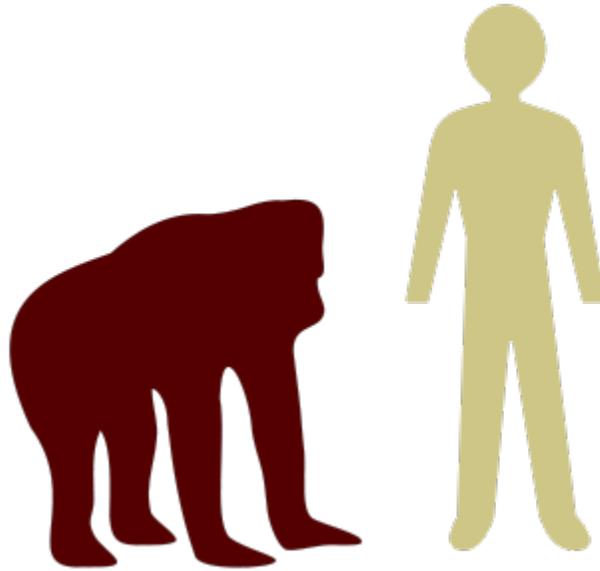
junior synonyms that have been suggested, have been considered likely to all be junior synonyms of the population listed as *pygmaeus* in the above, thus leaving the east Bornean populations unnamed.



Pongo pygmaeus

In addition, a fossil species, *P. hooijeri*, is known from Vietnam, and multiple fossil subspecies have been described from several parts of southeastern Asia. It is unclear if these belong to *P. pygmaeus* or *P. abeli* or, in fact, represent distinct species.

Anatomy and physiology



Size relative to a 6 foot (1.8 m) man

An orangutan's standing height averages from 4 to 5 ft (1.2 to 1.5 m). On average, an orangutan weighs between 73 to 180 pounds (33 to 82 kg). Males can weigh up to 250 lb (110 kg) or more. Orangutan hands are similar to humans' hands; they have four long fingers and an opposable thumb. Their feet have four long toes and an opposable big toe. Orangutans can grasp things with both their hands and their feet. The largest males have an arm span of about 7.5 ft (2 m).

Orangutans have a large, bulky body, a thick neck, very long, strong arms, short, bowed legs, and no tail. They are mostly covered with long reddish-brown hair, although this differs between the species: Sumatran Orangutans have a more sparse and lighter coloured coat.

The orangutan has a large head with a prominent mouth area. Adult males have large cheek flaps (which get larger as the ape ages) that show their dominance to other males and their readiness to mate. The age of maturity for females is approximately 12 years. On average, orangutans may live about 35 years in the wild, and up to 60 years in captivity. Both sexes have throat pouches located near their vocal chords that make their calls resonate through the forest, although the males' pouches are more developed. There is significant sexual dimorphism: females can grow to around 4 ft 2 in or 127 cm and weigh around 100 lb (45 kg) while flanged adult males can reach 5 ft 9 in or 175 cm in height and weigh over 260 lb (118 kg).

The arms of orangutans are twice as long as their legs, and an adult orangutan's arms can be well over seven feet from fingertip to fingertip. Much of the arm's length has to do with the length of the radius and the ulna rather than the humerus. Their fingers and toes

are curved, allowing them to better grip onto branches. Orangutans have less restriction in the movements of their legs than humans and other primates, due to the lack of a hip joint ligament which keeps the femur held into the pelvis. Unlike gorillas and chimpanzees, orangutans are not true knuckle-walkers, and are instead fist-walkers.

Ecology and behavior

Orangutans live in primary and old secondary forests, particularly dipterocarp forests and peat swamp forests. Both species can be found in both mountainous and lowland swampy areas. Sumatran orangutans live in elevations as high as 1500 m (4921 ft), while Bornean orangutans live no higher than 1000 m (3281 ft). The latter will sometimes enter grasslands, cultivated fields, gardens, young secondary forest, and shallow lakes. Orangutans are the most arboreal of the great apes, spending nearly all of their time in the trees. Most of the day is spent feeding, resting, and moving between feeding and resting sites. They start the day feeding for 2-3 hours in the morning. They rest during midday followed by traveling in the late afternoon. When evening arrives, they begin to prepare their nest for the night. Tigers are the major predatory threat to orangutans in Sumatra. Orangutans may also be preyed on by clouded leopards and crocodiles. The former can kill adolescents and small adult females but have not been recorded killing adult males. In Borneo, orangutans are not threatened by tigers and seem to descend to the ground more often than their Sumatran relatives. Orangutans do not swim. At least one population at a conservation refuge on Kaja island in Borneo have been photographed wading in deep water.

Diet



Flanged adult male

Fruit makes up 65–90 percent of the orangutan diet. Fruits with sugary or fatty pulp are favored. Ficus fruits are commonly eaten, because they are easy to harvest and digest. Lowland dipterocarp forests are preferred by orangutans because of their plentiful fruit. Bornean orangutans consume at least 317 different food items that include young leaves, shoots, bark, insects, honey and bird eggs.

Orangutans are opportunistic foragers, and their diets vary markedly from month to month. Bark is eaten as a last resort in times of food scarcity; fruits are always more popular.

Orangutans are thought to be the sole fruit disperser for some plant species including the climber species *Strychnos ignatii* which contains the toxic alkaloid strychnine. It does not appear to have any effect on orangutans except for excessive saliva production.

Geophagy, the practice of eating soil or rock, has been observed in orangutans. There are three main reasons for this dietary behavior; for the addition of minerals nutrients to their diet; for the ingestion of clay minerals that can absorb toxic substances; or to treat a disorder such as diarrhea.

Orangutans use plants of the genus *Commelina* as an anti-inflammatory balm.

Social life



Orangutans, Gunung Leuser NP, Sumatra

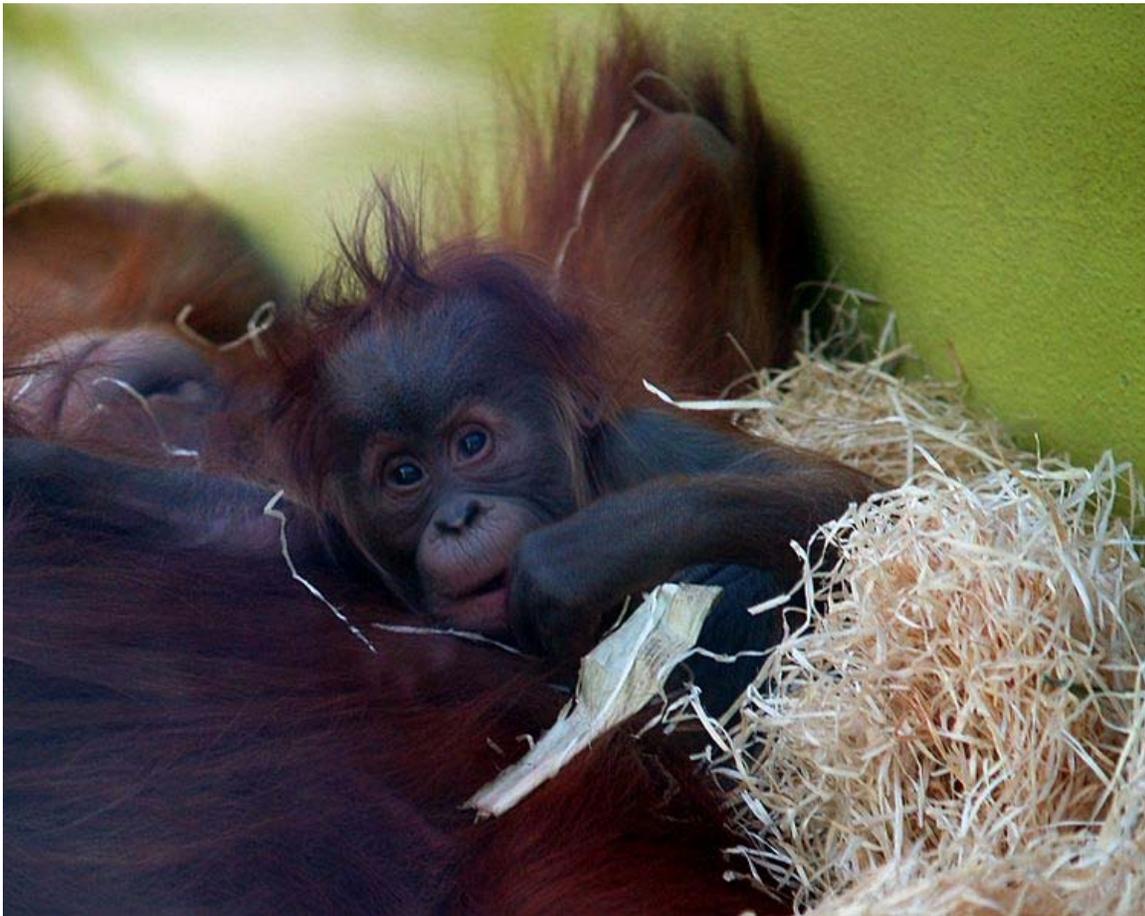
Orangutans live a more solitary lifestyle than the other great apes. Most social bonds occur between adult females and their dependent and weaned offspring. Adult males and independent adolescents of both sexes tend to live alone. The society of the orangutan is made up of resident and transient individuals of both sexes. Resident females live with their offspring in defined home ranges that overlap with other adult females, who may be their relatives like mothers and sisters. One to several resident female home ranges are encompassed within the home range of a resident male, who is their primary breeder. Transient males and females range broadly. They usually travel alone, but as sub-adults they may travel in small groups. However this behavior does not extend to adulthood. The social structure of the orangutan can be best described as solitary but social. As the ranges of males and females overlap, they commonly encounter each other while traveling and feeding and may have brief social interactions. Interactions between adult females range from friendly, to avoidance to antagonistic. Resident males may have overlapping ranges and interactions between them tend to be hostile.

During dispersal, females tend to settle in home ranges that overlap with their mothers. However, they do not interact with them any more than the other females and they do not seem to form bonds through affiliation, grooming, or agonistic support. Males disperse much farther from their mothers and enter into a transient phase. This phase lasts until a male can challenge and displace a dominant, resident male from his home range. There are dominance hierarchies between adult males that regularly encounter each other with the most dominant males being the largest and having the best body conditions. Adult males dominate sub-adult males. Both resident and transient orangutans aggregate on large fruiting trees to feed. The fruits tend to be abundant, so competition is low and individuals may benefit from social contacts. Orangutans will also form travelling groups in which members coordinate travel between food sources for a few days at a time. These groups tend to be made of only a few individuals. They also tend to be mating consortships, each made of an adult male and female traveling and mating.

Reproduction and parenting

Male orangutans exhibit arrested development. They mature at around 15 years of age by which they have fully descended testicles and can reproduce. However they do not develop the cheek pads, pronounced throat pouches, long fur or long-calls of more mature males until they gain a home range, which occurs when they are between 15 and 20 years old. These sub-adult males are known as unflanged males in contrast to the more developed flanged males. The transformation from unflanged to flanged can occur very quickly. Unflanged and flanged males have two different mating strategies. Flanged males use long calls to advertise their location which attract estrous females. Unflanged males wander widely in search of estrous females and upon finding one, will force copulation on her. Both strategies are successful, however females prefer to mate with flanged males and will seek them out for protection from unflanged males. Resident males may form consortships with females that can last days, weeks or months after copulation.

Female orangutans experience their first ovulatory cycle between 5.8 and 11.1 years. These occur earlier in larger females with more body fat than in thinner females. Like other great apes, female orangutans have a period of adolescent infertility which may last for 1-4 years. Female orangutans also have a 22-30 day menstrual cycle. Gestation lasts for nine months with females giving birth to their first offspring between 14 and 15 years old. Female orangutans have the longest interbirth intervals of the great apes, having eight years between births.



A two-week old orangutan

Male orangutans play almost no role in raising the young. Females are the primary caregivers for the young and are also instruments of socialization for them. A female often has more than one offspring with her, usually an adolescent and an infant, and the older of them can also help in socializing their younger sibling. Infant orangutans are completely dependent on their mothers for the first two years of their lives. The mother will carry the infant during traveling, as well as feed it and sleep with it in the same night nest. The infant doesn't even break physical contact with its mother for the first four months and is carried on her belly. The amount of physical contact soon wanes in the following months. When an orangutan reaches the age of two, its climbing skills are more developed and will hold the hand of another orangutan while moving through the canopy,

a behavior known as "buddy travel". Orangutans are juveniles from about two to five years of age and start to exploratory trips from their mothers. Juveniles are usually weaned at about four years of age. Adolescent orangutans seek peers and play and travel with peer groups while start having contact with their mothers.

Tool use and culture



A young Orangutan at the Toledo Zoo in Ohio. The Orangutan's opposable toes and fingers give them the ability to use tools.

Like the other great apes, orangutans are among the most intelligent primates. Wild chimpanzees have been known since the 1960s to use tools. Tool use in orangutans was observed by Biruté Galdikas in ex-captive populations.

Evidence of sophisticated tool manufacture and use in the wild was reported from a population of orangutans in Suaq Balimbing (*Pongo pygmaeus abelii*) in 1996. These orangutans developed a tool kit for use in foraging that consisted of insect-extraction

tools for use in the hollows of trees, and seed-extraction tools which were used in harvesting seeds from hard-husked fruit. The orangutans adjusted their tools according to the nature of the task at hand and preference was given to oral tool use. This preference was also found in an experimental study of captive orangutans (*P. pygmaeus*).

Carel P. van Schaik from the University of Zurich and Cheryl D. Knott from Harvard University further investigated tool use in different wild orangutan populations. They compared geographic variations in tool use related to the processing of *Neesia* fruit. The orangutans of Suaq Balimbing (*P. abelii*) were found to be avid users of insect and seed-extraction tools when compared to other wild orangutans. The scientists suggested that these differences are cultural. The orangutans at Suaq Balimbing live in dense groups and are socially tolerant; this creates good conditions for social transmission. Further evidence that highly social orangutans are more likely to exhibit cultural behaviors came from a study of leaf-carrying behaviors of ex-captive orangutans that were being rehabilitated on the island of Kaja in Borneo. The above evidence is consistent with the existence of orangutan culture as geographically distinct behavioral variants which are maintained and transmitted in a population through social learning.



Orangutan at Columbus Zoo and Aquarium

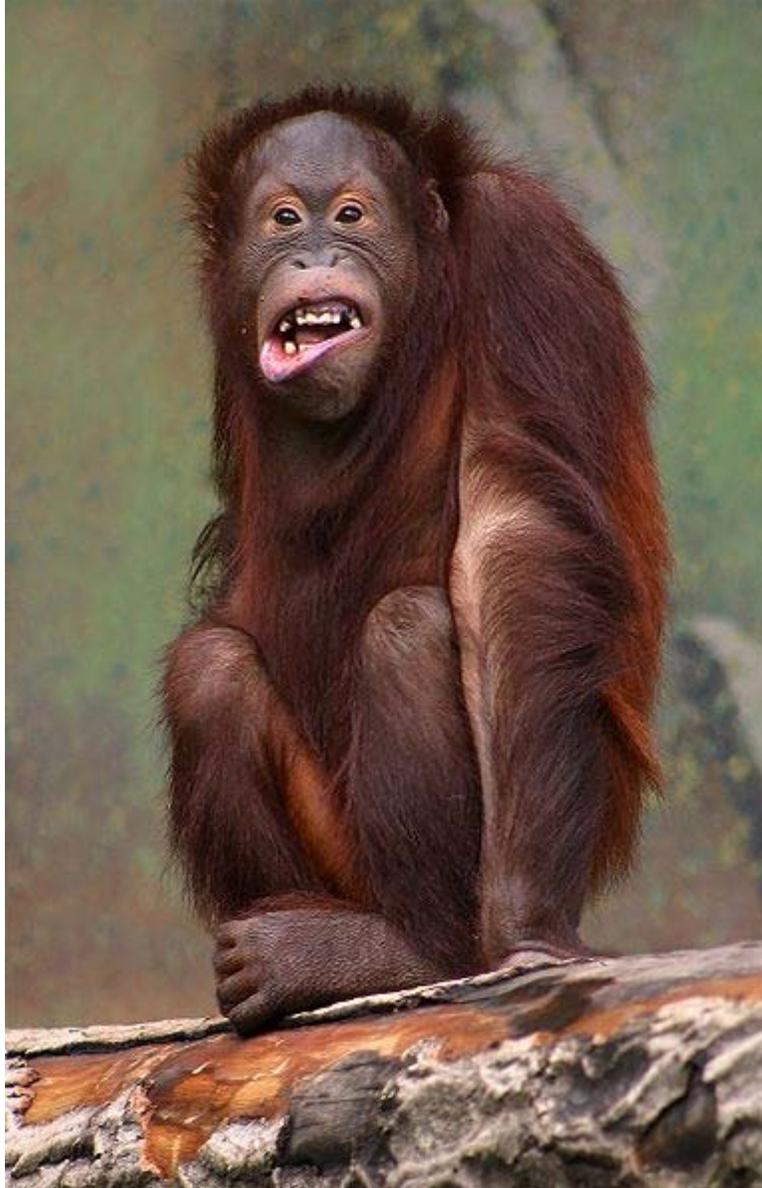
In 2003, researchers from six different orangutan field sites who used the same behavioral coding scheme compared the behaviors of the animals from the different sites. They found that the different orangutan populations behaved differently. The evidence suggested that the differences in behavior were cultural: first, because the extent of the differences increased with distance, suggesting that cultural diffusion was occurring, and

second, because the size of the orangutans' cultural repertoire increased according to the amount of social contact present within the group. Social contact facilitates cultural transmission. Carel P. van Schaik suggests that young orangutans (*P. abelii*) acquire tool use skills and cultural behaviors by observing and copying older orangutans.

Orangutans do not limit their tool use to foraging, displaying or nest-building activities. Wild orangutans (*P. pygmaeus wurmbii*) in Tuanan, Borneo, were reported to use tools in acoustic communication. They use leaves to amplify the kiss squeak sounds that they produce. Some have suggested that the apes employ this method of amplification in order to deceive the listener into believing that they are larger animals.

Communication

A two year study of orangutan symbolic capability was conducted from 1973-1975 by Gary L. Shapiro with Aazk, a juvenile female orangutan at the Fresno City Zoo (now Chaffee Zoo) in Fresno, California. The study employed the techniques of David Premack who used plastic tokens to teach the chimpanzee, Sarah, linguistic skills. Shapiro continued to examine the linguistic and learning abilities of ex-captive orangutans in Tanjung Puting National Park, in Indonesian Borneo, between 1978 and 1980. During that time, Shapiro instructed ex-captive orangutans in the acquisition and use of signs following the techniques of R. Allen and Beatrix Gardner who taught the chimpanzee, Washoe, in the late-1960s. In the only signing study ever conducted in a great ape's natural environment, Shapiro home-reared Princess, a juvenile female who learned nearly 40 signs (according to the criteria of sign acquisition used by Francine Patterson with Koko, the gorilla) and trained Rinnie, a free-ranging adult female orangutan who learned nearly 30 signs over a two year period. For his dissertation study, Shapiro examined the factors influencing sign learning by four juvenile orangutans over a 15-month period.



Orangutan "laughing"

The first orangutan language study program, directed by Dr. Francine Neago, was listed by *Encyclopædia Britannica* in 1988. The Orangutan language project at the Smithsonian National Zoo in Washington, D.C., uses a computer system originally developed at UCLA by Neago in conjunction with IBM.

Zoo Atlanta has a touch screen computer where their two Sumatran Orangutans play games. Scientists hope that the data they collect from this will help researchers learn about socializing patterns, such as whether they mimic others or learn behavior from trial and error, and hope the data can point to new conservation strategies.

A 2008 study of two orangutans at the Leipzig Zoo showed that orangutans are the first non-human species documented to use 'calculated reciprocity' which involves weighing the costs and benefits of gift exchanges and keeping track of these over time.

Orangutans, along with Chimpanzees, gorillas, and other apes, have even shown laughter-like vocalizations in response to physical contact, such as wrestling, play chasing, or tickling.

Sexual interest in human females

Male orangutans have been known to rape human women. The cook of noted primatologist Birutė Galdikas was raped by an orangutan. An orangutan tried to have sex with Actress Julia Roberts but was prevented by a film crew.

Conservation status



Male, child, and female Sumatran orangutans

The Sumatran species is critically endangered and the Bornean species of orangutans is endangered according to the IUCN Red List of mammals, and both are listed on Appendix I of CITES. The total number of Bornean orangutans is estimated to be less than 14% of what it was in the recent past (from around 10,000 years ago until the middle

of the twentieth century) and this sharp decline has occurred mostly over the past few decades due to human activities and development. Species distribution is now highly patchy throughout Borneo: it is apparently absent or uncommon in the south-east of the island, as well as in the forests between the Rejang River in central Sarawak and the Padas River in western Sabah (including the Sultanate of Brunei). The largest remaining population is found in the forest around the Sabangau River, but this environment is at risk. A similar development have been observed for the Sumatran orangutans.

A 2007 study by the Government of Indonesia noted in 2004 it was estimated that there was a total wild population of 61,234 orangutans, 54,567 of which were found on the island of Borneo. The table below shows a breakdown of the species and subspecies and their estimated populations from the report:

Scientific name	Common name	Region	Estimated number
<i>Pongo abelii</i>	Sumatran Orangutan	Sumatra	6,667
<i>Pongo pygmaeus</i>	Bornean Orangutan	Borneo	
<i>P. p. morio</i>	Northeast Bornean Orangutan	Sabah	11,017
<i>P. p. morio</i>	Northeast Bornean Orangutan	East Kalimantan	4,825
<i>P. p. wurmbii</i>	Central Bornean Orangutan	Central Kalimantan	>31,300
<i>P. p. pygmaeus</i>	Northwest Bornean Orangutan	West Kalimantan and Sarawak	7,425

This indicates a decline from some estimates between 2000 and 2003 which found 7,300 Sumatran Orangutan individuals in the wild and between 45,000 and 69,000 Bornean Orangutans. Thousands of orangutans don't reach adulthood due to human disruption. Orangutans are killed for food while others are killed because of disruption in people's property. Mother orangutans are killed so their infants can be sold as pets. Many of the infants die without the help of their mother. Since recent trends are steeply down in most places due to logging and burning, it is forecast that the current numbers are below these figures.

Orangutan habitat destruction due to logging, mining and forest fires, as well as fragmentation by roads, has been increasing rapidly in the last decade. A major factor in that period of time has been the conversion of vast areas of tropical forest to oil palm plantations in response to international demand (the palm oil is used for cooking, cosmetics, mechanics, and more recently as source of biodiesel). Some UN scientists believe that these plantations could lead to irreparable damage to orangutan habitat by the year 2012. Some of this activity is illegal, occurring in national parks that are officially off limits to loggers, miners and plantation development. There is also a major problem with hunting and illegal pet trade. In early 2004 about 100 individuals of Bornean origin were confiscated in Thailand and 50 of them were returned to Kalimantan in 2006. Several hundred Bornean orangutan orphans who were confiscated by local authorities have been entrusted to different orphanages in both Malaysia and Indonesia. They are in the process of being rehabilitated into the wild.

Conservation centres and organisations



Orangutans at a rehabilitation centre in Borneo

A number of organisations are working for the rescue, rehabilitation and reintroduction of orangutans. The largest of these is the Borneo Orangutan Survival Foundation, founded by Dr. Willie Smits, which employs between six hundred and a thousand people at a hundred sites. It operates a number of large projects, including the Samboja Lestari Forest Rehabilitation Program and the Nyaru Menteng Rehabilitation Program managed by Lone Drøscher Nielsen. Other major conservation centres in Indonesia include those at Tanjung Puting National Park and Sebangau National Park in Central Kalimantan, Kutai in East Kalimantan, Gunung Palung National Park in West Kalimantan, and Bukit Lawang in the Gunung Leuser National Park on the border of Aceh and North Sumatra. In Malaysia, conservation areas include Semenggoh Wildlife Centre in Sarawak and Matang Wildlife Centre also in Sarawak, and the Sepilok Orang Utan Sanctuary near Sandakan in Sabah.

Genomics

Orangutans have 48 diploid chromosomes, and its genome was sequenced in January 2011. Following humans and chimpanzees, the Sumatran orangutan has become the third species of hominid to have its genome sequenced. The draft of the genome sequence is based on a captive female named Susie.

The researchers also published less complete copies from ten wild orangutans, five from Borneo and five from Sumatra. It was found that genetic diversity was lower in Bornean orangutans (*Pongo pygmaeus*) than in Sumatran ones (*Pongo abelii*), despite the fact that Borneo is home to six or seven times as many orangutans as Sumatra. The comparison has shown that these two species diverged around 400,000 years ago, more recently than was previously thought. It was also found that the orangutan genome has evolved much more slowly than chimpanzee and human DNA.

The researchers hope that these data may help conservationists save the endangered ape, and also prove useful in further understanding of human genetic diseases.

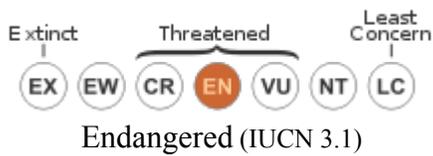
Chapter 9

Grévy's Zebra

Grévy's Zebra



Conservation status



Scientific classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Perissodactyla
Family: Equidae
Genus: *Equus*
Species: *E. grevyi*

Binomial name

Equus grevyi
Oustalet, 1882



Grévy's zebra range
(blue — native, red — introduced)

The **Grévy's Zebra** (*Equus grevyi*), also known as the **Imperial Zebra**, is the largest extant wild equid and one of three species of zebra, the other two being the plains zebra and the mountain zebra. Named after Jules Grévy, it is the sole extant member of the subgenus *Dolichohippus*. The Grévy's zebra occurs in Kenya and Ethiopia. Compared with other zebras, it is tall, has large ears, and its stripes are narrower. It is more ass-like in appearance as compared to other zebras, which are more horse-like.

The Grévy's zebra lives in semi-arid grasslands where it feeds on grasses, legumes, and browse; it can survive up to five days without water. It differs from the other zebra species in that it does not live in harems and has few long-lasting social bonds. Male territoriality and mother–foal relationships form the basis of the social system of the Grévy's zebra. This zebra is considered to be endangered. Its population has declined from 15,000 to 3,000 since the 1970s. However, as of 2008 the population is stable.

Taxonomy and naming

The Grévy's zebra was first described by French naturalist Émile Oustalet in 1882. He named it after Jules Grévy, then president of France, who, in the 1880s, was given one by the government of Abyssinia. It is the only extant species of the subgenus *Dolichohippus*. The plains zebra and mountain zebra belong to *Hippotigris*. Fossils of *Dolichohippus* zebras have been found throughout Africa and Asia in the Pliocene and Pleistocene deposits. Notable examples include *E. sanmeniensis* from China, *E. cautleyi* from India, *E. valeriani* from central Asia and *E. oldowayensis* from East Africa. The latter, in particular is very similar to the Grévy's zebra and may have been its ancestor. The modern Grévy's zebra arose in the early Pleistocene. Recent phylogenetic evidence suggests that Grevy's zebras are with asses and donkeys in a lineage separate from plains zebras, but perhaps not from mountain zebras. In areas where Grévy's zebras are sympatric with plains zebras, it is not unusual to find them in the same herds and fertile hybrids do occur.

Description



From left to right: a cranium, a complete skeleton, a left forefoot frontal, and a left forefoot lateral from a Grévy's zebra.

Grévy's zebra is the largest of all wild equines. It is 2.5–2.75 m (8–9 ft) from head to tail with a 38–75 cm (15–30 in) tail, and stands 1.45–1.60 m (4'7"–5'3") high at the shoulder. These zebras weigh 350–450 kg (770–990 lb). The stripes are narrow and close-set, being broader on the neck, and they extend to the hooves. The belly and the area around the base of the tail lack stripes. Grévy's zebra differs from the other two zebras in its more primitive characteristics. Its head is large, long, and narrow with elongated nostril openings. It is particularly mule-like in appearance with a brown muzzle. The ears are very large, rounded, and conical. The mane is tall and erect; juveniles have a mane that extends to the length of the back and shortens when they reach adulthood. Foals are born with brown and white striping, with the brown stripes darkening to black as they grow older.

Range and ecology



Zebra on the barren plains of Kenya.

The Grévy's zebra once ranged though most of Kenya, Eritrea, Ethiopia and Somalia. Today it now largely inhabits northern Kenya, with some isolated populations in Ethiopia. Its status in Sudan is uncertain. This zebra fills an ecological niche between the African wild ass, which prefers a more arid habitat, and the more water-dependent plains zebra. It has adapted to the barren plains of the Acacia-Commiphora bushlands and thickets. Lactating females and non-territorial males use areas with green, short grass and medium, dense bush more often than non-lactating females and territorial males.

Grévy's zebras rely on grasses, legumes, and browse for nutrition. They commonly browse when grasses are not plentiful. Their hindgut fermentation digestive system allows them to subsist on diets of lower nutritional quality than that necessary for ruminant herbivores. Grevy's zebras can survive up to five days without water, but will drink daily when it is plentiful. They often migrate to better watered highlands during the dry season. Females require significantly more water when they are lactating. During droughts, the zebras will dig water holes and defend them. Grévy's zebras are preyed on by lions, hyenas, wild dogs, cheetahs and leopards. In addition, they are susceptible to various gastro-intestinal parasites, notably of the *Trichostrongylus* genus.

Behavior



Herd of zebras.



Closeup of a zebra grazing.

Behaviourally, the Grévy's zebra differs from the other two zebra species as it does not live in harems. The basic social units of the species are adult females or mares with their immature offspring or foals. Numerous groups of females and young often gather into herds which are open and fluid and have no strict dominance hierarchies. Adult males or stallions will establish territories that average 5.75 km², though vocalizations and by marking them with dung piles. They mostly live in territories during the wet seasons but some may stay in them year round provided local water sources last. Stallions that are unable to establish territories are free-ranging and are known as bachelors. Females, young and non-territorial males wander through large home ranges. The females will wander from territory to territory preferring the ones with the highest-quality food and water sources. Most fights between territorial males occur over an estrous female who is

on the border of their territories. However, territorial stallions will tolerate other stallions who wander in their territory. Nevertheless when an estrous female is present the territorial stallion keeps other males at bay. One source suggests that non-territorial males avoid territorial ones because of harassment. When females are not around, a territorial stallion will seek the company of other stallions. Dominance is asserted with an arched neck and a high-stepping gait and the least dominant stallions submit by extending their tails and lowering their heads. The call of the Grévy's zebra has been described as "something like a hippo's grunt combined with a donkey's wheeze". Grévy's zebras do not perform mutual grooming. To get rid of flies, they roll in dust, water or mud or twitch their skin. They also rub against trees, rocks and other objects to get rid of irritations like itchy skin, hair or parasites.

Reproduction



Mother zebra with foals.

Grévy's zebras can mate and give birth year-round, but most mating takes place in the early rainy seasons and births mostly take place in August or September after the long rains. An estrous mare may wander through as many as four territories a day and will mate with the stallions in them. Among territorial stallions, the most dominant ones control territories near open watering points, which mostly attract mares with foals, while more subordinate stallions control territories away from water with more abundant vegetation, which mostly attract mares without foals. The resident stallions of territories will try to subdue the entering mares with dominance rituals and then continue with courtship and copulation. Grévy's zebra stallions have large testicles and can ejaculate a large amount

of semen to replace the sperm of other males. This is a useful adaptation for a species whose females mate polyandrously. Bachelors or outside territorial stallions sometimes "sneak" copulation of mares in another stallion's territory. While female associations with individual males are brief and mating is promiscuous, females who have just given birth will reside with one male for long periods and mate exclusively with that male. Lactating females are harassed by males more often than non-lactating ones and thus associating with one male and his territory provides an advantage as he will guard against other males.

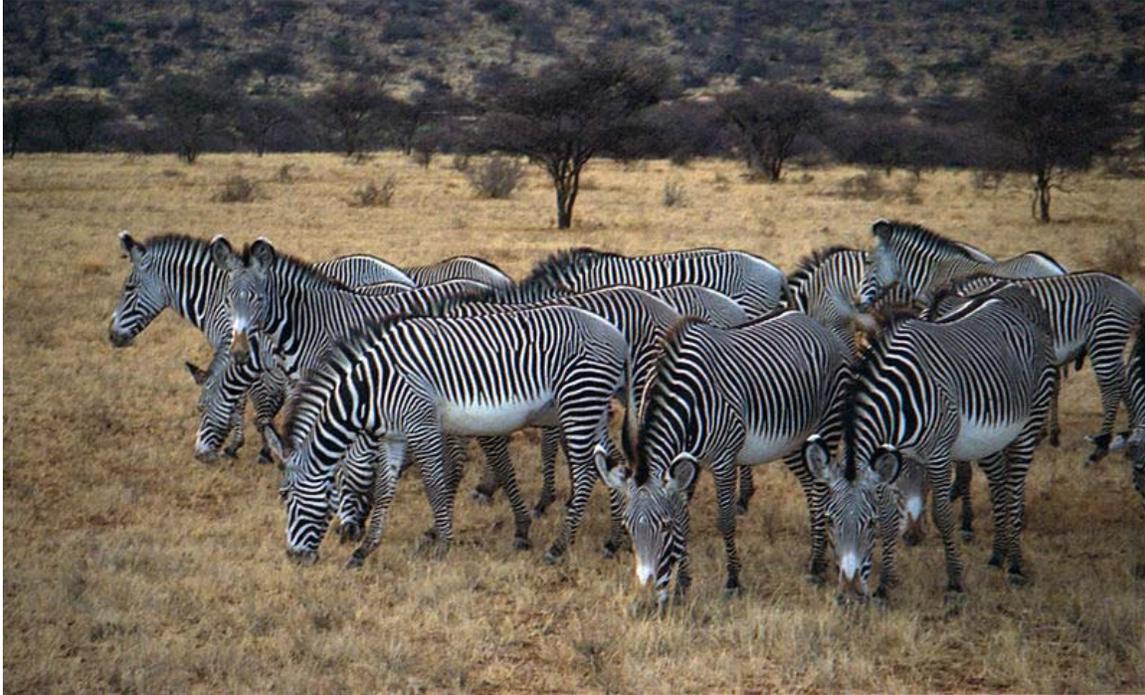


Zebra foal resting.

Gestation of the Grévy's zebra normally lasts 390 days, with a single foal being born. A newborn zebra will follow anything that moves, so new mothers prevent other mares from approaching their foals while imprinting their own striping pattern, scent and vocalization on them. This prevents the foal from imprinting on another female as its mother. From the time their foals are born until the foals reach an age of 3 months, females form small groups (three females and their foals). Mares may leave their foals in "kindergartens" while searching for water. The foals will not hide, so can be vulnerable to predators. However, kindergartens tend to be guarded by an adult, usually a territorial male. A female with a foal stays with one dominant territorial male who has exclusive mating rights to her. However, the male must look after a foal which is likely not his. For these males, infanticide is not an option as without her foal, the mother will leave the territory. Thus the territorial stallion must assist another male's offspring in order to ensure his own reproduction. To adapt to a semi-arid environment, Grévy's zebra foals

take longer intervals between suckling bouts and do not drink water until they are 3 months old. Foals become independent of their mothers after half a year but will continue to follow them for up to three years.

Status and conservation



Grevy's zebras in Samburu National Reserve.

The Grévy's zebra is considered endangered. Its population was estimated to be 15,000 in the 1970s and by the early 21st century the population was lower than 3,500, a 75% decline. It is estimated that there are less than 2,500 Grévy's zebras still living in the wild. There are also an estimated 600 Grévy's zebras in captivity. The Grévy's zebra population trend is considered stable as of 2008.

The Grévy's zebra is legally protected in Ethiopia. In Kenya it is protected by the hunting ban of 1977 but is still listed as a "Game Animal". In the past, Grévy's zebras were threatened mainly by hunting for their skins which fetched a high price on the world market. However hunting has declined and the main threat to the zebra is habitat loss and competition with livestock. Cattle gather around watering holes and the Grévy's zebras are fenced from those areas. Community-based conservation efforts have shown to be the most effective in preserving Grévy's zebras and their habitat. At present, protected areas form less than 0.5% of the range of the Grévy's zebra. In Ethiopia, the protected areas include Alledoghi Wildlife Reserve, Yabelo Wildlife Sanctuary, Borana Controlled Hunting Area and Chalbi Sanctuary. In Kenya, the Buffalo Springs, Samburu and Shaba National Reserves and the private and community land wildlife conservancies in Isiolo, Samburu and the Laikipia Plateau provide a core and crucial protection of the southern

population of Grévy's zebra. On the Laikipia Plateau, protection and reduced competition with domestic livestock have led to an increase in zebra numbers.