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Frequently Asked Questions About Elephants

Part I by Jeheskel Shoshani; Part II by Jeheskel Shoshani and Charles Foley — addresses below
with some answers by other contributors

Below is a compilation of some frequently asked questions about elephants that were addressed to our office (mostly to Hezy Shoshani). They were asked by interested individuals, schools, museums, Hollywood Squares Television Program, National Geographic Society, Elephant Listserver (<elephant-l@listserver.wineasy.se>; we assume that material distributed on the Internet is public domain and it is permissible for us to share it with our readers), and others. We take this opportunity to thank our readers/callers for sharing their thoughts with us, and we apologize for not recognizing individual names. Special thanks to Naina Mistry Producer, Wild Discovery Wired (see below). **Disclaimer:** Please do not use replies as definitive answers, check the original sources; this specifically applies to any medically related questions and answers. We are not responsible for results of incorrect usage of medication. This section is intended to satisfy curiosity. The brief replies are often unedited [detailed replies may be found in many elephant books and other sources; here are some citations: Reference nos. 331, 3263, 3415, 5123, 5137, 5140, 5153].

Note: there are two portions in this section — Part I: "A compilation of some frequently asked questions about elephants", Part II: "Live" on Discovery Channel's Website, Wild Discovery Wired. There are a few repetitions, but we decided to leave them for they are short (in Part I) and long (in Part II) answers, and some complement each other (e.g., question on elephant-manatee relationships). Abbreviations are defined on page 87.

Part I: "A compilation of some frequently asked questions about elephants" — compiled by Jeheskel Shoshani

Q. How many muscles are in an elephant's trunk?
A. There are eight major muscles on each side of the trunk (16 total, because like most organs in the body, the trunk is bilateral), and a total of about 150,000 fascicles (portions of muscles) for the entire trunk. For additional information see Reference nos. 5137, 5153.

Q. Do the nostril passages stay the same size the whole way up the trunk?
A. No, the nostrils are not the same size throughout, but the difference is very small. In one elephant that we measured, the nostril at the tip of the trunk measured about 4 cm and close to 5 cm close to the cranium.

Q. Can an elephant squeeze the nostrils shut along the trunk?
A. Yes, an elephant can squeeze individual nostrils at different lengths along the trunk.

Q. What are the functions of the trunk?
A. Functions attributed to the proboscis include help with: breathing, feeding, drinking, bathing, sprinkling (dust and grass on body), smelling, detecting (e.g., when a female is in estrus), offense, defense, sound production, courtship, calf assurance (a mother elephant frequently reassures her calf by touching it all over its body with her trunk, especially during nursing), and a variety of behavioral signals/displays.

Q. How does an elephant pick up food?
A. Usually, Asian elephants pick up objects with their trunks by the "grasp" and "pinch" methods, and Africans by the "pinch" method. Under captive situations when both species of elephant are together, African elephants learn that the grasp method enables them to collect food faster, and they employ that method as well [see "Learned behaviors", under ENN; cf. Reference no. 1501, p. 60]. Editors' note: Dr. M. Philip Kahl observed and photographed many times in the wild, African elephants picking up grass by the grasp method; he prefers to use the term "encirclement" rather than "grasp".

Q. Can the proboscis be used as a unique character for the order Proboscidea?
A. No, when the name Proboscidea was coined by Illiger in 1811, scientists knew of the living elephants and some extinct members of this order (e.g., the woolly mammoth). Today we know of many more, some of which did not possess a proboscis. Addendum by Dr. Ronald Orenstein [e-mail dated August 20, 1999]. Also, other mammal groups possess a proboscis or similar structure, though it may not be entirely homologous: e.g., living tapirs, elephant shrews, elephant seals, possibly extinct diprotodonts (marsupial), astrapotheres (South American ungulate), pyrotheres (South American ungulate), *Macrauchenia* (South American liptotern, an ungulate) and so on.

Q. Between an elephant and a giraffe, which of them can reach higher vegetation, and by how much?
A. An elephant can reach higher than a giraffe by about 10.5 feet (3.2 meters). Estimate of height to which an elephant can reach with the tip of its trunk, while standing on its hind legs, is 9.5 meters [about 31 feet; based on measurements taken for "Ahmed", see Elephant 2(3):19, and other sources]. A giraffe, while stretching its 20 inch (50.8 cm) tongue, can reach a height of 20 feet, 8 inches (6.3 meters).

Q. How many muscles are in an elephant's body?
A. Approximately 394 skeletal muscles.

Q. How many bones are in an elephant's body?
A. Total number of bones varies among individuals and species; it is somewhere between 324 and 347.

Q. Do African elephants flap their ears?
A. Yes, both African and Asian elephants flap their ears.

Q. Is the flapping of their ears a cooling mechanism?
A. Yes, it is; but it surely has a social/aggressive function as well!

Q. What is the weight of an elephant's ear?
A. Asian, 13 pounds (6.5 kg), and African, 20 pounds (8.8 kg).

Q. How often does an elephant bathe?
A. Depending on circumstances, 3-4 times per week in the wild, and 3-10 times per week in captivity.

Q. Does the elephant use its trunk for smelling?
A. In most cases the elephant uses its trunk to smell, but sometimes it will use the combination of trunk and upper palate, which contains the Jacobson's organ (a chemo-sensory device, also called vomero-nasal organ).

Q. Can an elephant survive without the trunk?
A. In captivity, probably yes. In the wild, it would depend on how much of the trunk is missing and the degree of infection from the wound.

Q. Why do elephants drink through their noses?
A. Elephants do not drink through their noses, but use their trunks to bring water to their mouths. A trunk is a combination of nose and upper lip. Since the elephant's neck is so short, it would be difficult and awkward for it to kneel down to reach the water with its mouth.

Q. Why do elephants have tusks?
A. Tusks are incisor teeth ("front teeth") which are a part of the set of teeth that most mammals (humans included) have developed during millions of years of evolution. Tusks are used for defense, offense, display, digging in the ground, lifting objects, food gathering, and for stripping bark from trees to eat.

Q. What are the differences between a "tusk" and a "tush"?
A. A tusk can be of any length, but it is usually clearly protruding beyond the lip, and it is usually thick at the base and ending with a point. A tush is said to be thin and not to protrude, or to protrude slightly, beyond the lip, and is said to be of a uniform thickness. In the Editor's opinion, these are confusing and subjective distinctions, and it is not always easy to tell which is a tusk and which is a tush. In addition, it has been claimed that tushes have softer ivory than tusks. "Softer" is a relative and subjective term. For these reasons, I (Hezy) avoid using the word "tush" altogether.

Q. Do female Asian elephants have tusks?
A. The majority of female Asian elephants do not have tusks. Some do have small tusks, which some authorities call "tushes".

Q. Why are elephants so heavy?
A. Size is hereditary, and could be influenced by environmental factors. Bigger animals have fewer enemies than smaller ones. Also, relative to the size of their bodies, heavier animals eat less food than smaller and lighter animals. This means that relative to smaller mammals, elephants invest less energy in searching and digesting food.

Q. Who was the first to weigh an elephant and how was it done?
A. The earliest record of weighing an elephant is that of Patrick Blair, who noted the total dry weight of all the cleaned bones of an elephant which died near Dundee, Scotland, April 27, 1706 [1710, Osteographia elephantina. Philosophical Transactions. Part I, 27(326):51-116, Part II, 27(327):117-168.] to be 312 pounds (about 95 kilograms). On page 42 in Elephant, 2(1), 1982, the dried bones of "Iki" (that weighed about 4,630 lbs = 2,100 kg) weighed 475.82 lbs (215.83 kg). Gilchrist (1851, see Benedict, 1936, p. 109) reported on an elephant cut into parts and weighed separately; the total was 4,355 pounds (1,975.4 kg). "Bolivar", a large Asian male at the Philadelphia Zoological Garden (approximately 47 years of age in 1908 when he died), was also cut into pieces; total weight was 12,000 lbs (5,443 kg) without organs, except for the heart. Another large male, an African, "Kartoum", died at the New York Zoological Park in 1931 at age 28; he was dissected prior to weighing, the total weight given by C.V. Noback (cf. Benedict, 1936, p. 112) was 10,390 pounds (4,712.9 kg). Francis Gano Benedict (1936, cf. pp. 22-23, 290 in The physiology of the elephant. Carnegie Institution of Washington, Washington, D.C., 302 pp.), who weighed 48 live circus elephants for his physiological studies at Carnegie Institution of Washington, reported that a female Asian elephant ("Mollie", reputedly 40 years old) had been weighed "on the Franklin Park yard scales on June 6, 1920", in Boston, 8.5 months prior to her death; she weighed 8,180 pounds (3,710 kg).

Q. Who was "Jumbo", where was he born, how was he found, where did he live, and for how long, and how tall was he?
A. Jumbo, an African elephant (*Loxodonta africana*) was the most famous elephant that ever lived. He was born in the French Sudan about 1861, and was transported to the Jardin des Plantes in Paris, France. He lived there until June 26, 1865, when he was exchanged for an Indian Rhinoceros by the London Zoo, where he lived until 1882 when he was sold to P. T. Barnum. Jumbo died on September 15, 1885, in a train accident in St. Thomas Ontario, Canada (a statue of Jumbo stands there now). Jumbo's height was 11 feet (3.25 meters) tall when he left London Zoo and he undoubtedly grew some few inches afterwards; some figures run as high as 13.5 feet (4 meters). His weight was said to be as much as seven tons. The skeleton of Jumbo (Type Specimen, AMNH 3283) is in storage at the American Museum of Natural History, New York. Additional information is given in Elephant, 2(2):86-122, see also "Elephants in the news", under the section ELEPHANTS NOTES AND NEWS in this issue of Elephant.

Q. How long does an elephant live? Who is/was the oldest?
A The elephant's life span is approximately equal to that of humans. The oldest documented age of a captive Asian elephant was that of "Jessie" in the Taronga Zoological Park, Sydney, Australia; her estimated age at time of death was 69 or 77 years. Raja (the Holy Elephant of Sri Lanka), however, was reportedly 81 or 82 years old when he died.

Q. How many chromosomes do elephants have?
A. Both living species of elephants have a diploid number of 56 chromosomes in the somatic (body) cells. The haploid number (28) in gamete cells (sperm cell or ovum) consists of 27 autosomes plus a single sex chromosome, either *X* or *Y*.

Q. How long is an elephant's trunk?
A. In a small adult, in relaxed state, a trunk is 1.8 meters (about 6 feet); in a larger elephant it can be 2.0 or more meters (about 6.5 feet or longer).

Q. Why does the structure of the elephant heart differ from that of other mammals, i.e., why does it have an extra septum at the apex?
A. In evolutionary biology it is very difficult, or close to impossible, to answer "why" questions, because we often do not know why structures evolved the way they did. Comparing hearts of mammals, we note that those of elephants and sirenians (manatees and dugongs) have double apex hearts. To the best of my (Hezy's) knowledge, there is no "extra septum at the apex". Tissues on the outside of the heart are folded into what is manifested in the two pinnacles. It is entirely possible that having a double apex heart is a primitive character, not a derived condition as appears in the literature (including my own). Perhaps a person who specializes in heart development can explain if the double apex heart is a remnant of bilateral symmetry merged into one — few structures in our body appear only on one side of the body, most appear on both sides.

Q. How big is an elephant heart?
A. A heart of an elephant may weigh between 12.0 and 21.0 kilograms (about 26 to 46 pounds) depending on the size, age, and possibly sex; length of an elephant heart varies from 44 to 57 centimeters (about 18 to 22 inches); width varies from 32 to 48 centimeters (about 13 to 19 inches).

Q. What is the average heart beat of an elephant?
A. According to Francis G. Benedict (1936, pp. 122, 291) the heartbeat is about 28 beats per minute when standing and 35 beats when lying. And from Zoo and Wild Animal Medicine (ed. M. E. Fowler) Current Therapy 3, page 436: heart rate, standing 25-30 beats/min; heart rate, lateral 72-98 beats/min; respiratory rate 4-6 breaths/min; body temperature 36-37°C (97.5 - 99°F). Data are without sedatives or immobilizing agents.

Q. Do elephants sweat?
A. Many investigators have searched for sweat glands, and found none. Nonetheless, it has been reported that when a saddle is removed from an elephant, moisture is noticed.

Q. How much water and how much food does a grown elephant need to consume per day?
A. An elephant drinks between 100 to 200 liters (26 to 52 US gallons) per day. The trunk of an adult elephant can hold 8.5 liters (2.25 gallons) of water. An elephant eats between 100 to 400 kg (220 to 880 pounds) of food per day. Only about 44% of the food is digested; cf. "Items passed through elephants' digestive systems and a warning" in ENN. Elephants may consume anywhere from 100 to 500 plant species.

Q. Do elephants eat coniferous trees (e.g., pine and/or spruce)?
A. According to Sheree Walters of Ivory Haven in Michigan (ivoryhaven@riverview.net), her female 17-year-old African elephant "Laura" always eats pine trees when they go for walks through the woods. "She will eat needles and smaller branches. We always recycle the Christmas trees by letting Laura and 'Buster' (male 18-year-old African elephant) eat them. The turpentine in the sap has me worried but then on the other hand many healing liniments have essences from trees like these, I think. Though you would not generally eat them. I have found that elephants seem to be quite adept at knowing what is poisonous and not good for them to eat." Editors' note: This question has many more ramifications than curiosity because it involves the ability of the elephant to digest spruce or pine trees. We know from the literature that American mastodons (*Mammut americanum*) ate coniferous trees, but it is not clear at what time of the year they ate them. Perhaps it was not when the trees produced sap rich in turpentine. It would be interesting to learn if Asian elephants also eat coniferous trees. Joann M. Holden comments that, in winter, wapiti or elk (*Cervus elaphus*), white-tailed deer (*Odocoileus virginianus*), and caribou or reindeer (*Rangifer tarandus*) also feed on evergreens.

Q. Of all five senses, which is most developed in elephants?
A. Acuteness and ability to detect external stimuli varies with age, but compared to other mammals, and generally speaking: sense of sight — poor, but good in dull light; hearing — excellent; smell — acute; touch — very good; taste — seems to be selective.

Q. How good is an elephant's sense of smell?
A. Elephants have a keen sense of smell, manifested by seven turbinals (scrolls of bones with sensitive tissue sensitized for olfaction); dogs have five such turbinals.

Q. Do elephants regurgitate water, so they can cool themselves by spraying on their body?
A. Regurgitation (usually a reflex action) of water, to the best of our knowledge, does not occur in elephants. They do voluntarily spray themselves with water taken from the pharyngeal pouch under extreme hot conditions when no water is available [see report on pharyngeal pouch in this issue].

Q. Do elephants ruminate?
A. No, they do not ruminate; they have a large saculated caecum where fermentation takes place.

Q. What is musth?
A. Musth is a physiological condition found in male elephants when testosterone levels in the blood are high. The elephant is often uncontrollable and may kill even its own mahout when in musth. Both male and female elephants have temporal glands from which temporin is excreted, but only males enter into musth [details below].

Q. What kind of medication may be used to inhibit the release of testosterone and perhaps calm down a male elephant in musth?
A. Based on a reply from the Elephant Listserver, "It has been recommended to us that we use a medication called Lupron on Butch, our African bull, to inhibit the release of testosterone and (perhaps) eliminate (or greatly reduce and control) the changes seen in him in musth."

Q. Can you explain the erratic behavior and attacks by elephants in captivity on people as we have seen on TV?
A. Four aspects of elephant behavior need to be taken into consideration simultaneously: (1) Idiosyncrasies of elephants and people who work with them, (2) Dominance, (3) Musth, (4) Encephalization quotient. Idiosyncrasies require familiarity with the animals. Dominance implies that certain elephants seem to behave as if they, and not the keepers, are the dominant animals. Encephalization Quotient (EQ) is the relative size of the brain compared to the body size; elephants have large EQ value (about 2, similar to some higher primates). It is possible that a combination of, "bad" temper, being in musth, "not willing" to be dominated, and a relatively high EQ result in an elephant attacking even its own mahout/trainer [see also two previous questions and one as part of Discovery Channel questions and answers].

Q. What are the differences among "Free Contact", "Confined Contact", and "Protected Contact" when working with elephants?
A. Free Contact is defined as "direct human handling of unconfined elephants". Confined Contact is defined as "use of an Elephants Restraint Chute" [a 'squeeze apparatus'], "Protected Contact" is defined as "managing unconfined elephants through or from behind a shielding barrier by the use of positive reinforcement operant conditioning and by very careful handler positioning relative to the animal." Both elephants and workers have to be trained in an effective system. SOURCE: EMA Statement of Free/Protected Contacted [*sic*], *The Elephant Managers Association Newsletter* (June 1992), III(2):9 - 12; for additional information see articles in "Protected Contact Forum" in issues of JEMA.

Q. How long is the estrous cycle in elephants and, how often are they in estrus?
A. Estrous cycle lasts for about four months, which is the period between ovulation; ovulation occurs during estrus which lasts about 4 days. If a successful pregnancy occurs, and the calf nurses

healthily (suckling strongly to stimulate continuation of milk production, and thereby suppressing hormones which stimulate the ovarian cycle), the mother will not enter into the estrous cycle until weaning, which is about two years. Taking about two years for gestation plus two years for nursing adds up to a four-year calving interval, but it may last for 10 years.

Q. What is the correct term for an elephant's breast, a teat or a nipple?
A. An elephant's breast (or mammary gland), like most mammals terminates in a cone-shaped process containing (a) milk or (a) lactiferous duct(s). A nipple is such a process with two or more ducts, whereas a teat (found only in derived artiodactylans, e.g., cow, sheep) have only one lactiferous duct. In some elephants there are about 10-12 lactiferous ducts.

Q. Does the elephant trunk position (up or down) imply good or bad luck?
A. A belief in the Orient holds that when an elephant's trunk is up, it is a sign of good luck (as though holding precious liquid or money), and when the trunk is down, its contents will be lost.

Q. Do elephants sleep both lying down and standing up?
A. They sleep lying down on their sides; they do not sleep (but doze) when standing.

Q. Can an elephant untie a shoestring with its trunk? ["an elephant is strong enough to uproot trees and dexterous enough to untie shoes" from Better Times Magazine]?
A. Perhaps, depending on how tight the shoelaces are tied and given enough time.

Q. You and your elephant have been bitten by a tarantula; which of you will survive or heal faster?
A. The elephant.

Q. How tall is an elephant grass?
A. On the average an elephant grass [*Pennisetum purpureum*] is 18 feet (5.5 meters), with a maximum height of 25 feet (about 7.6 meters).

Q. How old can/should an elephant be before it is put to work?
A. About 10 years or older.

Q. Can an elephant stand on its head? Are there any other animals which can?
A. Yes, trained elephants can. So can humans, trained dogs and bears.

Q. Do you know of an Elephant Obedience School in Baton Rouge, Louisiana?
A. Not sure, could be; see, however, "Riddle's Elephant Breeding Farm and Wildlife Sanctuary" under Organizations in ENN.

Q. Is it true that it is easier to train Asian than African elephants?
A. Assuming that all training methods are equal, and that the elephants are of comparable ages, some trainers/handlers (e.g., Gary Johnson of "Have Trunk Will Travel", and Bucky Steele from Texas) believe that Asian elephants are more intelligent than the African elephants. Certain "tricks" that Asian elephants perform in circuses (e.g., carrying a person by the knee or the head and swirling around; cf. Reference no. 5258, Bucky Steele, p. 181) are not commonly performed by African elephants. On the differences between the two elephants' training ability, B. Steele wrote (cf. Reference no. 5257, Bucky Steele, p. 155): the African elephant is "...not as quick to learn as the Asian; it is always one step behind." He added that "...the African elephant does not seem to be able to walk on its hind legs alone. All in all, one may compare the Asian elephant to a draft horse and the African to a thoroughbred horse." [cf. *"FLORA"*. (1994), under Elephant Films and Videos, ENN].

Q. Elephants prefer coffee and doughnuts over peanuts; true or false?
A. It depends on the elephant's exposure to these food items and its personality!

Q. Asian elephant calves are usually hairier than African calves, and a lot hairier than the adult elephants — when do they lose their hair? Also, is it rare to see an elephant with a head of hair?
A. Variation in amount of hair is related to age and habitat. Elephant calves have more hair than adults, and Asians more than Africans. It is possible that loss of hair in African elephants may be related to their habitat, being closer to the equator than Asian elephants and woolly mammoths. Often adult Asian elephants (possibly more females than males) have "a head of hair".

Q. Is it true that they used to trim elephant hair with a blow torch? With hedge clippers?
A. I wouldn't be surprised that they used a blow torch! Elephant hair is not that thick or strong enough to require hedge clippers.

Q. Does ivory come from bone?
A. No, ivory is composed of dentin found in elephant tusk and other teeth; it has a similar chemical formula to that of bone.

Q. How are the sea-cow (manatee) and hyrax related to the elephant?
A. Relationships are based on morphological (e.g., bones) and molecular (e.g., blood proteins) data. An example of a unique morphological character shared by an elephant, a manatee and a hyrax is the arrangement of wrist bones in a straight line (serially), one on top of another, like tiles on a floor, while wrist bones of a cat or a human, for example, are arranged alternatively (staggered, the primitive condition), one on top of two, like bricks on a wall.

Q. Does anyone know the whereabouts of "Tommy" (King Tusk)?
A. As of 1999 Tommy is with the Ringling Brothers and Barnum & Bailey Circus. His tusks measure more than 6 feet (about 183 cm) long, and about 6 inches (15 cm) in diameter. His 50th birthday was on October 9, 1992.

Q. How do teeth grow and move in an elephant's jaws?
A. There are six cheek teeth (premolars and molars referred to as molars I through VI) in each half jaw/quadrant in an elephant's lifespan. Molars I and II are present at birth, and as the animal grows, teeth in front wear down, break up, and fall out or are swallowed. New teeth from behind develop and displace those in front as though they were on a slow moving conveyor belt. Once the last molar has been worn down, the elephant can no longer chew its food and may die from starvation. Tooth I is displaced at the age of 2-3 years, tooth II at 4-6 years, tooth III at 9-15 years, tooth IV at 18-28 years, and tooth V at 35-50 years. Tooth VI or part of it usually remains until the elephant dies at 60-70 years. Tooth VI can weigh 5 kg or more.

Q. How much blood is there in the body of an elephant?
A. In a small (about 2,100 kg) elephant, there is about 220 kg of blood; for a larger elephant the volume can be calculated using the value that blood is about 9.5% to 10% of body weight.

Q. What was the length of the tongue of a mastodon (an extinct proboscidean)?
A. The length of the tongue of a female Asian elephant ("Iki" weighed 2.100 kg) was 70.5 cm (28 inches); presumably a mastodon of similar weight would have a tongue of approximately the same length.

Q. Is it possible for countries in Africa that have an excess of elephants to move them to countries where elephants have been depleted?
A. Physically possible, yes. Realistically, it is difficult, laborious and expensive. It has been done on a small scale, from Zimbabwe to South Africa.

Q. To stop culling and killing/poaching elephants, would it be possible to cut the tusks of wild elephants and, secondly, would it be possible to make false ivory to satisfy the demand?
A. A tusk is an incisor tooth, live tissue containing pulp cavity with blood and lymph vessels and nerves. It is not possible to tell how far the pulp extends from the base, thus cutting the tusk may cause infection and pain. It is extremely costly and requires professional personnel to tranquilize elephants; they often die. Substitute ivory does not satisfy ivory collectors, just as false diamonds would not satisfy diamond collectors. Addendum by Dr. Ronald Orenstein [e-mail dated August 20, 1999]. According to Dr. Kay Mehren of the Toronto Zoo, it takes about 3 hours to remove a tusk from an adult elephant, using a steam winch, and would require daily post-operative care for about two months. There are ivory substitutes, from artificial resins to mammoth and mastodon ivory, compressed bone, hippo teeth (a growing item in trade) and "vegetable ivory", the endosperm of the seed from the "tagua", a South American palm. All of these have been used commercially (as have false diamonds!) and can replace demand for ivory for certain purposes (e.g., piano keys).

Q. Can sterilization be used to avoid elephant overpopulation?
A. Yes it can be, but it has its own complications; also it is costly and requires professional personnel to tranquilize elephants that often die in the process [see also a paragraph on Contraception under "Conservation-related articles" in ENN].

Q. What does "El Khartoum" mean [also spelled Kurtum]?
A. Khartoum is the capital of Sudan in Africa. In Arabic, "el" means "the", and "khartoum" (pronounced with a guttural "h") means a "water hose", in this context, the trunk of an elephant.

Q. Do elephants use their trunks, tusks, and feet as weapons?
A. In desperate situations, they will use any organ or part of their body as weapons. Under normal circumstances, however, tusks are most often used as weapons of offense.

Q. How thick is the skin of an elephant, and how many cell layers thick is the epidermis?
A. Data taken from the skin of "Iki" indicate that thickness of skin (dermis and epidermis) varies from 1.8 mm on medial side of the ear to 32 mm on rump and parts of head. There are 50-100 cell layers in the epidermis and it can be up to 10 mm thick.

Q. Do elephants have 4 knees?
A. No, all mammals have two knees and elephants are no exception. The so-called "knees" in the front legs are the wrist joints, but because the elephant is large, their wrist joints are elevated above the ground, and appear to some people as "knees". Knees (the joints between the femura and the tibiae and fibulae) are found only in the hind legs.

Q. How intelligent are elephants?
A. Elephants have a developing intelligence. They are one of the few mammals known to make and use tools. It is difficult to measure intelligence, but in my opinion [Hezy Shoshani, see also replies to question on brain and temporal lobe sizes in Part II below], intelligence can be summed up as the ability of an animal to cope with new situations. Three factors may contribute to the level of intelligence: [1] Encephalization Quotient (EQ) is the relative size of the brain compared to the body size; elephants have large EQ value (about 2, similar to some higher primates; see also below); [2] Surface area of the brain due to great numbers of gyri and sulci; and [3] Density of neurons. All factors are directly related to the degree of memory in all five senses: auditory, visual, olfactory, tactile, and gustatory.

Q. Have elephants always been large-brained, or is this a recent development which allowed the survival of selected lineages with the increased threat from humans?
A. Measurements of cranial capacities of some earliest proboscideans provided data for EQ value of less than 1 (see preceding Q&A). It is not possible to answer why the brain became large, perhaps some of the replies in this section may help you better understand relative brain size structure.

Q. Is it still legal to hunt elephants in Africa?
A. Some countries, mostly in eastern and southern Africa, permit the hunting of elephants with registered guides. There is supposedly strict regulation as to the number of elephants that can be killed, though abuses have occurred in some countries.

Q. If an elephant is shot in the brain, will it still attack?
A. If the shot is direct, in a side or frontal view, and hits with force into the brain, the elephant will be unable to attack. If, however, the shot damages only part of the brain, the elephant may still be capable of attacking.

Q. If an elephant were blind, would it still be able to live and survive in the wild?
A. Chances of survival would be greater if the elephant were to live in a herd.

Q. How many subspecies are there of the African elephant? Asian elephant?
A. Until recently, African — two [see, however, article by Grubb *et al.* in this issue], Asian — three.

Q. Is it true that elephants can "speak" in a secret language that we cannot hear?
A. Yes, they can communicate in frequencies (5-24 Herz) below human range of hearing (average for adult: 50 to 8,000 Herz).

Q. Has anyone dissected the elephant eye to determine the % of rods versus cones to determine if elephants can see color?
A. We (ERF) are working on this project; soon we will provide some information.

Q. Do elephants have brown eyes?
A. Elephants eyes come in yellow, brown, hazel, gray, blue and pink-like (albino elephant).

Q. Is there a truly albino elephant?
A. Rarely is an elephant depigmented on all of its body. Only then, is it called an albino, and may be considered sacred.

Q. Where can one get a picture of "Motty" to make into a slide for educational elephant talks?
A. Contact Chester Zoo, England, or the Mammal Slide Library of the American Society of Mammalogists; slides of elephants should be ready soon (see notes under "Elephant, and related ERF business" above).

Q. How much heat or cold can elephants tolerate?
A. It is better to avoid extreme environmental conditions. In the wild, elephants live in desert conditions and on the fringes of snow-capped mountains. In either situation, they are free and capable of moving to more suitable conditions when it becomes intolerable.

Q. Are the lungs in elephants attached to the chest wall with no pleural cavity setup as in the human body?
A. Yes and No, the lungs in elephants are attached to the diaphragm and partially to the lining of a pleural cavity.

Q. A member of the Elephant Listserver (December 1, 1996) asked about wild population of forest elephants, *Loxodonta africana cyclotis* (in captivity there is one in Europe — 1.0 in Paris Zoo, any in America?). NOTE: a shorthand formula to write numbers of male and female elephants is to write the number of males first, followed by a period (.) then by the number of females. Here one male, no females.
A. Dr. Ronald Orenstein of International Wildlife Coalition replied (excerpts): Estimates as of 1995 by the African Elephant Specialist Group of the IUCN Species Survival Commission give totals of 14,725 elephants in West Africa, and 225,219 in central Africa. Numbers for Central Africa undoubtedly include members of savannah elephants, since, in some areas, savannah and forest elephants seem to occur together. This would make it almost impossible to have separate geographic listings for the two populations even if you could tell their ivory apart easily.

Q. Has anyone seen wild Asian elephants, or photographs of them, standing on their hind legs as has been observed for African elephants? References: cover page of "Natural History Magazine", November 1997 (photograph by Urlich Döring), and page 46 in Janvier 1998 issue of "Sciences et Avenir" (photograph by M. & C. Denis).
A. By Dr. Jayantha Jayewardene. "The Frontispiece of my book [The elephant in Sri Lanka, 1994] shows a wild elephant standing on its hind legs and reaching for some leaves. I have, over the years, seen many wild elephants in Sri Lanka standing on their hind legs reaching out for branches and leaves".

Q. Do scientists plan to clone or produce a mammoth, and how?
A. Yes, there have been reports that certain scientists plan to clone/grow mammoths. According to Dr. Adrian M. Lister (University College London, England), in order to have a successful cloning, it is necessary to have intact DNA from a mammoth (male or female). All conditions must be absolutely correct, that is, remove an ovum from an Asian elephant and extract the nucleus from it. Next, the DNA from the mammoth is inserted in its place. This man-made "zygote" is implanted in the uterus of an Asian elephant. Theoretically, if a successful pregnancy ensues, the offspring is a mammoth; cf. Reference no. 4387. Another method to "produce" a mammoth is to fertilize an elephant egg with a mammoth sperm. This would produce a hybrid which could then be repeatedly back-crossed with mammoth to produce an offspring increasingly like a mammoth. Editors' note: a team of scientists excavated a woolly mammoth, cf. "Raising the Mammoth" in ENN.

Q. Did you ever hear the buzz about the structure of an elephant foot aiding circulation?
A. Pads at the posterior side of elephant feet are composed of elastic tissue, fat, connective tissue, blood and lymph vessels, and nerves. As in other parts of the body, muscles in the feet/legs, when contracting, act as "vascular pumps"; they squeeze blood vessels and aid in circulation. When walking, an elephant squeezes blood vessels in the vicinity of its foot pads, and thus may accelerate blood flow. Another function attributed to foot pads is "shock absorbers". Also the pads enable an elephant to walk in soft soil reducing the risk of getting mired down.

Q. If elephant legs were too long for the trunk to reach the ground, would they develop longer trunks over evolutionary time?
A. Different body parts evolve in concert, that is, they complement each other for the greatest efficiency in terms of energy conservation. For example, when the neck is short, the trunk is long, and when the trunk is short the mandible may be longer, or a combination thereof. In other words, if the legs were not so long, instead of the trunk being longer, the mandible might lengthen. But if the mandible would be too long, it would upset the center of gravity in the head. Thus, a balance among different body parts would be Mother Nature's solution.

Q. What can I do to help save the elephant?
A. Tell your friends and family members that elephants are important members of the ecosystem in which they live — they have been called "Keystone Species" and "Super Keystone Species" (a Keystone Species is one which modifies the habitat in which it lives, and other animals benefit from the modifications). Become a member of an organization that strives to save elephants.

ADDENDA

Q. What is important about the discovery of the early proboscidean *Phosphatherium escuilliei*?
A. *Phosphatherium escuilliei* is the earliest proboscidean discovered. It has affected our view of elephant classification, evolution, and dispersal through geological history. Until the discovery of *P. escuilliei*, the oldest known proboscidean was *Numidotherium*, dating from the middle Eocene, about 50 million years ago (if we ignore other fossils, anthracobunid taxa, which may or may not be proboscideans). *P. escuilliei* is dated to the late Paleocene, about 58 million years ago. Not only is this the earliest age for the Proboscidea, it is also one of the earliest dates for any eutherian mammal in Africa. *Phosphatherium* becomes a new genus in the family Numidotheriidae. The structure of its teeth is bilophodont - that is, it is similar to that of *Numidotherium*, *Barytherium*, *Prodeinotherium*, and *Deinotherium*. The teeth of *Moeritherium* — once thought to be the most primitive proboscidean — are bunodont. *Phosphatherium*'s tooth morphology may mean — contrary to our earlier ideas — that bilophodont teeth are more primitive in proboscideans than bunodont teeth and, therefore, *Moeritherium* may be more derived than we thought. If we ignore anthracobunids, Africa has been considered to be the place of origin for the Proboscidea. *P. escuilliei* appears to corroborate this hypothesis, and perhaps narrows it to north-western Africa, where the fossil was found. Like many discoveries, the finding of *Phosphatherium escuilliei* was accidental. It was discovered in the Phosphates Basin of Ouled Abdoun, in Morocco. This find extends the range of the earliest proboscideans and may shed light on their ancient migratory routes. The name *"Phosphatherium"* is derived from the Phosphates Basin. Its species name, "*escuilliei*", is in

honor of Mr. F. Escuillié, who found its fossilized skull fragments there in 1994-5, while excavating for commercial minerals, including phosphate. Based on the material found, *P. escuilliei* is estimated to have weighed 10-15 kilograms, making it apparently the smallest extinct proboscidean found to date, except for the dwarf elephants and mammoths known from some islands. Undoubtedly, *P. escuilliei*, the earliest known proboscidean, and the questions it raises will continue to occupy scientists for many more years; c'est la vie! [See Reference nos. 3558, 3559.]

Q. I heard they found fossil evidence of pygmy mammoths on Wrangel Island in the Siberian Arctic; is it true?

A. Based on the available evidence, the mammoth of Wrangel Island is classified as a new subspecies of *Mammuthus primigenius*, namely, *M. p. vrangeliensis*. Estimates of its shoulder height of about 180 centimeters and of a weight of around 2,000 kilograms are based mostly on dental material. This discovery of an isolated historical population of mammoth, which survived into historical times (based on radiometric dating) until about 3,700 years ago, close to the time when the pyramids were built in Egypt, is extraordinary.

Q. Can you fill me in on details about ["Jarkov"] the most recent frozen mammoth discovered?

A. Jarkov the mammoth is believed to be a male between 47 and 49 years old when it died about 20,380 years ago. It was discovered in 1997 by a 9-year-old child of the Jarkov family, reindeer herders in the permafrost of central Siberia, and was excavated in 1999 with the help of the Dolgans, native people, and flown by helicopter to the town of Khatanga 300 kilometers (~180 miles) from the discovery site near the Bolshaya Balakhnya River. Jarkov is stored frozen. Scientists will study every possible aspect of this unique find, including its habitat, possible cause of extinction, and genetics. They will also collect tissue samples to extract DNA for possible cloning. Alternatively, they will try to produce a hybrid from a sperm and an ovum from an Asian elephant (see question "Do scientists plan to clone or produce a mammoth, and how?" under "Frequently asked questions about elephants"). Team members include Larry Agenbroad, Bernard Buigues, Dirk Hoogstral, Dick Mol, Nikolai Vereshchagin, others [see also "*RAISING THE MAMMOTH*" under Elephant Films and Videos].

Q. Why is an African elephant's backbone concave, while an Asian elephant's is convex?

A. Although we observe concave and convex back profiles, what we really seeing are the overall shapes made by the tips of the spinous processes (the top portions of the vertebrae). The central sections of the vertebrae — the parts that the spinal columns run through — form an arched or nearly an arched vertebral column in both elephants. From an engineer's point of view, such architecture is similar to an arched bridge which supports heavy weight. Source: Reference no. 5104.

Q. Can elephants have diabetes?

A. Dr. Susan Mikota (Audubon Institute, New Orleans, Louisiana, USA) wrote: We have a fair amount of data on normal elephant blood values. I am not aware of any documented cases of diabetes in elephants.

Q. What are the differences between the musth gland and the "vent gland"?

A. What has been identified as the musth gland should properly be called the temporal gland because it does not secrete "musth"; it secretes temporal fluid, temporin. Much has been written about the temporal gland and musth (see other Questions and Answers above). The "vent gland" was described by Benedict in 1936, pages 78-79 as "check vent". It is located at about the middle of the cheek region on either side of the face below the temporal vent and the cheek bone, in line with the mouth. The check vent is found in all living elephants, of any age, of both sexes. In most cases, there is a small dimple with 1-5 (usually 3) dark, stiff hairs protruding from it. Gross anatomical observations on two specimens in the region beneath the skin showed no glandular tissue. Benedict did not suggest a function. My (J. Shoshani) investigation in search of glandular tissue and possible function(s) continues. It is possible that the origin of this "vent gland" and associated hairs is in cheek vibrissae (specifically genal vibrissae), which are tactile whiskers found in many mammals.

UNANSWERED OR PARTLY ANSWERED QUESTIONS

Q. Received from Elephant Listserver 29 January 29, 1998. "(1). Has Leishmania [insect-born disease] ever been diagnosed in elephants before? (2). What is the treatment for Leishmania in elephants? (Lomedine has been used when an elephant previously had this problem with good effect.) (3). What are other causes of edema in elephants? (4). Can Metrendazol be used for Leishmania?

A. Send reply(ies) to Elephant Listserver, attention: Arshid Toosy at < elephant-l@listserver.wineasy.se >.

Q. What is the size of the thyroid gland in an elephant? Large thyroids cost more iodine than small thyroids, and iodine is a scarce nutrient, deficient in many human communities. Has goiter ever been recorded in elephants? Analyses of the Mount Elgon salt crusts, for which elephants go underground, indicate they are extraordinarily rich in iodine!

Part II: "Live" on Discovery Channel's Website, Wild Discovery Wired — compiled by Jeheskel Shoshani and Charles Foley

During the week of May 3-9, 1998, there was a "Live" program in which participants could ask questions about elephants and get answers on the "air". It was a part of a program on the Internet, Wild Discovery Wired <http://www.discovery.com/conv/wilddiscovery/wilddiscovery.html>, Discovery home page <http://www.discovery.com>. Below are questions and answers that were a part of the program; a couple of questions appeared before the program began. People who asked questions did not always identify themselves, thus names are not included. Replies by Charles Foley and Hezy Shoshani, names given at the end of answers. Presentation in sequence of appearance on the "air". Material presented is Copyright © 1998 Discovery Communications Inc., and by Copyright © 1998 Elephant Research Foundation. No portion of this text is to be used without written permission.

About Charles A. Foley <cafoley@Princeton.edu>

"Charles Foley has been studying elephants in Tanzania since graduating with a degree in zoology from Oxford University in 1989. In 1990 he spent a year working on Mount Kilimanjaro establishing elephant numbers in the montane forest surrounding the mountain and monitoring elephant movement patterns on and off the mountain. In March 1993 he started a field study on

elephants in Tarangire National Park in north Tanzania as part of his doctoral work at Princeton University. For the past four years he has been researching the long term effects that poaching has on the social structure of elephants. Through his work he has individually identified over 350 elephants that form the basis of his study population. His fieldwork involves studying the demography and behavior of the elephants, as well as monitoring their reproductive and stress hormones through steroid hormone analysis of the feces. Charles will be returning to Tarangire in July of 1998 for another two years of fieldwork."

About Jeheskel (Hezy) Shoshani

<jshosh@sun.science.wayne.edu>; <hezy@bio.uoa.edu.er>

Hezy became interested in elephants after reading "Burma Boy" by Willis Lindquist. His primary research has been the evolutionary biology of elephants, their anatomy and physiology and how to apply this knowledge to our understanding of elephant behavior and ecology. He taught at Wayne State University in Detroit, Michigan USA [as of fall 1998 he teaches at the University of Asmara, Eritrea]. In 1977 he established the Elephant Research Foundation (an international nonprofit organization) and is the editor of its publication, Elephant. Hezy has published more than 100 scientific and some popular articles and was the editor of two books on elephants and their relatives: a popular book, Elephants: Majestic Creatures of the Wild (1992, Rodale Press, USA) and a technical volume (with Pascal Tassy), The Proboscidea: Evolution and Palaeoecology of Elephants and Their Relatives (1996, Oxford University Press, England).

Comments [by Hezy Shoshani] on general information provided for Discovery home page.

(1). Until recently, scientists who work with living and extinct elephants thought there were 362 species and subspecies; this number now stands at 162, of which at least two species survive.

(2). It is misleading to say "...they [elephants] could be in danger of extinction within the next few years". They may be extirpated (locally extinct) in some parts of their range, but they will not become extinct within a few years.

(3). Height given as "12 feet tall" is shorter than the record for shoulder height which is 14 feet 6 inches (442 cm).

Q. Are manatees closely related to walruses? They look so much alike!

A. No, manatees are not related to the walruses. Some early taxonomists made the same mistake. Manatees belong to the Order Sirenia, which includes 3 species of manatees and 1 species of dugong. Based on molecular data, manatees and dugongs (order Sirenia), elephants (order Proboscidea), hyraxes (order Hyracoidea), and aardvarks (order Tubulidentata) are closely related in this sequence. Based on morphological data, however, Sirenia, Desmostylia (extinct marine mammal), and Proboscidea are most closely related, and placed in a taxon called Tethytheria. Joining them next on the tree is Hyracoidea and all are placed in the taxon Uranotheria. Tubulidentata joins this assemblage only after Perissodactyla (e.g., horses), Cetacea (e.g., whales), and Artiodactyla (e.g., deer) join. This type of information can be found in the book "Classification of Mammals" by Malcolm C. McKenna, Susan K. Bell, and others (1997), published by Columbia University Press [Hezy Shoshani].

Q. Why do African elephants have such large ears?

A. Animals of the same species that live at different latitudes on the globe have different sizes of extremities (tails, external ears=pinnae). For example, rabbits that live in the northern latitude have smaller ears than those of the same species that live in warmer areas which will have larger ears. One of the functions of the pinnae is to help in thermoregulation (controlling temperature). Comparing the sizes of the ears of the two species, the African has larger ears than the Asian which lives at a more northern latitude. Closer to the equator, the African has to get rid of as much heat as possible from its body. Having large ears with a very intricate network of blood vessels close to the surface helps to dissipate heat and keep the animal cool. This process is called evaporative cooling [Hezy Shoshani].

A. To add to Hezy's answer, elephants regularly flap their ears to facilitate heat loss. This serves to increase the flow of cool air over the ears. Watch a television program on elephants and notice how often the elephants flap their ears, or hold them at a 90 degree angle to their heads to 'catch the breeze' [Charles Foley].

Q. How many offspring does an average female produce during her lifetime?

A. Female elephants reach puberty between 10 to 18 years of age. Like human females, they experience a form of menopause in their 40's or early 50's, after which they cease to reproduce. In between those 30 or so years they will be producing infants at a rate of one every 3-6 years depending upon food resources. The gestation period (duration of pregnancy) is 22 months, and females usually do not conceive for 1-2 years following parturition (birth). So if conditions are good, elephants may have 6-8 or possibly even more offspring in their lifetime, though not all may survive. In areas where there is a low density of elephants and plenty of food, they will reach puberty at an earlier age and give birth more often. In some of the Ugandan Parks where food is abundant and elephant numbers are low as a result of severe poaching in the past, some females are having twins every 4 years! [Charles Foley].

Q. Do elephants feel pain?

A. Following is the conclusion from a recent paper that I submitted to a police detective in England. Conclusions: It is often stated that animals experience pain. For example, Campbell (1993, p. 1019) wrote: "Virtually all animals experience pain, although we cannot say what perceptions they actually associate with stimulation of their pain receptors". Haas (1978, p. 298) reported that an elephant, which used to be easy to handle, suddenly showed signs of dangerous and abnormal behavior. Postmortem examination showed bony structures that pressed on nerves, damaged them, and "caused pain", which was the reason for the change in behavior. Based on the evidence we provide, from Histology (presence of free nerve endings and their interpreted functions as pain receptors), from Neurology (presence of all major structures, including nucleus accumbens and its interpreted functions associated with pleasure and possibly pain), and from Endocrinology (presence of hormones known as endorphins that function as natural analgesics or "painkillers"), in our professional opinion, elephants are able to experience pain, equivalent to the extent to which humans experience pain. The fact that elephants produce endorphins (e.g., beta-endorphin; Cheng and Yamashiro, 1991) is an unequivocal datum in support of the hypothesis that elephants do feel pain, for otherwise why would they need "painkiller"? [Hezy Shoshani; see article on pain in this issue of Elephant].

Q. How can we save elephants from extinction?

A. Education for younger generations, with emphasis that elephants are one of the players in a delicate and balanced ecosystem. Any player removed from this ecosystem is going to affect all others. One of the most important concepts in conservation is the Keystone Species — (1) many other animals benefit when elephants modify their habitat, e.g., elephants dig water holes in dry river beds, and after they drink, other animals can quench their thirst; (2) longevity in elephants and humans is similar and many age-dependent diseases, e.g., cardiovascular diseases and arthritis, have been studied in elephants to better understand them in humans; (3) by conserving the elephant, we conserve a significant number of other species and thus enrich our own biological inheritance. Elephants require large home ranges, and by conserving them, it will automatically save other animals in the same ecosystem; the reverse is not true, that is, reserving areas for smaller animals would not be sufficient to conserve elephants [Hezy Shoshani].

Q. What were the elephant species like that didn't survive? How were they different from the African and Asian?

A. The smallest and oldest known proboscidean (extinct elephant) is called *Phosphatherium escuilliei*. It lived about 58 million years ago, along the shores of the Mediterranean Sea close to Morocco (called the Tethys Sea). It was the size of a dog and did not have a trunk as do living elephants. During the many millions of years since, proboscideans increased in size and, concomitantly, their tusks and trunks developed. Some of them, e.g., *Gomphotherium* (lived about 20 million years ago), had four tusks, two in the upper, and two in the lower jaw. The woolly mammoth had the longest teeth (tusks) of any known mammal. The mammoths and the two living elephants are classified in one family, the Elephantidae. They differ from extinct species by having only one pair of tusks, and their grinding teeth have many parallel plates that enable them to chew the hard grassy material more efficiently [Hezy Shoshani].

Q. Is it true that an elephant's brain has the same surface area as a human's? My dad said that a human brain is slightly larger.

A. An adult human brain weighs about 1.6 kg (3 lbs, 8 oz) and that of an adult elephant weighs about 5 kg (over 11 lbs), but in terms of ratio, that of the elephant is 1/500 of its body weight, whereas that of a human is 1/50 of body weight. Concerning surface area, this is a complicated issue because the convolutions of the cerebrum and cerebellum contribute a great deal to the surface area, and some of them penetrate deep below the surface. If we examine a specific portion of the brain, such as the temporal lobe (which is known to function in memory in humans), it appears as though the temporal lobe of elephants is proportionally larger and more convoluted than that of humans [Hezy Shoshani].

Q. If the temporal lobe of elephants is larger than that of humans then maybe the old saying that "an elephant never forgets" might be close to the truth. I guess that elephants need good memory to remember where and when the water and vegetation are during their migration. I am guessing all elephants migrate or at least travel a lot. Is this correct?

A. On the temporal lobe, see reply to previous question. On migration: Yes. The majority of elephants do migrate or travel considerable distances to find food and water. The level to which they need to migrate is dictated by the resource abundance in their home ranges (see the answer under Endangered Elephants). Elephants do need to have a good knowledge of their environment in order to be able to find food and water, particularly during the dry season. They undoubtedly have good memories that allow them to remember locations of water supplies many years later. In Kenya, for instance, elephants will still occasionally attempt to migrate between Mount Kenya and the Aberdares, even though this migration route has been blocked by farmland for over 25 years [Charles Foley].

Q. Do elephants live in social groups?

A. Yes, elephants are extremely social animals and live in tight social groups. Elephants live in a matriarchal society, in which family groups are led by old females. Family groups are usually comprised of an older female, her daughters and their offspring, or two sisters and their offspring. Females generally remain within the family group for life and develop very strong social bonds with other group members. When these groups get too big, they split into what we call bond groups — members from bond groups will perform intense greeting ceremonies when they reunite after an absence. Beyond bond groups there is an expanding hierarchy consisting of clans (family groups that share the same dry season range), and then subpopulations (groups that share the same wet season range) that form the actual population. Elephants appear to enjoy being together and will often gather in the largest group that the feeding conditions will allow. And what about the males? Well, they get booted from the family group in their teens and wander around alone or in small dynamic groups of other males [Charles Foley].

Q. I've heard that elephants have something called "musth" which causes them to go totally out of control. Can you explain what this is and why it happens?

A. Musth is a periodical phenomenon known to occur in both Asian and African male elephants and is associated with physiological and behavioral changes. During musth, secretion oozes from the musth (temporal) gland, the orifice of which is located beneath the skin midway between the eye and the ear on each side of the elephant's head. It is not found in any other living mammal, but was found in remains of the extinct woolly mammoth. Musth does not occur in female elephants although they secrete fluid (which stains the sides of the face), but it apparently differs in composition from that of adult males in musth. Functions attributed to these secretions include sexual activity and communication. Some believe that musth is analogous to rut when males have a heightened mating drive and aggressiveness and the females are receptive. But musth does not necessarily involve heightened mating drive, nor are the females receptive when the males are in musth. In Hindi, musth means intoxicated. Elephants in musth can become uncontrollable, and captive elephants may kill their keepers [Hezy Shoshani].

A. Male elephants have a distinct dominance hierarchy which is based on the size of the animal. Normally males interact fairly peacefully with each other and seem to enjoy each other's presence. When a bull comes into musth, however, that changes. The testosterone levels of the animal rise dramatically, making it more aggressive, and the bull may go off in search of females with which to mate. Should other males challenge the bull, fights can often occur. In general, the largest male in the population will come into musth at the optimum time (usually during the wet season), when there are the most estrous females available. The largest males will also stay in musth for the longest periods (up to 4 months has been recorded in African bulls) and consequently monopolize most of the matings. Females seem to prefer to breed with musth bulls; the two will form a consortship for the few days when she is most receptive, and the musth bull will keep away all other bulls. Musth takes its toll on the males. They tend to eat

much less during this period and spend a lot of time walking in search of females. Musth bulls have a peculiar gait known as the 'musth walk', characterized by them holding their heads up high and swinging them from side to side. With all this extra activity their body condition deteriorates and eventually they fall out of musth, whereupon they go back to their sedate life with the other boys [Charles Foley].

Q. What is the typical home range of an elephant group? Does it vary with season, food abundance, competitive groups, human disturbance, or group size? What's the farthest distance a group might cover while migrating?

A. Elephant family group ranges do vary considerably. The smallest recorded range is 14 square km, by a group in Lake Manyara National Park in Tanzania. The largest recorded thus far is over 18,000 square km, by a group of elephants in Namibia. Most groups in East African Parks have ranges between 300 and 3,500 square km. Resource availability is probably the most important factor determining home ranges. Lake Manyara has plenty of thick bush and fruiting trees for the elephants to feed on, so they need not move much. The desert elephants in Namibia, on the other hand, have to move large distances in order to obtain enough food and water. In East Africa, family groups tend to range further in the wet season, as they are no longer restricted to permanent water sources. I imagine that the opposite would happen with the desert elephants, as greater forage availability would reduce the need to travel to find food in the wet season. Little is known about how the dominance of the group or group size may affect home ranges. Human disturbance generally has the effect of compressing elephants into small safe havens and thereby, reducing range size. Elephants can easily travel over 20 km in a day and have been known to cover over 100 km in 3 days [Charles Foley].

Q. Endangered elephants - what can we do to protect them?

A. 1) First encourage people not to buy ivory. We do not have any reliable method of determining which ivory comes from legal sources (natural death or culling) and which has been poached. Buying ivory increases demand and encourages the illegal market. It was, after all, the rise in ivory prices in the 1970's and 1980's that led to the decimation of over a million elephants in Africa. 2) Adequate protection of land will be crucial to many elephant populations in the future. As the human population grows in areas of elephant habitat, there is increasing human/wildlife conflict, usually to the eventual detriment of the elephants. By no means can countries protect all of the potential elephant habitat, but they can encourage the protection of key elephant ranges, as well as the wildlife corridors that elephants use to migrate to and from National Parks and other protected areas [Charles Foley].

Q. Which are more endangered, Asian or African elephants?

A. It would have to be the Asian elephant of which there are thought to be under 40,000 left in the wild. By contrast there are over 600,000 African elephants spanning the African continent. Large scale deforestation continues to be a big problem in Asia, and the available habitat for elephants is constantly being reduced [Charles Foley].