Elephants

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Taxonomy


Brief facts

- General information

Elephants (order *Proboscidea*), largest terrestrial mammals, are characterized by columnar limbs, bulky bodies, and elongated snouts (*trunks*). There are only three surviving species of the order *Proboscidea*: *Elephas maximus* (Asian elephant), *Loxodonta africana* (*African savannah elephant* or *African plains elephant*), and *Loxodonta cyclotis* (*African forest elephant*).
Other famous representatives of the order, such as mastodon (*Mammut americanum*) and wooly mammoth (*Mammuthus primigenius*), are extinct. The fossils of oldest known proboscidean *Eritherium azzouzorum*, dated about 60 million years ago (MYA), were found in Morocco (Africa). The estimated body mass of these animals varies between 3 and 8 kg (6.5 - 17.5 lbs).

**Aquatic origin of elephants**

There are many indications that elephants have aquatic ancestors:

- **Elephants exhibit snorkeling behavior.** Elephants can snorkel through their trunks while completely submerged below the surface of water. Trunk develops on very early stages of embryo, which indicates its very ancient origin.

- **The elephant is the only mammal whose pleural cavity** (a space between the two layers of the pleura) **is completely obliterated by loose connective tissue, thus protecting blood vessels from rupturing under pressure during snorkeling and drinking through the trunk.**

- **Elephant's testes do not descend into a scrotum during embryonic development and remain intra-abdominal after birth.** This feature is characteristic to aquatic mammals, whose testes need to be protected from the cold. Elephants and dugongs are primary testicond mammals (their testes never have been scrotal), whereas seals and whales are secondary testiconda (their testes once have been scrotal, but were subsequently withdrawn back into abdominal cavity in the course of the evolution).

- **One of the striking features that is not seen in other mammalian embryos and indicates aquatic ancestry of the elephants is the development of nephrostomes (connections between the fetal kidney and the coelomic cavity).** Nephrostomes are a characteristic feature of the mesonephric kidneys of freshwater vertebrates such as sturgeons and frogs.

- **Dentition**, anatomy of the middle ears, immunological and molecular evidence strongly suggests that the elephant (order *Proboscidea*) and the sea cow (*Sirenia*) must share a common ancestor.

**Distribution**

- **African savannah elephant**: south of the Sahara Desert to
the south tip of Africa, from the Atlantic coast (west) of Africa to the Indian Ocean (east).

- **African forest elephant**: dense rainforests of Congo and other Central and West African states.

- **Asian elephant**: parts of India and Southeast Asia, including Sumatra and Borneo. Wild Asian elephants are rare and endangered.

### Eating habits

In nature, elephants consume food with the lowest concentration of calories and protein of any mammalian species. They spend about 60-80% of each 24-h day foraging on savannah and forest vegetation. Daily food intake of elephants ranges between 1 and 2% of the body mass (approx. 110 tons of vegetation annually). Elephant drinks up to 225 L of water every day, and can go without drinking for up to 4 days. Elephants' ability to reliably locate scattered, distant food and water resources is crucial for their survival.

### Social structure

The core social unit of the African elephant is the group consisting of female relatives and their offspring under leadership of an oldest and most experienced **matriarch** elephant. There are two larger social tiers: family units form larger "bond-groups" and multiple bond-groups form "clans". Elephant society is usually described as having **fusion-fission** organizational structure, where core family groups exhibit stable association over time, but the two larger social tiers are transient and result from opposing pressures. For example, food competition may create pressure for smaller group size (fission), but social benefits such as security and knowledge sharing may create pressure for larger group size (fusion). Male elephants leave their family units around the age of sexual maturity to socialize with older bulls in all-male group. They periodically enter a behavioral and physiological state of reproductive readiness (**musth**), during which they visit female families to mate with estrous females.

### Elephant cognition

Elephants have the largest brains among terrestrial mammals, including the greatest volume of cerebral cortex. For ages the elephants were perceived as being highly
sociable, cooperative, and intelligent animals, however, there are very few controlled experiments that support this perception. Because elephants' size and life style do not allow an easy laboratory setup, the studies of their behavior and cognitive abilities are usually confined to a limited number of experimental animals, who seems to vary widely in their mental capacities. Main trend is, however, very clear: elephants are very slow in learning and solving core tasks and problems routinely presented to primates and birds. However, many researchers argue that the conventional set of experimental problems is not relevant to elephant's survival in the fields and discuss the necessity of designing elephant-specific experiments to showcase their cognition, which is highly developed but is divergent from that of primates and birds. Elephants fail in tests designed for primates (and by primates) but excel in specific field problems requiring extensive long-term memory. Moreover, elephants exhibit behaviors that are highly unusual for non-human animals suggesting an existence of some elements of Theory of mind in their cognition. The following comparative table was derived mostly from Hart BL et al. (2008). "No data" means that we did not have definitive answers at time of the writing. It is possible that we will be able to fill the blanks later.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Elephants</th>
<th>Great apes</th>
<th>Birds</th>
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<tbody>
<tr>
<td>Tool use</td>
<td>use branches to switch flies; throw stones at rodents; scratch with sticks</td>
<td>crack nuts with stone; use stick to fish termites</td>
<td>use sticks to fish invertebrate prey</td>
</tr>
<tr>
<td>Tool manufacture</td>
<td>modify branches and sticks</td>
<td>choose and modify sticks</td>
<td>choose and modify sticks and wire to be hook-like</td>
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<tr>
<td>Insight behavior (understanding and/or learning how to get bait by pulling strings or moving obstacles, etc.)</td>
<td>fail most of the time</td>
<td>can solve and excel in learning</td>
<td>can solve and learn easily</td>
</tr>
<tr>
<td>Visual discrimination (distinguish between shapes, colors, sizes)</td>
<td>very poor learning ability</td>
<td>learn easily</td>
<td>learn easily</td>
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### Spatial-temporal memory

Excel in remembering distant (hundreds of miles apart) water holes or foraging grounds for decades

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### Social memory (acoustic characteristics, chemosensory signals)

Can recognize calls of about 100 other elephants from various families and clans; can recognize family members after decades after separation

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### Self-awareness and recognition (can recognize its image in the mirror)

Documented, not considerably better than in elephants

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### Empathy to disabled/deceased conspecifics

Helping to injured or distressed conspecifics; recognition of remains of dead conspecifics (corpses as well as bones)

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### Comparison of African and Asian elephants

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<tbody>
<tr>
<td>Breeding interval</td>
<td>4-9 years</td>
<td>3-4 years</td>
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<tr>
<td>Preferred breeding season</td>
<td>rainy season</td>
<td>throughout the year</td>
</tr>
<tr>
<td>Average number of offspring</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Gestation period</td>
<td>22 months</td>
<td>18 - 22 months</td>
</tr>
<tr>
<td>Birth mass</td>
<td>~105 kg (~230 lbs)</td>
<td>~107 kg (~235.5 lbs)</td>
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<tr>
<td>Time to weaning</td>
<td>~6.5 years</td>
<td>~4 years</td>
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### Developmental stages (life cycle)

The following descriptions are based mostly on development of *Loxodonta africana*. However, embryonic development is similar in both major elephant species (*L. africana* and *E. maximus*).

- **Prenatal**
  - **Early embryo**
    
    ![Early embryonic development of elephant](https://www.geochembio.com)
Late embryo

Post natal

- Neonate
  - Newborn baby elephant. Newborns are **precocious**: typically they can stand and walk within very short time after birth. The brain of a newborn elephant is **underdeveloped** (about 30-40% of the size of that of an adult). Body mass is about 77 - 113 kg (170 - 250 lbs). Elephants are born without innate knowledge of how to use their trunks. Neonate has to learn the skills by mimicking adults and exercising thousands of muscles comprising the trunk.

- Infant
  - Baby elephant until weaning. Elephants usually are fully weaned by 5-6 years of age. Baby elephants are brought up in matriarchal society, surrounded by complex layers of extended family. Infants develop close relationship with other elephants, and especially, with other female family members (**allomothers**), who actively participate in raising the young. It was shown that infants, who witnessed killing of their family members, exhibited signs of post-traumatic stress disorder very similar to humans: abnormal startle response, depression, unpredictable asocial behavior and hyperaggression, which can persist through their lives.
- **Juvenile**
  Young elephant from weaning until puberty (~18 years of age). Weaning begins during the first year of life and continues until another sibling is born. Puberty occurs between the ages of 9 and 15, and sexual maturity is reached at 15-17.

- **Adolescent**
  Young elephant from puberty until first mating. Elephants rarely mate until they are in their 30s. At about 29 years of age, males experience their first **musth** (a period of sexual activity in male elephants characterized by high testosterone levels, urine dribbling, green penis syndrome and swollen temporal glands. Only a few mammalian species undergo a period of adolescence. Adolescent male elephants leave their natal family to participate in all-male groups while females continue staying with their natal families. This is when individuals acquire skills and experience, and develop relationships that are of great importance for their immediate and future survival and reproductive success.

- **Adult**
  Mature, experienced and independent elephant about 30-36 years of age and older. Female can become a matriarch at this age. Male occupies higher levels of social hierarchy in all-male "batchelor" groups.
African elephants (*Loxodonta africana*) in Maryland zoo
African forest elephant (*Loxodonta cyclotis*)

Borneo elephant (*Elephas maximus*)

Asian elephant infant (Elephas maximus)

References

Articles


West JB. Snorkel breathing in the elephant explains the unique anatomy of its pleura. Respir Physiol. 2001 May. PMID: 11311306


Gaeth AP, Short RV, Renfree MB. The developing renal, reproductive, and respiratory systems of the African elephant suggest an aquatic ancestry. Proc Natl Acad Sci U S A. 1999 May 11. PMID: 10318922

Websites

ADW: Loxodonta africana, African bush elephant.
• ADW: *Elephas maximus*, Asiatic elephant.
• *Loxodonta cyclotis*, forest elephant: facts, videos.