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Felis catus, cat

Taxonomy

cellular organisms - Eukaryota - Fungi/Metazoa group - Metazoa - Eumetazoa - Bilateria - Coelomata - Deuterostomia - Chordata - Craniata - Vertebrata - Gnathostomata - Teleostomi - Euteleostomi - Sarcopterygii - Tetrapoda - Amniota - Mammalia - Theria - Eutheria - Laurasiatheria - Carnivora - Feliformia - Felidae - Felinae - Felis - Felis catus

Brief facts

Origin of domestic cat

- Fossils suggest that felid-like animals first appeared about 35 million years ago. Modern cats descended from a mid-size cat that existed about 10-11 million years ago, when saber-tooth tigers were long extinct. The earliest predecessor of living cats, *Pseudaelurus*, lived in Eurasia during Miocene. Molecular phylogeny defined eight principal Felidae lineages that form basis for recognition of main Felidae taxons: Panthera, Bay cat, Caracal, Ocelot, Lynx, Puma, Leopard, and Domestic cat lineages.

- Domestic and Leopard cat lineages branched out about 6.2 million years ago. For millions of years ancestors thrived in the world without humans. By about 10,00 years ago, there were several diminutive cat species in Eurasia: jungle cat, desert cat and a ubiquitous wildcat, *Felis silvestris*, whose Near East subspecies, *Felis silvestris lybica*, ventured to the territories occupied by ancient settlers, and thus initiated one of the more successful "biological experiments" ever undertaken.

Cat domestication

- The oldest known archeological deposits with co-occurrence of human and cat remains are dated to 9,500 years ago in Cyprus (Crete); therefore, humans and cats co-existed side by side some 5,000-6,000 years before the ancient Egyptian civilization, which was considered as a cradle for cat domestication.
- Molecular data indicate that Near Eastern subspecies of *Felis silvestris*, *Felis silvestris lybica*, gave rise to modern domestic cat, *Felis catus*. The domestication event occurred around the time when the first agricultural settlements started to appear in the Fertile Crescent about 10,000 years ago.
- Divergence of domestic cat from wildcat occurred **sympartically**. It is believed that wild cats initiated domestication because human habitat offered more opportunities for hunting (barn pests) and reproduction (shelter, absence of enemies). Cats' evolution to companion animals was and to some degree still is a process of natural, rather than artificial, selection (with notable exception of fancy breeds, which undergo strict artificial selection pressures). For thousands of years they not only hunted for their own food but also continued to intermingle with wild cats. Occasionally, in the course of domestication, some of them retreated back to their natural habitats only to return again. Tamest and most sociable of them were allowed to enjoy food availability and protection provided by humans. Over generations these profiteers diverged from their wild relatives and became true and valued companions.
- Domestic cat varies little morphologically from the wild cat body plan, although, as Darwin noted, domestic cats have longer intestines than wildcats, a trait that might reflect departure from the strict carnivorous diet while feeding on the kitchen scraps.
  Domestic cats have become polyestrous; their coat color frequently differs wildly from the wildcat's striped mackerel tabby. Domestic cats can tolerate and even enjoy company of other cats (especially if they are siblings), whereas wildcats are solitary and fiercely territorial.
- Modern cat breeds derive from the earliest fancy breeds (Siamese, Persian, Corat, Egyptian Mau, Manx, Turkish Angora and others) established around the 17th century. The most recent breeds (American Curl, Selkirk Rex, and Singapora) were established during the late 20th century.

Feeding habits and nutritional requirements of domestic cat

- Cats have higher protein and dietary nitrogen requirements than other domestic animals. While most animals reduce the activity of enzymes involved in amino acids' catabolism when fed protein-deficient foods (carbohydrates, fat), cats do not seem to be able to so.
- Felids evolved as obligate carnivores, and as such they have numerous nutritional idiosyncrasies. They totally lack or have low levels of key enzymes for synthesis of vitamin A, arachidonic acid, taurine, niacin, and ornithine.
- Cats are unable to synthesize arginine from glutamate and glutamine. Therefore, unique among nutrient deficiencies of cats is that ingestion of single arginine-free meal causes severe illness in cats: anorexia, hyperammonemia, emesis, ataxia, and even death.
- Cats show preference for the amino acids described as "sweet" in man (such as proline, cysteine, ornithine, lysine, histidine, and alanine) and reject the "bitter" amino acids (such as arginine, isoleucine, phenylalanine and tryptophan).
- Cats are insensitive to taste of salt and sugar.
- Unlike dogs, domestic cats derived from exclusively solitary hunters, and therefore usually take prey with much lower body mass than their own, which necessitate multiple small kills per day. This is reflected in feeding patterns of the domestic cats that usually prefer take multiple small meals throughout the 24 hours of the day.
- Small kills, one per a meal, also mean that the freshness of food is also very important for cats. Cats usually reject foods rich with monophosphate nucleotides and other compounds that accumulate in mammalian tissues after death, and this may be partly responsible for the cat's dislike of carrion.
- Cats frequently exhibit a growing aversion to monotonous repetitive foods. When offered palatable novel and long-fed food, they will choose the former with much higher probability. In nature, this strategy should reduce likelihood of unbalanced diet.
- Cats are equipped with flexible behavioral strategies and are able to adjust their feeding habits based on previous experiences. Although kittens are strongly attracted to diet of their mother, they can change their preferences considerably especially during the first year of life.

Cat as a model organism

- There are approximately 70 million house cats in the United States and several times that number worldwide. The reasons for the large population of cats include mankind's fascination and domestication of the species plus a relatively high fecundity, adaptability, and exceptional survival abilities ("cat's nine lives") - features that increase the cat's potential as a genomic model for medical and biological application.

- Cats, like dogs, enjoy extensive medical surveillance that is second only to human health care. They have approximately 250 genetic diseases analogous to human disorders such as some neurodegenerative disorders, diabetes, acromegaly, muscular dystrophy, hemophilia, etc. Feline pathogens represent natural models to human infectious diseases including HIV-AIDS (feline immunodeficiency virus (FIV)), SARS (feline coronavirus-FCoV), neurotropic and cancer-inducing viruses.
- In 2005, the cat, together with other 24 mammals, was selected for whole genome sequencing by National Human Genome Research Institute (NHGRI), to facilitate interpretation of the human genome sequence. Abyssinian breed was chosen for sequencing as the most inbred, which makes genome assembly easier. Cat by name Cinnamon provided her DNA.
- *Toxoplasma gondii*, one of most important pathogens, which is believed to affect the humanity profoundly, originates from felids that are its definitive hosts. Many companies that produce litter for domestic cats place important warning on their packages concerning toxoplasmosis, which can be distributed with cat's feces. Please read important details about toxoplasma and toxoplasmosis **at MetaPathogen.**

Reproductive cycle

Cats usually have one breeding season annually. The duration is greatly depends on the seasonal daylight variations (i.e. latitude); noticeable variations among individuals are also present.

- Estrous cycle

  The period of cyclic physiological and behavior changes in non-primate female mammals that exhibit estrus.

  - Proestrus

    Precedes estrus. During proestrus, the Graafian follicles undergo maturation. First behavioral changes in cats: increased socialization, affection, and playfulness; increased rubbing against the furniture.

  - Estrus

The period in the reproductive cycle associated with maximum sexual receptivity and fertility in non-primate female mammals. Cats are polyestrous. During the estrus queen suffers discomfort and exhibit all or most of the signs of sexual receptivity: intense rubbing, spinal flexion (**lordosis**), treading with hind legs, tail deflection, body and tail tremor and rigidity, loud yowling, vaginal discharge, head shaking, and spraying. Estrus is usually induced by long daylight seasonally or artificially: fourteen hours of light administered during non-breeding season (anestrus) induces estrus in about 2 weeks at any time of the year. Estrus lasts approximately 3 to 10 (5 - 8 on average) days or until the cat is mated. Mating induces ovulation in cats. Repeated mating may be needed for ovulation to occur. Non-ovulated cat (and her owners) will experience about 5 - 9 esrus periods for the duration of the breeding season (~19 days per each estrus or 1.5 - 2.2 cycles/month). Ovulation will delay the next estrus. Successful fertilization will result in anestrus.

- Metestrus

The period following estrus during which the phenomena of estrus subside in those animals in which pregnancy or pseudopregnancy does not occur. Pseudopregnancy occurs after ovulation of mature follicles without subsequent fertilization. Pseudopregnancy delays the next estrus.

- Interestrus

The period between estrus without signs of sexual behavior when queen is non-ovulatory.

- Diestrus

  Diestrus is a period of sexual quiescence separating phases of estrus in polyestrous animals.

- Anestrus

  A state of sexual inactivity in female animals exhibiting no estrous cycle. Causes of anestrus include pregnancy, presence of offspring, season, stress, and pathology. Usually anestrus separates breeding seasons.

Developmental stages (life cycle)

- unfertilized egg

  Unfertilized mature eggs are usually not released from the ovaries until mating.

- Prenatal

  Gestation period lasts from 53-67 (about 9 weeks) ranging from less than 54 to more than 74 days. There are very little data on development of cat embryo *in vivo*. The following are data from 2 studies (see references).

  - embryo
    - Pre-implantation embryo
      - fertilized egg

        Ovulation and fertilization occurs in about

24 - 30 hours after mating. In one study natural multiple mating resulted in 73.1% fertility in cats 38 of 52). The remaining non-fertile cats had either ovulatory or fertilization failure. Fertilized egg is located in the oviduct. The following time intervals are given in hours **after first copulation** (because exact moment when
fertilization occurs is almost impossible to determine).

- Cleavage

  Cleavage starts in the oviduct.

  - 2-8 cell embryo

    In 64 hours after first copulation.

  - 8-16 cell embryo

    In 76-100 hours after copulation.

- Morula

  An early embryo that is a compact mass of about 16 cells (blastomeres), which differentiated into two types of cells, outer cells and inner cells. Morulae and compact morulae appear in about 124 hours post copulation in cats. They are still in the oviduct.

  - Compact morula

    By 148 hour post copulation most morulae are compacted and migrated into uterus.

- Blastocyst

A preimplantation mammalian embryo that develops from a 32-cell stage into a fluid-filled hollow ball of over a hundred cells. A blastocyst has two distinctive tissues. The outer layer of trophoblasts gives rise to extra-embryonic tissues. The inner cell mass gives rise to the embryonic disc and eventual embryo proper. First blastocysts were found in 148 (~6 days) hours after copulation. The blastocysts undergo intrauterine migration and become equally spaced in the uterus. After this they undergo triphasic implantation (which involves apposition, adhesion, and intrusion).

- Post-implantation embryo

  By 480 hours (20 days) after copulation all normal embryos are implanted and development of fetal membranes and organogenesis had began.

- Fetus

  At day 53 of pregnancy in the cat, the fetus is almost completely developed inside the amnion (the innermost membranous sac that surrounds and protects the developing embryo which is bathed in the amniotic fluid), which is totally enveloped by allantois (an extra-embryonic membranous sac derived from the yolk sac; it lies between two other extra-embryonic membranes, the amnion and the chorion; the allantois serves to store urinary wastes and mediate exchange of gas and nutrients for the developing embryo).

- Post natal

- Neonate

  Parturition lasts from 2 to 6 hours in majority of cats. Litter size varies from 1 to as much as 13 kittens with average of about 3-5 kittens. Kittens are born with underdeveloped brains and sensory organs: eyes and external auditory canals are closed; mean weight is about 70-110 grams ranging from 30 and up to 170 depending on the breed. Neonatal period lasts approximately 3-4 days after birth.

- Developing cat

  - Sensory development: visual and auditory

    Eyes usually start opening gradually and asymetrically at about 6-10 days of age; palpebral and blink reflex appear shortly after birth (blink response is getting dulled with age and may be absent by 15-43 days of age especially if the cat is fully awakened). By about 8-17 days of age both eyes are completely open; opening of auditory canals occurs at 4-17 days of age; at this time first startle responses on sharp noises are observed. By end of the first week weigh of healthy kitten is nearly doubles.

  - Locomotor development and weaning

    - Uncoordinated walking and learning to lap (milk, water)

      At about 3 weeks of age.

    - Starting to play and weaning to solid food

      At about 4 to 7 weeks of age.

- Juvenile

  Relatively independent and actively growing animal until age of sexual maturity (6-12 months). Independence is achieved at about 10 to 12 weeks of age. About this time, social kittens become more solitary. Plays with peers continue but take on more aggressive character. At about 14 weeks of age social play is almost completely replaced with object play.

- Adult

  After attainment of sexual maturity. Age of first estrus in female cats ranges from 180 days to 560 days and may depend on date of the birth. On average male and female kittens reach puberty at about 1 year of age. Well-cared for animals can live for 16 years and more.

Pictorials

Stray tabby in Japan

Cat in one of Japanese hostels on the way to Nikko

Polydactyl cat in Hemingway museum (Key West, Florida)

Lounging stray in Budapest

Mexican stray feeds on fish scraps (Ixtapa region)

Mexican stray lives on hotel premises (Ixtapa region)



Taxonomic place of domestic cat among other *Felidae* (cat family)

Cat family is divided into three subfamilies, each of which contains one or more genera.

- Acinonychinae
  - Acinonyx
    - Acinonyx jubatus

      Cheetah
- Felinae
  - Caracal
    - Caracal caracal

      Caracal
  - Catopuma
    - Catopuma badia

      Bay cat
    - Catopuma temminckii

Asiatic golden cat

- Felis
  - Felis catus — Domestic cat
  - Felis chaus — Jungle cat
  - Felis margarita — Sand cat
  - Felis nigripes — Black-footed cat
  - Felis silvestris — Wild cat - considered a progenitor of the domestic cat.
    - Felis silvestris bieti — Chinese desert cat
    - Felis silvestris cafra — Southern African wildcat
    - Felis silvestris libyca — Near Eastern wildcat
    - Felis silvestris ornata — Central Asian wildcat
    - Felis silvestris

- silvestris
  - European wildcat

- Herpailurus
  - Herpailurus yaguarondi
    - Jaguarundi

- Leopardus
  - Small spotted cats mostly native to Central and South America.
  - Leopardus colocolo
    - Colocolo
  - Leopardus geoffroyi
    - Geoffroy's cat
  - Leopardus guigna
    - Kodkod
  - Leopardus pardalis
    - Ocelot
  - Leopardus tigrinus
    - Little spotted cat
  - Leopardus wiedii
    - Margay

- Leptailurus
  - Leptailurus serval

- Serval

- Lynx
  - Lynx canadensis
    - Canada lynx
  - Lynx lynx
    - Eurasian lynx
  - Lynx pardinus
    - Spanish lynx
  - Lynx rufus
    - Bobcat
- Oreailurus
  - Oreailurus
- Otocolobus
  - Otocolobus manul
    - Pallas's cat, manul
- Prionailurus
  - Prionailurus bengalensis
    - Leopard cat
  - Prionailurus iriomotensis
    - Iriomote cat
  - Prionailurus

- planiceps
  Flat-headed cat
- Prionailurus rubiginosa
  Rusty-spotted cat
- Prionailurus viverrinus
  Fishing cat

Profelis

- Profelis aurata
  African golden cat

Puma

- Puma concolor
  Puma

Pantherinae

Neofelis

- Neofelis diardi
  Bornean clouded leopard
- Neofelis nebulosa
  Clouded leopard

Panthera

- Panthera leo — Lion
- Panthera onca — Jaguar
- Panthera pardus — Leopard
- Panthera tigris — Tiger

- Pardofelis
  - Pardofelis marmorata — Marbled cat
- Uncia
  - Uncia uncia — Snow leopard

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Websites

- **Sequencing the Genome of the Domestic Cat (*Felis catus*).**

Questions answered

- What are the ancestors of domestic cats?
- How cats were domesticated?
- Why should a person not feed dog food to a cat?
- How to avoid unwanted behavior exhibited by female cat in estrus?
- For how long is a cat pregnant?
- At what age kitten can be safely separated from their mother?

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