

The Cat Behaviour

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The Origin of Cats – How Did the Cat Become Tame and Domesticated?

Our cherished pet cats have not always been domesticated. They resemble a lot of small wild cats from Africa and Eurasia, and still retain many similarities with them. Because domestic cats are now found all over the world, including places with resident populations of small wildcat species, we are not sure precisely where, when and how the domestic cat originated, but genetic, archaeological and historical studies provide good indications.

According to the International Union for Conservation of Nature, the domestic cat is classified as a species, in Latin called *Felis catus*, which can be distinguished from six wild species of *Felis* including the European wildcat (*Felis silvestris*; Fig. 1.1), the African wildcat (*Felis lybica*, Fig. 1.2) and the Chinese mountain cat (*Felis bieti*). There is uncertainty about this classification, and it may change based on future research. Some texts place the domestic cat as a subspecies of *Felis silvestris* known as *Felis silvestris catus*, with the European wildcat, African wildcat and Chinese mountain cat forming other subspecies of *Felis silvestris* with which the domestic cat is known to interbreed. Domestic cats can also potentially interbreed with other small cat species found in Africa and Asia. They can even be crossed with certain small wildcat species found in South and Central America but, with only 36 instead of the usual 38 chromosomes, fertile offspring are unlikely.

The European wildcat has been one candidate for ancestry of the domestic cat. Resembling a large brown tabby domestic cat, the European wildcat can be found in low numbers scattered across the temperate forests of Europe and western Asia. Once widespread in Great Britain, an isolated population still exists in Scotland, although on the verge of extinction in its pure form due to hybridization with feral domestic cats. Occasional reports of big black wildcats in Scotland, called Kellas cats, have turned out to be hybrids between the European wild-cat and the domestic cat. The European wildcat is a really wild cat – timid, aggressive and solitary, and even the kittens are almost impossible to tame. These behavioural characteristics seem to be the opposite of those that would make a wildcat an obvious candidate for domestication; that is, easily tamed, sociable and functioning well in close contact with people.

The African wildcat is a more promising candidate for domestication. While there have been few studies of this species in the wild, African wildcats can be found living close to villages, and can be easily tamed if taken in as kittens. Although usually solitary, females are occasionally seen in groups with members of successive litters, as is also sometimes seen in domestic cats. The older offspring may then assist their mother in supplying food for their younger siblings. The African

wildcat typically inhabits semiarid areas and is found throughout much of Africa excluding the central Sahara and tropical rainforest. Not restricted to Africa, its range extends through the Middle East and across Asia to western China. The closely-related Chinese mountain cat is a large, blue-eyed wildcat adapted to life on the Tibetan Plateau, where it is not known for tractability. There are, however, other species of small wildcat in addition to the African wildcat that can be easily tamed.

The question arises whether domestic cats could have arisen from multiple domestication events in different parts of the world, involving more than one species of wildcat. The answer is yes and no. There is some evidence for early domestication of the mainland leopard cat, *Prionailurus bengalensis*, in China around 5000 years ago. However, those early domestic cats appear to have died out, as it has been discovered that the domestic cats found in China today can be traced back to African wildcats of Middle East origin. A DNA analysis of 979 wild and domestic cats from Europe, the Middle East, Africa and Asia showed that, in fact, all the tested domestic cats were derived from the African wildcat.

The analysis further indicated that they were descended from a subspecies of African wildcat found in the Fertile Crescent, the belt of land extending from the Egyptian Nile to Palestine and Mesopotamia where agriculture is believed to have originated roughly 12,000 years ago. Further research has shown that the Chinese mountain cat is not the original source of today's domestic cats in Asia, although it has subsequently interbred with domestic cats.

The relatively new cat breed, the Bengal cat, is derived from deliberate crossing of the domestic cat with the mainland leopard cat, a trend that started in the 1960s (Fig. 1.3). Joining the Bengal cat are several other new synthetic breeds created by crossing domestic cats with other wildcat species. See Chapter 9 for discussion of ethical issues arising from this practice.

The Cat in Ancient Times

The very earliest sign of cats living with humans comes from a 9500-year-old archaeological site in Cyprus. Excavations unearthed an approximately eight-month-old cat of the African wildcat type that had been buried in its own small pit just 40 cm from a person, aligned in the same direction. Cats have never lived wild in Cyprus, so it must be humans who brought the cat to this Mediterranean island. The fact that the cat was buried intact alongside a person suggests that the person had a strong relationship with this cat. Similarly, in Israel, dogs were being buried with people 12,000 years ago.

The area in the Middle East where the domestic cat originated is considered the cradle of civilization, where people gave up their hunter-gatherer lifestyle and began to cultivate the soil. Mice and other small rodents lived well on the stores of cereals that humans cultivated and harvested. These prey animals attracted wildcats that had spotted a rich food source. The humans no doubt welcomed this unexpected help. The cats and the people enjoyed a mutual benefit. It is likely that those cats that thrived and reproduced the most in human settlements were those that were the least fearful of people and the most willing to tolerate the proximity of livestock, dogs and other cats. Over generations, this natural selection for tameness and sociability would have led to

the genetic divergence of domestic cats from their wild ancestors. These cats were friendly and funny, and interacting with them in kittenhood would have further accentuated their friendliness. It is no surprise that some cats became pets, enjoying the care and protection of their owners even when they grew old and were no longer efficient mousers.

From the above, we can see that rather than humans 'domesticating' the cat, cats essentially domesticated themselves. While domestic cats are typically smaller than the African wildcat, and have a smaller brain, they are quite adept at training their owners to be their obedient servants. It suffices to scratch on the wall by the door to have the owner rushing to open the door. In Chapter 10, we shall see how we can easily train cats to avoid any unwanted behaviour. This allows us to live with them in harmony, continuing a close association that began at least 10,000 years ago.

The divine cat

The ancient Egyptians worshipped cats and kept many in captivity. A 4000-year-old wall painting in the tomb of Baqet III depicts a cat facing a rat, indicating that the cat was valued as a rat catcher. Where The Bengal cat has become a popular breed in North America and Europe in recent decades. It is derived from crossing the mainland leopard cat with domestic shorthair cats.

Where rats are found, it is not surprising that they attract snakes who eat them. The cat is also good at killing small snakes, as a source of prey or perhaps because snakes pose a threat to their kittens. This was probably known to the Egyptians 3500–4000 years ago when they carved 'magic knives' of ivory, decorated with cat figures to repel venomous snakes.

The Egyptians had many gods. In one myth, the sun god Ra, in the guise of a great tomcat, slays the serpent god Apophis. Around 3200–3500 years ago, cats were associated with the goddess Hathor, especially when she presented herself as Nebethetepet. This goddess represented sexual energy, and the association with the cat may relate to the fact that female cats can mate multiple times and bear offspring with different fathers in a single litter.

The most famous cat god was Bastet, who was associated with fertility, birth, protection and care of children. Initially, she was depicted with a lion head but about 2700–3000 years ago, this was replaced by a cat head signifying a more friendly deity.

Many cats were kept in temples and sacrificed in the name of Bastet. Veneration of Bastet centred on the city of Bubastis in the south-eastern Nile delta but eventually spread throughout Egypt. The famous Greek historian Herodotus described the Bastet cult when he travelled in Egypt c.450 bce. He recounted that festival worshippers at the temple of Bubastis arrived from miles around bearing cat mummies as offerings. When a family cat died, the people of the house shaved off their eyebrows to show their grief. Rich cat owners embalmed their dead cats and buried them in special cat cemeteries with bronze statuettes of cats as grave monuments. In some cases, a cat mummy was buried together with a human mummy. If someone happened to kill a cat, there was great concern. This was considered a serious crime and cat murderers risked lynching. Herodotus also described incidences where male cats killed kittens. This would have caused their mother to come into heat, allowing her to be mated by the infanticidal male. Today, infanticide by males is a recognized phenomenon in the behavioural ecology of many species, and it is especially well

known in lions. It is reported occasionally in feral domestic cats. Herodotus can thus be regarded as one of the first cat ethologists.

The Cat Spreads Out

As a result of the domestic cat being so useful, it was forbidden to export cats from ancient Egypt. Special agents were sent out to buy back and bring home cats that had been illegally exported. However, cats gradually spread out from the Fertile Crescent along trade routes. Various archaeological and historical sources show that domestic cats existed in the Indus Valley 4500–5000 years ago, in the Minoan culture of Crete 3100–3500 years ago and in Greece and southern Italy around 2500 years ago. The Greeks and Romans used ferrets and weasels to catch mice and rats, which initially limited the need for cats. However, the value of cats caught on and, with the expansion of the Roman Empire, cats spread through Europe, including England, where they are first described around 350 ce.

The cat arrives in Scandinavia

It is unclear when cats first arrived in Scandinavia, but cat bones have been found in Danish burial sites dating from about 1 to 375 ce. This suggests that cats spread north from areas of Roman occupation. However, cats remained uncommon until the Viking Age (c.850–1050 ce), when they were brought by Vikings returning home from travels to the south. In Iceland and elsewhere in Scandinavia, cat skins became a valuable commodity used to make gloves and other garments. According to a law established by the Norwegian King Magnus Lagabøte in 1274 ce, cat skins were a valid means of payment, with the skin of an adult male cat being worth three fox skins. Cats were important for controlling mice and rats both on land and on the Viking ships, but they also developed symbolic value. In Norse mythology, the goddess of fertility, Freya, was described as driving a wagon pulled by two cats (Fig. 1.5). Present-day cats in Scandinavia are often bigger than those kept by the Vikings, probably due to better nutrition and adaptation to colder climates.

Cats around the world

Based on historical records, domestic cats of Middle East origin were present in China during the Tang dynasty (618–907 ce) and in Japan in 889 ce, when Emperor Uda wrote of his joy in owning a black cat. Cats were valued for protecting silkworm cocoons from predation by rats. They are thought to have spread south and east with the early Arab maritime traders. In Madagascar, which had no indigenous wildcat species, domestic cats became the ancestors of today's wild forest cats. This occurred through the process known as feralization, which works in the opposite direction to domestication. Over generations of natural selection, populations of domesticated animals no longer supported by people become increasingly adapted to living in the local natural habitat and revert to wildtype behaviour and colouration. However, this only happens if conditions are favourable in terms of weather, food and ability to withstand native predators.

The Vikings took cats on their travels to Greenland and may have taken them as far as Vinland (now Newfoundland), though no sign remains. Columbus also carried cats aboard his ships. Cats became established in European settlements in the Americas in the 16th to 18th centuries. Cats were brought to Australia and New Zealand by European settlers in the late 18th century, although

possibly earlier by Indonesian traders. In Australia, thousands of cats were released in the 19th century to control rabbits, native rats and infestations of mice at goldmining settlements.

How many cats are there?

Today, the cat is the most popular pet in the world based on numbers owned, with an estimated 373 million owned cats and a further 480 million stray and feral cats (in 2018). The countries with the highest numbers of cats are the USA (74.1 million) and China (53.1 million). The European Pet Food Industry (FEDIAF, 2021) estimates that there are 113 million domestic cats living in Europe, Russia and Turkey, with 26% of households owning at least one cat. There were around 22.9 million cats in Russia, 12 million in the UK and 780,000 in Norway. In the UK, cats are found in about one in four homes, and in Norway, one in five households have a cat. These are only rough estimates, and the actual numbers may be much higher. The estimates vary greatly depending on the methods used to collect the data and do not account for all cats.

The Cat Was Persecuted in the Middle Ages

As we have seen, cats were worshipped in ancient Egypt. They were also admired in Muslim countries, unlike dogs, which were considered unclean. Alas, cats were persecuted by the Christian priesthood in Europe during the Middle Ages. Cats did not conform to the dogma that animals were created to serve man – they were independent and not overly attentive to the wishes and demands of people. This was seen as evidence of their allegiance to the devil. Black cats, especially, were linked to witchcraft due to the belief that witches could transform themselves into cats at night and sneak about unseen doing the devil's work. Single women who kept cats and did not conform to social conventions were easily accused of being witches. In England, hundreds of female cat owners were executed between 1560 and 1700 ce because of friendship with cats. When they were burnt at the stake after sham trials, their cats were often burnt with them. In France, cats could themselves be placed on trial for witchcraft. Cats were burned alive during festivals or, in Ypres, Belgium, tossed from the bell tower. In Japanese mythology, it was thought that a cat's supernatural proclivities were signified by a long tail. To prevent kittens from becoming demons, their tails were cut off.

Perhaps an underlying biological explanation for the persecution of cats lies in their role in transmitting zoonotic diseases such as rabies and toxoplasmosis, and a periodic need to reduce cat over-population. On the other hand, any reduction in cat numbers might have facilitated the spread of Bubonic plague by flea-carrying rats. Clearly, medieval views about cats were steeped in superstition, with people burning cats for good luck while wearing their fur as a cure for rheumatism. Even today, people hold varied attitudes about the habits of cats and many cat owners struggle with their relationships with neighbours and landlords, as we address in Chapter 12.

Emergence of Cat Breeds

Even today, most domestic cats do not belong to any particular breed. They are the product of so-called random breeding by cats that have found their own mates without human intervention.

These cats are termed non-pedigree cats, house cats or, in the UK, domestic short-haired cats. As with feral cats and strays (that are rarely pedigree cats), they express basic anatomical and behavioural characteristics that are not very different from those of wildcats.

During the early stages of domestication, most cats had wildtype mackerel (striped) tabby (Fig. 1.6) or black coats that camouflaged them from wild predators when hunting at night. However, association with people facilitated the survival of cats deviating from the wildtype, such as cats with patches of white fur, a typical signature of domestication. The blotched (swirl) coat pattern referred to as classic tabby (Fig. 1.7) was first noted in domestic cats in Turkey during the early Ottoman Empire (13th century). It subsequently spread to other regions of the world although it did not become common until the 19th century. The other two tabby coat patterns, spotted (Fig. 1.8) and ticked (producing faint tabby markings), probably spread in a similar manner.

The orange coat colour is determined by a sex-linked gene on the X chromosome. So males having the orange allele on their single X chromosome are always orange, while females can be orange if both their Xs carry the orange allele or tortoiseshell (orange mixed with black or tabby) if one X chromosome carries the orange allele. It appears that the

Vikings favoured orange cats and were responsible for their dispersal along trade routes from Miklagard (today's Istanbul) to northern Europe.

The Siamese and Persian are among the earliest known breeds, already distinct several hundred years ago. However, deliberate selective breeding of fancy breeds for specific traits only began in the 19th century when the rules of inheritance became better understood. Five breeds were exhibited at the first cat show at London's Crystal Palace in 1871 while over 40 breeds are recognized today, with the number of breeds varying between breed registries. This number continues to rise. The defining characteristics of breeds can also differ between breed registries and be amended over time. The popularity of cat breeds varies between regions and is influenced by changing fashions and attraction of buyers to novel and unusual traits (Table 1.1). Many of the recently developed breeds have emerged as a result of selection for particular mutations, such as the hairless Sphynx, or the Ragdoll that hangs passively while being picked up.

Genetic defects can easily be propagated when selecting for specific mutations within a narrow gene pool. Therefore, it is important to ensure broad genetic diversity within the breeding population of each breed so that one can breed in a favourable direction in terms of health and behaviour. In Chapter 9 we look more closely at welfare problems that can arise as an unintended consequence of pedigree breeding.

Relationships between cat breeds

Comprehensive DNA studies show that cat breeds can be divided into four main groups based on genetic relatedness: Europe, Asia, the Mediterranean basin, and East Africa, with differences between these populations arising due to geographical separation. The American breeds cluster with the European breeds, in keeping with their European descent. Thus, the Norwegian forest cat is closely related to the American Maine coon, but also to the Siberian cat, a type of forest cat found in Russia. Among the Asian breeds, the Siamese, Balinese and Oriental shorthair are closely

related to each other and are also crossbred today, so they are considered to belong to the same gene pool.

Table 1.1. The most popular cat breeds in 2021.

Rank	The Cat Fanciers' Association registrations (international)	The Governing Council of the Cat Fancy registrations (UK)	Association of Pedigree Cat Clubs (NRR) registrations (Norway)	Cat insurance contracts (Anicom - Japan)
1	Ragdoll	British shorthair	Maine coon	Scottish fold
2	Maine coon	Ragdoll	Siberian	Mixed-breed cat
3	Exotic shorthair	Maine coon	Ragdoll	Munchkin
4	Persian	Siamese	British shorthair	American shorthair
5	Devon rex	Burmese	Sacred Birman	Norwegian forest cat
6	British shorthair	Persian	Norwegian forest cat	Ragdoll
7	Abyssinian	Oriental shorthair	Neva masquerade	British shorthair
8	American shorthair	British longhair	Bengal	Minuet (Persian hybrid)
9	Scottish fold	Birman	Persian	Siberian
10	Sphynx	Russian	Devon rex	Bengal

Around 20 breeds are referred to as 'natural breeds' as they are thought to pre-date the cat fancy of the 19th century, having originally been derived from the local landrace cats in different regions of the world. Nowadays, some of these breeds bear relatively little genetic evidence of their historical roots, having been heavily crossed with other breeds to achieve a certain appearance. For example, based on their DNA, the Persian is placed among the European breeds along with the Exotic shorthair and Himalayan, with other relatives being the British shorthair and Scottish fold. Also found in the European group are the Abyssinian and Somali cats. These breeds are related to the hairless Sphynx cat, which is, in turn, closely related to the Devon rex. Although reputed to originate from the temples of Burma, the Sacred Birman was reconstructed in post-World War II France by crossing two remaining cats with Persian and Siamese cats.

In the Mediterranean basin group, the Egyptian mau is related to the Turkish angora while the Turkish van is more closely related to random-bred cats found in Egypt. The Sokoke falls into the East African group, being closely related to random-bred cats in Kenya.

Cat breeds can differ from each other not only in appearance but also in behaviour, as we shall see in Chapter 3.

The Development of Kittens and Their Relationship with Their Mother and Siblings

The kitten's life during the first months will have a great impact on how it will function as an adult cat. This includes its experiences in the environment in which it lives, and its relationship with its mother, littermates and people. Therefore, the cat breeder has a great responsibility to ensure the kitten has a good start in life. The new owner must then continue to offer suitable experiences for the kitten's further development. For the cat to live in harmony with people, without behaviour problems, it is important to know how experiences of handling, socialization and play affect the kitten's future behaviour. In this chapter we examine how kittens develop. But we must begin before their birth; without heat, mating and a successful foetal period, there will be no kittens.

Heat, Mating and Gestation

Fertility of the cat

Female cats can be very fertile. A breeding female, called a queen, can potentially produce four litters a year, though two litters is more common. After a smaller first litter, three to five kittens per litter is typical up to six years of age, with a slow decline at higher ages. Litter sizes tend to be highest in short-haired, so-called oriental breeds such as the Burmese and Siamese, with one Burmese reported to have given birth to 15 liveborn kittens and four stillborn. Queens are most fertile from 1.5 to 7 years of age, but can have kittens until 8–10 years old, and occasionally after this. One mother even managed to produce two kittens when she was 30 years old. Queens can also become pregnant while nursing an existing litter, especially if the litter is small. All this goes to show that one queen has the potential to produce many kittens during her lifetime.

It is physiologically demanding for a queen to have frequent litters, especially if the litters are large, so best for her health to avoid more than two litters per year. To prevent unwanted pregnancies, contraceptive pills can be prescribed by a vet. However, these should not be given while a queen is nursing offspring, as they may reduce milk production or otherwise affect the kittens. The only solution then is to keep the queen away from males.

We must also consider that when more kittens are born than there are homes to take them, cat over-population quickly becomes a problem. Therefore, if we cannot be sure of finding good homes for all the kittens, a queen should not be allowed to have kittens. To ensure that she cannot

become pregnant, it is safest to get her spayed. Owners of male cats must also take their share of responsibility in preventing the birth of unwanted kittens, not least among homeless female cats, by getting the males castrated.

Heat

Heat, or oestrus, means that a female is receptive to being mated (Fig. 2.1). Female kittens usually have their first heat at 6–10 months of age, but some come into heat by 4–5 months. Male (tom) cats usually reach puberty at 6–12 months but, like females, some may start breeding as early as four months of age. Except for the short-haired oriental breeds (e.g. Burmese), pedigree breeds typically become sexually mature a little later than non-pedigree cats. A general rule is that once a female reaches a weight of about 2.3–2.5 kg, we must expect her to come into heat. She will then cycle at roughly two-to three-week intervals, with the heat typically lasting 4–8 days.

Cats are considered seasonal breeders, being most likely to produce kittens during the spring and summer. If a queen gets less than 12 hours of daylight, she usually does not come into heat.

During long winter nights, her brain produces enough melatonin to suppress her cycles. But as the days get longer with the approach of spring, both males and females become restless indicating that the breeding season (or rut as it is termed for males) is on its way. Indoor cats can come into heat throughout the year if they get at least 12–14 hours of bright light. A heat is also more likely if there are fertile tomcats around, or other queens in heat. When living in social groups, queens can have synchronized heats and, if they then mate and become pregnant, their litters will arrive around the same time.

Normal heat cannot be mistaken. The queen shows clearly changed behaviour both towards the owner and towards male cats. She gets very cuddlesome, frequently brushing her body against our legs and the furniture. She rolls around on the floor and miaows loudly and deeply, attracting visits by the tomcats in the neighbourhood. She often urinates and may mark vertical structures in her territory by spraying urine on them. Unfortunately, this can include us and the furniture. Her urine contains chemical signals, called pheromones, which attract toms. She may suddenly become aggressive if someone pats her on the back. If she reacts similarly to a tom, this tells him that she is not yet willing to be mated. Eventually, she will stand with stiff legs and her tail upright or held to the side, treading with her front paws. This typically occurs about three to four days into the heat period and shows that she is becoming more receptive. If there is a tom nearby, her enticing heat behaviour may be even more pronounced.

However, if a female is young or has a low rank in her social group, she may have what is known as a silent heat, not showing the typical signs of being in heat. While it is not obvious that she is in heat, she can nevertheless still copulate and become pregnant.

Mating

The tomcat starts his courtship by sniffing the queen's head and hindquarters. If she is receptive, she will lie down on her chest, lift her pelvis and swing her tail aside. This posture, called lordosis, is an invitation to the tom to mate with her. He mounts her quickly and holds her by biting the

scruff of her neck. The copulation itself may last for just a few seconds, and when the tom withdraws his penis, the female yowls. She then rushes forward or rapidly swings around towards the tom and hisses or snarls at him. The male pulls back quickly, while the female rolls around on the ground for a few minutes, licks her genitals and miaows. Mating usually occurs multiple times, and the male therefore waits nearby until the female is receptive to another mating – often after approximately 20 minutes.

It is possible for a queen to ovulate spontaneously without mating, especially if a tom is present but prevented from mating. However, most ovulations are triggered by copulation, with ovulation occurring around 24–48 hours later. This is called induced ovulation. The tom's penis is covered with tiny backward-pointing spines that play a role in stimulating ovulation (Fig. 2.2). It is the bit of pain the queen experiences as he withdraws that causes her to hiss at him. Multiple copulations increase the likelihood of ovulation. If there are other toms nearby, they can also mate with the queen. The consequence is that, in a single litter, different kittens can have different fathers. However, queens can be somewhat choosy about which males they will accept. They also show inbreeding avoidance, meaning that they are more likely to reject the advances of a closely related male if other males are available.

Gestation period

The gestation period of cats lasts about 63–66 days on average, but it may vary from about 52 to 71 days. Siamese cats tend to have a relatively long pregnancy. In general, gestation lengths and birthweights are lower in cats having larger litters. If you suspect that your cat is pregnant, a vet can check for this by examining the stomach (abdominal palpitation), or by ultrasound or X-ray. By about five weeks into the pregnancy, you will notice that your cat is getting a typical hanging belly. Pregnant cats can be as active as before, and they can catch mice. In the wild, a feral cat will be even more dependent on her hunting skills as her pregnancy proceeds and she needs more food. Only near the end of pregnancy does the queen become less active. She sleeps a lot and may hide away in places where she won't be disturbed.

Maternal Behaviour

Birth den

When nearing term, the queen will start looking for a suitable place to give birth. She favours a dark and safe place, separate from the activities of people and other animals. It is not uncommon for her to find a place inside a closet, well hidden behind shoes and clothes – or under the duvet, as Bjarne experienced once. This is not so desirable for the cat owner, so it is better to offer her a birthing den that both parties can accept. It should be available a couple of weeks before the expected delivery, as the queen prefers to have this decided in good time.

The birthing den does not need to be a complicated construction, but must be a good hiding-place, well sheltered and with a roof to make it dark and secure. The mother seeks a place that she perceives to be safe from potential predators. Therefore, the opening of the den should be small

enough for only the cat to enter, and not larger animals such as dogs. The cat owner can make a simple nest using a cardboard box of about A3 size (about 30 x 40 cm). Cut out a round opening approximately 15 cm in diameter near one end of the long wall and 5 cm up from the floor. Add newspaper to the bottom to capture the birth fluids, and place clean towels on top of the newspapers. Remember to close the lid, which should be set so it can easily be opened without creating a lot of disturbance. Put the box in a quiet place such as a bedroom or spare room where the door is always open. If the queen does not examine the box you offer, try putting it somewhere else. Keep all your cabinet doors and drawers closed if you do not want them to become the chosen nest site!

Behaviour around parturition

During the final days before parturition, the queen's behaviour will change. If she has not yet found a secluded den, she will look for one in all sorts of unthinkable places. She may become more aggressive towards both people and animals with whom she does not feel completely comfortable, especially dogs. But towards people with whom she is socially bonded, she can become more affectionate and social. Through this behaviour, she distances herself from potential threats to her offspring while remaining open to those she trusts who, under natural conditions, are close relatives such as sisters or her own mother.

When the delivery is underway, avoid disturbing the queen. Cats have the instinctive ability to give birth by themselves. Especially if your cat has a nervous disposition, disturbance may interfere with the natural behavioural sequences involved in giving birth. These include cleaning the newborns, biting through the umbilical cords, providing the first milk (colostrum) and bonding with the kittens. It is important that all the kittens get colostrum within the first hours after birth as it is rich in antibodies needed to protect them from disease. Nevertheless, you can quietly monitor the process from some distance, especially if this is the queen's first litter. A few mothers can 'forget' to bite the umbilical cord. While there is no rush for them to do this, if there are many kittens and the cords become tangled, then we may need to provide assistance. It is best to keep young children, dogs, and visitors away from the kittens for the first three weeks. If the mother perceives too much disturbance, she may carry her kittens to a new nest site.

Newborn kittens soon begin to crawl to find the mother's teats. They do not have to move much because the mother lies down beside them to nurse. If they become too scattered, she will gently retrieve them with her mouth. They just need to crawl a bit, and they will soon find the teats. However, if a kitten is very weak after birth and fails to find a teat, we can gently push it onto a teat to stimulate suckling behaviour. If the kitten does not manage to suck or if the mother has too little milk, we can feed it from a pipette and later, a bottle (Fig. 2.3). This must be done carefully; otherwise, we risk the kitten getting milk in its lungs. We must not use regular cow's milk as this is very different from cat's milk. Instead, buy a milk mix specifically made for cats and give the milk slowly. We need to see that the kitten is able to swallow it before giving more.

A queen will cannibalize stillborn kittens and those born very small and weak. It is rare for her to show infanticide towards healthy kittens, but the potential exists if she is highly stressed for some reason. It is safest to keep tomcats away from newborn kittens, as they can occasionally practise infanticide. This is most likely in the case of a non-resident male who is not a father of the kittens.

With no kittens to nurse, the queen will return to heat sooner, giving him the chance to father her next litter of kittens.

Nursing period

The queen eats much more than usual in the last part of pregnancy. Her body stores fat for milk production after birth. Normally, the queen will not eat in the first day after giving birth, but after this she will eat a lot. A nursing mother with four kittens will usually eat two-and-a-half times more than she did before becoming pregnant. Nevertheless, the nursing period will gradually deplete her body reserves. Studies show that she loses an average of 5–6 grams of bodyweight daily over the course of lactation, depending on the litter size.

The cat mother is active around the clock in the first couple of weeks. The kittens suckle on a regular basis, and the mother takes only brief breaks to eat, drink and sleep. Already on the first day, nursing can occupy a total of 6–8 hours, and by the end of the first week, it is occupying about 70% of the 24-hour day. While nursing and resting with the kittens, the mother often spends time grooming them. This includes licking the area around the anus and genitals, which stimulates the kittens to eliminate urine and faeces. She consumes the waste that they eliminate. This behaviour, called coprophagy, is normal behaviour until the kittens are around 30 days old, helping to keep the kittens and nest clean.

Over the first three weeks, the mother takes the initiative to nurse her kittens by adopting a body posture that gives the kittens easy access to her teats. She mainly lies on her side but, as the kittens grow, she can also nurse in a sitting position. Over the next three weeks, this behaviour gradually declines as she spends more time lying on her belly or sitting in a manner that makes the teats inaccessible. In this way, she controls how much milk the kittens obtain and starts the gentle, slow process of weaning.

It is important to be aware that the kittens suckle eagerly during the first three weeks whether the mother has enough milk or not. Therefore, it is useful to check that the kittens are growing normally. A kitten weighs around 90–120 grams at birth depending on breed and litter size, with kittens in larger litters having lower birthweights than those in smaller litters. The most important thing is that each kitten grows steadily – a weight gain of 10–14 grams per day is typical. A digital kitchen scale with a flat surface, that shows the exact weight, can be used to weigh the kittens individually one or two times a week for the first few weeks. As a rough guide, kittens in litters of three to four weigh about 170 grams after one week,

230 grams at two weeks, 310 grams at three weeks, 400 grams at four weeks, 800 grams at eight weeks, 1200 grams at three months and 1600 grams at four months. However, growth rates vary and kittens in bigger litters tend to grow more slowly. By four months, we can see a clear difference in weight between females and males. While growth rates vary, as long as the kittens are continuing to grow, there is no need to worry. It is also normal for growth to spurt when the kittens begin eating solid food, especially in large litters.

From about three weeks of age, kittens play a more active role in initiating nursing sessions through begging for milk when they are hungry. After six weeks of age, if they don't beg for milk,

they will not get any. Usually, kittens do not need milk after two months, but they enjoy suckling if allowed, and it does not harm kittens to continue suckling. The most important thing is that weaning from milk does not occur suddenly. A gradual weaning process leads to a natural end in suckling motivation. If weaning is abrupt, the kittens may remain motivated to suckle throughout life. This can result in a cat sucking on sweaters and other soft fabrics (see Chapter 11).

After the kittens are weaned, production of lactase stops. Lactase is an enzyme that breaks down lactose, the sugar found in milk. If they are later given milk again – for example because the owner gives the cat cow's milk – they may experience stomach pain because they cannot digest the lactose. Therefore, cats usually prefer to drink water after they are weaned from their mother's milk.

In nature, a cat mother will start bringing home mice to her kittens when they are around three-and-a-half weeks old. By then, the kittens are ready to start eating solid food. Cat owners can therefore start providing food for kittens from 3–4 weeks of age. Use wet food in the beginning, as it takes a while before the kittens can eat dry food pellets. When introducing pellets, you can mix them with wet food for the first days or weeks to provide a gradual introduction to pellets.

The queen must be able to get away from her kittens when she wants to. This becomes more important as the kittens grow older, so she can get enough rest. If the mother is not allowed to go outdoors or even leave the room, give her a shelf high enough off the floor so that she can be inaccessible to the kittens. Keep in mind that by two to three months of age, kittens can easily jump half a metre into the air.

Development of the Senses

Kittens are born quite helpless. Their most important tasks during the first three weeks are suckling and sleeping. To find the milk, they only need the senses of touch, smell and taste, and these senses are well developed at birth. They move their head from side to side as they crawl and when they smell milk, they know they are on the right track. If their nose touches a protrusion on the mother's abdomen, which is normally a teat, the kitten puts its mouth over it and begins to suck. The milk tastes good, causing the kitten to continue suckling – it has now learned where to find milk.

In the first few days, kittens cannot hear or see anything. The ear canals are closed and will not open until after about five days. Therefore, the mother cannot attract the kittens with sound even though the kittens miaow to attract her attention. Instead, she responds to the kittens' calls by licking them. The kittens' sense of hearing gradually improves after five days. Once developed, their hearing range is impressive. It extends from about 48 Hz, which we can also hear, to 85 kHz, which is in the ultrasound range and well above what we can hear. Later, when the kittens start to hunt, their large, flexible ears and ability to detect ultrasound will help them to pinpoint mice and other prey that communicate in ultrasound.

The eyes are also closed at birth (Fig. 2.4). After a few days, you can see small slits between the eyelids. The eyes open fully by nine days, on average, but there is great variation. Bjarne studied

eye opening in 153 domestic kittens. On average, eye opening started at six-and-a-half days but ranged from one to eleven days. The time until complete eye opening ranged from four to thirteen days. Therefore, you cannot use the time of eye opening as a precise measure of a kitten's age. When Bjarne studied what could cause this big variation, he found that kittens who had a young mother up to two years of age opened their eyes earlier than kittens who had an older mother. Female kittens opened their eyes a little earlier than male kittens. If the cats were kept in a completely dark room, the kittens opened their eyes earlier than if there was bright light in the room. But the biggest effect was genetic; some tomcats had offspring that opened their eyes particularly early. In an Italian study, it was found that kittens of oriental cat breeds opened their eyes at five to six days, on average, while Norwegian forest cats did not have fully open eyes until they were nine to ten days old.

Nevertheless, it is not the case that kittens can see perfectly from nine days of age. The eye lens is present but there are still small blood vessels and connective tissue around the lens. This matrix of nutrient channels is involved in building the lens. Its presence causes kittens to have cloudy vision when the eyes first open, but it gradually disappears by about four weeks of age, after which kittens have clear vision. This is also why kittens appear to have blue eyes initially and their underlying true eye colour is revealed later.

Once their eyes are fully functional, cats are more near-sighted than people, but have much better night vision. This is due to a higher ratio of rods to cones in the retina, as well as the presence of a reflective tapetum lucidum behind the retina which causes their eyes to glow in the dark. The kittens' night vision will come in handy for future nocturnal hunting forays, as will their eyes' excellent motion-detecting ability. In the daytime, they can see the difference between blue and yellow-green colours but, like people with red-green colour blindness, cats cannot clearly discriminate red colours.

Behavioural Development

Behaviour during the first three weeks

The cat is a typical altricial species, having off-spring that are born in an undeveloped state and who stay in the nest for a period after birth, rather than following their mother from day 1, as do the young of sheep and horses. During the first two to three weeks, kittens use their legs as paddles to crawl around. This restricts their movement to the nest area. Gradually, their ability to hold their legs beneath their body improves, allowing them to start walking. From three weeks of age, they can move quickly and efficiently, and they become much more active (Fig. 2.5). A new phase of development emerges, the socialization period.

The socialization period: 3–12 weeks

Play is important

Once the kittens become active, they will try out all kinds of movements – jumps, bounces, somersaults and short sprints. This is obviously fun for the kittens and is also an important part of their development. Through this locomotory play, they gradually gain better control of their muscles and develop well-co-ordinated movements. It is amazing how accurate their movements become as they grow up. For example, look at a cat deftly stepping around objects on a shelf without touching them, or elegantly jumping onto a shelf a metre above floor level without jumping a centimetre too high.

As the kittens' movements become stronger and more co-ordinated, their interest in social play (play-fighting) increases. People may participate in these games to some extent, but if a kitten becomes too rough, immediately stop playing, turn away and ignore the kitten. We don't want kittens to get in the habit of biting or scratching people. It is better to offer objects that encourage object play. All forms of play have a central place in the kitten's behavioural development and are fun for them just as play is fun for us. During play, the brain releases dopamine, which is a neurotransmitter secreted in situations when an animal is rewarded or experiences a positive expectation of a later reward (see Chapter 8).

Socialization to cats

Kittens neither experience enjoyment nor thrive if they are isolated from others of their own kind. If kittens are taken from their mother at two weeks of age and live just with people, they will develop emotional disorders. They grow up more aggressive, stubborn and frightened in novel situations. Such kittens are timid towards other cats. If they are taken from their mother and littermates between three and 12 weeks of age, they are also likely to have their psychological development negatively affected. This clearly shows how important it is for kittens to live with other cats during their first few months, and why it is strongly recommended that they stay with their mother and littermates until at least 12 weeks of age.

Just as in dogs, cats have a sensitive period for socialization, meaning that they need to learn basic social skills during this period if they are to behave appropriately in social situations later in life. The socialization period lasts from about three to 12 weeks of age, with social experience in the period between three and seven weeks of age being the most crucial for avoiding behavioural problems in adulthood. This experience is gained mainly through social play. Kittens begin to play with their mother and siblings at three weeks of age and their social play increases to its highest level between eight and 14 weeks of age. Through social play and general interaction in these weeks, they learn more and more details about cat social behaviour (Fig. 2.6). They become familiar with the characteristics of the different individuals with whom they interact. They learn to use their communication signals in the correct manner and context by finding out how others respond to them. For example, through social play, kittens learn to inhibit the strength of their bites and scratches because if they hurt their play partner, the play partner will not want to continue playing and the fun will stop.

Socialization to people

Socialization is important, not only with other cats but also with people. If kittens have no contact with a range of different people before three months of age, they will remain shy of people and be very difficult to tame later. The cat breeder has a great responsibility in this respect. The kittens must get experience of being lifted from the floor and held by humans. They also need to learn what different people look, sound and smell like, and how they behave. This experience can start from about two weeks of age through brief handling by the breeder. After three weeks of age, additional people can be involved, both in gentle handling and in playful activities.

Socialization activities should be enjoyable for the kittens and not forced, as the important goal is that the kittens learn to be comfortable around people and not afraid of them. We also want them to generalize from the positive experiences they have with known people to unfamiliar people who they will meet in the future. Such learning about people involves familiarization with a diversity of sensory stimuli, movements and activities of different people as well as socialization so the kittens learn to behave appropriately around people. Socialization includes learning to inhibit scratching and biting of people, learning to recognize when people are open to friendly interactions such as play, social grooming and resting together, learning to avoid being accidentally stepped on or bumped into by people, and learning from positively reinforced training exercises conducted by people. You can read more about learning and training of cats in Chapter 10.

Experiments show that the most effective socialization is achieved if the kittens have positive exposure to people for 30–60 minutes each day, especially during the period from three to seven weeks. Contact beyond one hour daily gives no added effect. It is easier to socialize kittens if the mother is present and she shows friendly behaviour towards people. If the mother is not friendly, then it is better to socialize the kittens in a different room, but with all their littermates so they provide social support to each other. Kittens that are well socialized to one person will more quickly accept new people, too. Therefore, their social experience can be gradually expanded over the period from three to 12 weeks, so they get to know different types of people, both women and men, children and adults. The kittens will then get a more general understanding of humans. Many cats that have only ever lived with a woman fear men, particularly when they hear the deeper sound of a man's voice. If you are a single cat breeder, please include people of the opposite sex in your socialization programme. If you do not have children, you can invite neighbours to bring their children to socialize with the kittens. Of course, you can also dress up to change your appearance to look different.

Socialization to dogs

The above guidelines for socialization also apply to different kinds of animals with which we want the kittens to be social as adults, such as dogs. As this is to teach the kittens about dogs, it is important that the right dogs are used so they do not frighten the kittens by barking at them or attempting to chase them. It is safest to restrict this socialization experience to dogs that have themselves been socialized to cats when they were puppies, and are trained to be calm and to look away from the kitten to the owner when asked. Initially, dogs should be on a leash or separated by a fence when introduced to kittens and they must be supervised. If kittens are going to a home that has a dog, it is important that the owners have prepared and planned for the introduction and continue to supervise the relationship as the kitten gets older and more active so all the good work by the breeder is not undone by the kitten being chased by the family dog. They may need to ask a

dog trainer or behaviourist for advice (see Chapter 11).

Care should also be taken to avoid introducing diseases to the kittens through exposure to other animals such as cats and dogs from outside the household. Follow your veterinarian's advice regarding vaccinations.

Object play and hunting training

Kittens and many adult cats love running after and catching small, moving objects. Table tennis balls, yarn balls and strings are excellent objects for stimulating object play. Such play occurs from around four weeks of age, but the most active period for object play is from 18–21 weeks. Object play develops hunting skills and is sometimes referred to as predatory play. The kitten learns to intercept the movements of objects and capture them while in motion. For wild-living cats, it is essential that they become competent at this if they are going to eat.

When the kittens are around five weeks old, the mother may bring a live mouse home and drop it in front of the kittens. Their attempts to catch it give them valuable training in catching prey. If the mother is an indoor cat or does not have access to mice where she lives, the kittens will miss out on this early training. This practice in catching prey is continued throughout life, especially when cats are not very hungry. That is why they often do not kill the prey they catch right away but take opportunities to catch and release the same mouse several times. This does not look pleasant to humans (or the mouse), but it is important, if the cat will have to be dependent on catching live prey for its survival.

Object play is the play best suited for people to participate in (Fig. 2.7). Be sure to have appropriate objects, small enough for the cat to move and lift easily. The simplest things we can use are a table tennis ball or the traditional string with a piece of paper or cardboard tied to the end. When you move the string near the cat, be patient. Do not expect the cat to run after it immediately. As we shall see in Chapter 6 on hunting behaviour, cats often prefer to lie in ambush until they suddenly pounce with lightning speed. Part of the fun of play is the surprise element, which you can contribute to by moving objects suddenly in different directions. A string by itself is also an attractive play item. Cats have an instinctive urge to catch long, narrow objects. In nature, they could be small snakes, which cats can be highly skilled at catching, the instinctive urge perhaps being evolved to kill a predator that may be a threat to their kittens.

When can kittens go to new owners?

To ensure that kittens learn what they need to learn about social behaviour, you should not take them away from their mother and littermates until they are at least 12 weeks old. It is a legal requirement in some countries (e.g. Norway) not to separate kittens before 12 weeks of age, and it is also a requirement of some pedigree cat clubs. The FIFe (Fédération Internationale Féline, an international cat fancier society covering 39 countries) has decided to extend this to 14 weeks, effective from 2023. Remember that the third month of life is the peak period for social play between kittens. It is a great advantage if the new owners can make some visits to develop familiarity with a kitten before it comes home with them. This will make the transition to the new

home less alarming for the kitten. Some breeds, such as the oriental breeds, may develop more slowly than others, and many cat experts suggest kittens of these breeds should wait until they are 14 weeks old before they are sold. Also, consider the development of the individual kitten. If growing more slowly than average, you may wish to wait a few more weeks. A recent large survey in Finland shows that kittens transferred to new owners at eight weeks of age are more likely to show aggression towards people and cats as well as other behavioural problems. The fewest behaviour problems were reported in kittens that moved to their new home after 14 weeks of age.

New Home from 12 Weeks of Age – How to Achieve a Good Start

Choosing a kitten – the choir of choice

There is little gender difference in behavioural development before the kittens reach 12–16 weeks. From around 12 weeks, one can observe that male kittens play somewhat more actively than females. Therefore, potential owners who come to inspect a three to four-month-old litter are easily attracted to male kittens when comparing the littermates. But you should not just note the activity level; think about what kind of relationship you would like to have with the cat. If you want a pet, choose a kitten that comes to you and does not object to being picked up and petted. An active male cat may become too independent, but at the same time may be fun to play with. Be somewhat sceptical about the smallest kitten in the litter. Is it completely healthy? If the eyes show secretions, it may indicate an eye infection or, in some Persian cats, improperly formed tear ducts. Is the kitten shy of its littermates? If you want just one indoor cat, this kitten can still be a good choice. If there are dominant cats in your neighbourhood, or you already have another cat, you could be more sceptical about this kitten.

If you are unsure how a new kitten will adapt to your cats at home, you may ask the breeder if you can try it out for a couple of weeks with return rights. During these weeks, you will get a good indication of whether the cats will get along, although they will hardly become best friends in only two weeks. Some breeders agree to such a test arrangement, as they really want their kittens to thrive well in their new home, while others are unwilling due to concerns about introducing diseases to their cattery with a returned kitten.

Knowledge is required

To ensure the proper care of cats, new cat owners are obliged to acquire the knowledge needed to understand their needs. The official owner should be at least 16 years old and have the maturity and competence to be responsible for the cat. Feel free to give children co-responsibility, but parents should not delegate the main responsibility for the animal to a child. This book aims to give you the necessary knowledge to be a responsible cat owner. Cat breeders, or anyone else who sells or gives away a cat, are responsible for ensuring that the new owner has the necessary information to take care of the cat. This includes telling you about the food the cat is used to, what kind of cat toilet and cat litter it uses, typical places where it is used to finding water, any health issues of the cat or its parents, the vaccinations and medications it has received, and particular aspects of the cat's personality and history you should know about. If the cat has been exposed to any unusual

situations, new owners should be told about them as this information can provide an important background for understanding behavioural problems that may occur later on. If you receive no such information, ask for it. Ideally, all animals would come with a manual, like the technical equipment you purchase. The new owner must at least note the address, telephone number and e-mail address of the person supplying the cat and be able to contact him or her if any questions arise, especially if they may be related to the previous experience of the cat.

Be sure to meet the cat in its current residence before buying it, and look at the conditions in which it has been kept. Avoid buying a cat without directly seeing where it has been living. Beware of 'cheap' purebred cats – get them only from reputable breeders.

Anyone selling or giving away a cat must be able to assess potential owners and check that they have the necessary knowledge, attitude and time to look after a cat, and provide them with appropriate advice. If you are in doubt as to whether your cat will do well in its new home, find someone else to be the new owner.

Vaccination, ID marking and neutering

When a kitten is sold or given away at three months of age, it should have already been vaccinated for the first time and labelled with a micro-chip for identification. Cats should be given vaccines according to recommendations of the veterinary authorities in your home country. The most critical ones give protection against feline distemper (feline panleukopenia virus), feline viral rhinotracheitis or cat flu (feline herpesvirus 1), feline calicivirus, and rabies, but there are several others that could also be relevant. A new owner must, of course, receive a certificate of vaccination and proof that the kitten is ID-marked. They must also follow up with booster shots and regular re-vaccinations. Cats are usually quite healthy animals, but your cat may suddenly catch a serious infection. Cat distemper is common and is highly contagious. The owner can bring an infection from outside to indoor cats, so no cat is safe without vaccination.

Some veterinarians propose six months or a bodyweight of 2.5 kg as a general rule for the age to neuter or spay a kitten. Other veterinarians recommend that this be done earlier, at three to four months of age, to avoid unwanted kittens. There appear to be no medical or physiological arguments that speak against this. It is currently unclear whether early neutering weakens a cat's ability to cope with social competition from other cats or increases the risk of behaviour problems.

At the new home

When you are ready to bring a new kitten home, it can be a good idea to bring the carrying basket from your home and leave it in the room with the kitten overnight or for a few hours on the day of collection so that the kitten can start getting used to new smells from your house while still in a familiar place. You can also wipe a cloth or towel over the kitten's mother or let her rest on one that you then place in the carrying basket so you can bring home her familiar scent.

Once you have brought your new kitten home, open the carrying basket but leave it in the room as a safe retreat for several days, after which it can be gradually moved to its final location where it

will remain as one of the cat's resting places (Chapters 10 and 11). Allow the kitten to decide when to come out of the carrying basket – do not force it. Let it sniff and check all the nooks and crannies in any rooms it is allowed into. The kitten will not feel safe until it becomes familiar with all parts of its new home. It must learn where it can sleep, where to find food and water, where the cat toilet is and, not least, possible hiding-places. If the kitten is scared of something, it must know immediately to where it can run and hide. Make sure it cannot get outdoors. In a big house, restricting the kitten to one or two rooms initially will help it to establish a home base. Along with the carrying basket, you may provide a cardboard box as an extra hiding-place. Give the kitten the same type of food and cat litter that it is used to. After a few days, you can allow access to additional rooms, perhaps one at a time.

As important as getting to know the new home is getting to know individuals with whom the kitten will have social contact, both people and other animals. This must be done in a gentle, unforced manner. Do not chase after the kitten trying to catch it, and be careful that children do not do so. Make contact in the kitten's premises and at the kitten's pace – you need to work in 'kitten time'.

Sit down on the floor and wait for the kitten to come to you, but have great patience. The kitten will come only when it feels safe. How long this takes can vary enormously, depending on the personality of the cat, hereditary characteristics and past experiences with strangers. If you have already been visiting the kitten before bringing it home, you have made a good start, but remember that this occurred in the kitten's home environment and probably in the presence of the mother and littermates.

Now everything is new, and some adjustment time is needed.

Keep other animals in the household, both cats and dogs, at a good distance in the beginning. The best thing is to let the new kitten get to know its new home well before it starts meeting other animals; then it will feel safer when it meets them, as it already knows where to find hiding-places and there is less risk that the kitten will panic. Be present in the room when the animals meet for the first few times. Be careful not to allow older cats to attack the new arrival. At the same time, avoid jealousy; give your older cats plenty of play and petting. They must not get the impression that you will replace them with the new cat. If they regard the new one as an intruder who will compete with them for resources, the relationship between the cats can be difficult for a long time. Give all the cats food at the same time, but in individual food bowls placed a good distance apart. It is a good idea to give the kitten its own litter tray, as it may be afraid to enter one that smells of unfamiliar cats.

Once your kitten has become familiar with its new home, you can start some basic training (see Chapter 10). One of the first things to teach the kitten is for it to come to you when you give it a specific signal such as a whistle or calling its name. When it comes to you, reward it with a treat or gentle stroking. It is also useful to train the kitten to walk on a leash.

Many owners will keep their cat indoors, or give them access to a safe, enclosed outdoor area, a catio. Others will want to take their cat out for walks on a leash or let it roam the neighbourhood.

There are advantages and disadvantages to both these choices (see Chapter 11).

A new cat must not be let outdoors before it is familiar with its new home – this may take two to three weeks. It must also have been well socialized to people. This is equally important whether the new cat is a kitten or an adult cat. Nevertheless, a kitten should not go outdoors until it is four to five months old and is fully vaccinated. You must wait longer if there is a lot of traffic or other hazards where you live.

The first few times the new cat goes out, you must go out with it. If you have trained the cat to walk on a leash, you can easily take it out and go for a walk around the house or in the garden (see below for a link to a short video clip showing Ruth's kitten making an early foray on a leash). Otherwise, stay outside the house and let the cat see you while it gradually inspects the surroundings and gets familiar with them (Fig. 2.9). Then the cat learns that the area around the house is your territory, and eventually it will consider this as its own territory, too. If possible, leave a door open so the cat knows that it can escape indoors if it is scared by something. Give your call signal a few times while the cat is outdoors, so it learns where the door is and knows that it is welcome indoors.

The sense of place does not come by itself. The cat will develop good orientation ability as it becomes more familiar with the area and walks further away from home, and then finds its way home again. Therefore, you can gradually give the cat greater freedom, but be sure to stay close by in the beginning so the cat can come in whenever it wants to. Look and listen so you know when it wants to come in, or signal for it to come home if it is getting late. If you have a cat flap in a door, you can now teach the cat to use it. This training should also be done gradually. First, teach the cat to go through the cat flap with the flap taped open. When the cat easily enters through the hatch, close it almost completely and let the cat learn to push the flap up with its head. Once this has been learned, you can close the flap completely. You can read more about the cat's orientation and navigation capabilities in Chapter 7.

When the cat is fully familiar with coming and going and wants to be out for extended periods of the day, it can be out alone during the day while you are at work. Then it will soon learn that you usually come home at a certain time and will be ready to enter the house with you when you arrive home. That does not mean that the cat has been waiting for you all day; cats quickly learn regular routines and while you are at work, the cat is on reconnaissance trips, hunting or resting under a bush. If you approach this stage gradually, the cat will feel secure while learning to master new challenges outdoors.

The Cat's Personality – Individual Variation and Breed Characteristics

Experienced cat owners know very well that you will not find two cats with exactly the same personality or behavioural traits. Cats can be as different as people, and this is one reason why cats are so fascinating. Some characteristics may change with age and there may be gender-based differences in behaviour. There are also marked differences in typical behaviour between cat breeds. As with other animals, and people, cats develop different individual characteristics due to their inheritance (genes), environment and personal experiences. This chapter looks at various factors that lead to the individual characteristics of cats.

What Is the Typical Behaviour of Cats?

In 2014, a survey of cat behaviour was conducted by Silja Eriksen for her Master's thesis in ethology (animal behaviour) at the Norwegian University of Life Sciences. Cat owners answered 99 questions about the behaviour of their cats (the Fe-BARQ survey). The owners scored their cat on a scale from 1 (never occurs) to 5 (always occurs) for each question. Results were received on 1204 cats and the answers were grouped into 22 more general traits.

From the results, we can conclude that most of the cats were quite sociable towards people, seeking contact and vocalizing to attract attention. They were moderately active and playful, and liked to hunt for prey if the opportunity arose, but also rested and slept a lot, as expected for carnivores. Most cats were considered easy to train. They learned to come when called, though did not always do so when motivated to do something else. Some cats had separation problems that were apparent when the owner was getting ready to go out, but few cats had toileting or other behavioural problems. Aggression towards unfamiliar people, or dogs and cats in the household, was quite rare. Aggression when touched or being held was not common if the cat and owner had a good social bond. The graphs in Fig. 3.1 show the response distribution for these behavioural traits. You can see what was typical across the cats in general, but at the same time note that there were big differences between individuals.

Differences in Personality

If two cats show consistent, long-lasting individual differences of behaviour, they can be said to differ in personality. Certain traits tend to occur together, allowing them to be grouped into major personality types. In Austria, the behavioural scientist Kurt Kotrschal and his colleagues have

described four main personality axes in domestic cats: active/ playful; anxious; sociable; and feeding style. The latter concerns whether the cat shows gluttony, which is most common in male cats, or carefully examines its food before deciding whether it is safe to eat, which is more typical of females. Another typical personality difference is whether a cat is calm, not showing much response to things around it, or alert, quickly exploring new things in the environment and paying close attention to what other cats are doing. You can also talk about personality types like *nervous*, *aggressive* and *self-confident*. All cats will be somewhere on a scale for each of these personality types, from very low to very high.

The owner's personality affects their cat Kotrschal and colleagues have also investigated the relationship between the personality of the cat and the personality of the owner, measured across the five domains of human personality (see Chapter 12). *Neurotic* owners have intense social interactions with their cats. They often kiss their cats and are typically very particular about the type of food they give. At the same time, they tend to engage in less object play with their cats compared to more *extrovert* owners. For neurotic owners, the cat is important to them for social support. Cat owners who score high on *openness* participate in more object play with their cat. Their cats tend to have lower levels of fear and tension. They are also likely to be more self-confident and to spend less time exploring new things before deciding if they are safe. To cat owners scoring high on openness, the cat is also a source of social support, especially in the role of a playmate.

Some behaviour traits tend to increase or decrease with age. Older and geriatric cats may become more aggressive towards other cats in the household, and miaow more to obtain something from the owner. They can become less interactive and show more reluctance to be held. They can also become generally less active and playful, less social towards people and unfamiliar cats, and catch less prey.

Old cats may get dementia

Older cats do not generally have more behavioural problems than younger cats, but when they reach 12–15 years of age, some may develop new problems; they may nag their owner more about something, wake up the owner more frequently at night, show anxiety, or start urinating or defecating outside the litterbox. Some may also become disoriented, wander off, stare straight ahead or become more restless. They may show repetition of a behaviour, termed a *behavioural stereotypy*.

Many such behavioural problems can be due to physical illness. Arthritis gives a stiff gait, and the cat typically becomes cautious when jumping from heights due to aching joints. Toileting problems may be due to urinary tract disorders or finding it difficult to get into the litter tray. Other problems may be due to diabetes, cardiovascular disease, high blood pressure or impaired vision or hearing. If your cat suddenly changes its behaviour, take it to the vet for a health check (see Chapter 11).

Several behavioural changes may be associated with *cognitive impairment*. Cats and dogs can develop dementia, similar to Alzheimer's disease in humans. The same changes can occur in the brain, with disturbed nerve function and, eventually, shrinking of the cerebral cortex. Gary Landsberg from Canada has found signs of cognitive impairment in 28% of cats aged 11–14 and

50% of cats over 15 years of age. If the vet can rule out other illnesses or injuries, or an unsuitable environment, dementia may be the cause. On the other hand, old cats may have dementia along with other health conditions.

How can we prevent dementia? Today, there is no effective medicine against dementia, although some preparations may slow down its progress. Instead, we must try to prevent cognitive impairment and dementia through providing mental stimulation and environmental enrichment throughout the cat's life, even when elderly. Give your cat tasks that stimulate the intellect. There are cat puzzles and feeders where the cat has to work to get toys or dry pellets. Engage your cat in object play to stimulate the senses and encourage movement. This is particularly important for indoor cats. If you suspect that your cat has dementia, avoid big changes. Introduce one new thing at a time. The cat may become stressed if exposed to novel objects or situations too frequently.

Sex Differences

At 12–16 weeks of age, male kittens become more active than female kittens. In adult cats, apart from behaviour associated with mating and reproduction, the clearest sex difference found in the study by Eriksen was in sociability towards unfamiliar cats. Here the males scored higher than the females. On average, males also sought more attention and purred more when in contact with their owner, whereas females were more reluctant to be held. This may be part of the reason why people tend to develop a stronger social bond with male than female cats (see Chapter 12). Female cats were more likely to show aggression towards other cats in the household and had a clearer preference for specific rest areas.

Genes and Behaviour

People sometimes ask whether a particular type of behaviour is determined by inheritance or environment. In practice, it is invariably both. All behaviours have a certain genetic basis and are influenced by the conditions in which the cat lives. The genes make it possible for the brain to control the muscles and hormones so a certain behaviour can be performed. Genes also vary in their activity over time and influence the sequence of changes in behaviour as a kitten matures. However, when responding to particular stimuli, the cat's current needs and learning from past experiences influence decisions about when and where to perform particular behaviour patterns. Experience tells the cat in which situations it is wise to perform a certain behaviour.

Some behaviour patterns are strongly influenced by genes, such as how the cat eats, drinks and grooms, and how it mates, gives birth and nurses offspring. There is little individual variation in how cats perform these behaviours. Most other behaviour patterns show pronounced individual differences between cats. These differences are more influenced by specific environmental conditions or experiences. Environmental conditions during the mother's pregnancy can even affect kittens before they are born by altering the expression of their genes. Variation between individuals in the way they are affected by the environment explains why cloned cats with identical genes will not grow up behaving exactly the same way.

In England, Sandra McCune found that the cats that were most friendly to people were more likely to have a father with the same trait, even though they never had contact with their father. This

shows that this trait is related to a specific genetic makeup. Cats with fathers that were more sociable towards people were also less reluctant to explore novel objects. Such studies indicate that there is a relationship between the cat's confidence or boldness and its inclination to be sociable. Socializing involves some risk, and more timid cats usually prefer to be alone.

Several interesting studies indicate that the cat's hair colour is related to its behaviour. This is linked to the genes behind the different colour pigments, which also affect the production of hormones affecting behaviour. Black cats tend to be tolerant of other cats whereas cats that have the red/orange gene variant, such as orange, cream-coloured and tortoiseshell cats, may show a more offensive attitude. These cats are more likely to be aggressive than black cats and may struggle to escape if handled by strangers. In Italy, the ethologist Eugenia Natoli and her co-workers have investigated how cats with different coat colours behave during the mating season. Where there is a high population density of cats, such as in Rome, black males are more successful in obtaining copulations with females than are orange males. While the orange males spend time arguing with each other, the black males are busy courting and mating the females. In rural areas, on the other hand, where cats are spread further apart, an orange male can focus on keeping black ones away from females in heat. This can explain why black cats are more common in places with a high cat population. An aggressive attitude places the orange males at a disadvantage, so they father fewer offspring and orange males become rarer. However, this behavioural difference between orange and black cats is not pronounced and has not been found in all studies (Fig. 3.3).

A relationship between colour and aggression is not only found in cats; something similar is seen when comparing red cocker spaniels with black and other spaniel colour variants, and when comparing farmed salmon with many pigment spots to those with few. An old myth says that red-haired Scottish people are particularly aggressive. Anyway, such tendencies may show up only when we observe many individuals. Orange cats are not always aggressive; many are very pleasant cats, including famous ones such as the streetcat Bob, in England; the library cat Dewey, who lived in Iowa, USA; the tomcat Bolle, in Lübeck, Germany; and the Norwegian cats Jesperpus, famous for accompanying his owner on cross-country skiing tours, and Pusur, a Facebook favourite. There might be a connection here. These famous cats are obviously very self-confident. This self-confidence may form the basis for the competitive ability of orange males in social contests.

Inheritance of behavioural traits

In another Master's thesis from the Norwegian University of Life Sciences, Ingrid Westbye examined hereditary differences in behavioural traits among Siamese and Persian cats. She examined the effect of paternity by having 20 males of each breed each father five litters. The highest heritability was found for the degree of activity and playfulness. The cat's tendency to approach unfamiliar adults or children visiting the family also had high heritability. Among behavioural problems, Westbye found the highest heritability for anxiety or fearfulness when exposed to loud sounds or unfamiliar people. These results are probably applicable to other cat breeds.

Behavioural traits that are desirable for the cat owner and improve the cat's welfare must be considered when selecting breeding males and females. This will have positive ripple-down effects. Behavioural problems will diminish, and cat owners will be more pleased with the behaviour of their

cat. The behaviour will also be more in line with owner expectations.

The international breed standards for cats should also consider cat behaviour. The standards should encourage the selection of cats with lower fearfulness of people and novel environments, higher sociability towards unfamiliar people, and lower likelihood of aggressive behaviour. The latter has already been achieved to some extent, as judges at cat shows may refuse to judge aggressive cats. Because both parents contribute to the temperament of their offspring, cat breeders must carefully consider the behaviour of both males and females to be used as breeding animals.

Breed Differences in Behaviour

In her Master's research, Westbye also described behavioural differences between Siamese and Persian cats and non-pedigree house cats. She found several consistent differences in behaviour between them which are summarized here, but keep in mind that there is marked individual variation within each breed. The Persian cats were calm, showing little fear or anxiety towards unfamiliar people or when hearing loud sounds. Aggressiveness towards people and other cats was rare, and Persians rarely engaged in social conflicts with other animals in the household. Persians often approached familiar and unfamiliar people, though not as frequently as the Siamese cats.

Cats of the Siamese breed were active and outgoing. They frequently approached both adults and children, and they showed little fear or anxiety towards unfamiliar people. They vocalized often when communicating with their owner, greeted the owner often, and frequently visited the owner's lap to be stroked or to rest for extended periods. On the other hand, if there were other animals in the household, they could have social conflicts with them – the Siamese cats demanded attention by their owner and would rather have the owner all to themselves. The Siamese could be somewhat more difficult to houstrain; they were more prone to urinate outside the litterbox than house cats, and they did the most frequent urine marking.

Of the three breed types, the non-pedigree house cats were most likely to go outside when allowed to and roamed the most widely. They were the most likely to encounter other cats in the neighbourhood, which could trigger aggression and social conflicts. They were also the most likely to show aggression towards other animals in the household. They showed the most fear or anxiety towards other cats, loud noises and unfamiliar people, and were the most reluctant to approach unfamiliar adults and children. Their tendency to be more fearful also increased the risk of aggressive scratching and biting. Overall, as might be expected, their behaviour was more reminiscent of that of wild ancestral cats. In Italy, scientists compared behavioural development of the Norwegian forest cat with the oriental breeds (mainly the Oriental and Siamese). When kittens were placed in an unfamiliar environment, the kittens of oriental breeds were more passive and had a higher heart rate than the forest cats, who were more eager to explore the new surroundings.

In her Master's study, Eriksen used the owner reports to examine differences in the behaviour of the most common breeds found in Norway. Table 3.1 shows which breeds scored the highest and the lowest for each of 13 important behavioural traits. As can be seen, the Burmese was ranked the most sociable and contact-seeking, while the Persian, Norwegian forest cat and Egyptian mau were the most sociable towards unfamiliar cats. The most active and playful breeds were the

Bengal, Abyssinian, Oriental, Burmese and Siamese. The Abyssinian ranked highest for aggressiveness, whether towards other cats in the household or unfamiliar people. The Bengal showed the most separation problems and the most fear of novelty, probably because this is a new breed formed by crossing domestic cats with a wild species, the mainland leopard cat, for whom being cautious of novelty is an important survival trait. Scores from an American survey by Benjamin Hart suggest that American Bengal cats may exhibit a wilder nature than those found in Norway, possibly due to strong selection for tameness by Norwegian breeders.

Although Eriksen's survey indicated statistically significant breed differences, the differences were not dramatically large. Is your pedigree cat unlike the breed averages shown in the table? It may well be so, as there is great individual variation within each breed. Therefore, when picking a kitten, watch the behaviour of each kitten in the litter closely. Find one that you think will suit you and your lifestyle. Do you prefer an active, independent cat, or a highly social cat that wants to stay near you? In Figs 3.7 and 3.8 you can see how the most common breeds varied in sociability towards people and in activity/playfulness, with scores from 1 (never) to 5 (always).

On average, the non-pedigree house cats were more reluctant than the pedigree cats to be held by people, and they were more likely to exhibit fearfulness towards unfamiliar cats and dogs. Several studies indicate that these cats, which are more often allowed outdoors than are pedigree cats, may be stressed by things that happen when roaming outdoors and bring some of this stress into the house, resulting in some behavioural problems.

Intensive cat breeding has not been practised for long (only about 60–150 years for many breeds), and it has been directed to selecting for different physical looks rather than behavioural traits. Breed differences in behaviour are likely to increase as systematic selective breeding continues across many generations. Pedigree cat breeders have a responsibility to contribute to the selection of more healthy cats in terms of both physical and psychological health, by reducing breed-specific diseases and anatomical defects and promoting favourable behavioural traits that result in satisfied cat owners.

Environment and Experience

Although genes are important for behaviour, you cannot always blame your cat's parents if the cat has behavioural problems. We have previously considered how important it is that a kitten develops a good relationship with its mother and the people in the household. But the environmental impact already begins at the foetal stage. Research

Fig. 3.6. Norwegian forest cat in its element. (Photo: Maria Myrland, 2019)

Table 3.1. Breeds scoring the highest and the lowest for each major behavioural trait, on a scale from 1 (never) to 5 (always). The breeds are ranked, so the one with the highest score is presented first in the middle column and the one with the lowest score is presented first in the right-hand column. Non-pedigree cats are termed 'house cats' for simplicity. (From Silja C.B. Eriksen, 2014)

Fig. 3.7. Breed differences in the degree of sociability towards people. The scale goes from 1 (not at all) to 5 (very much). The breed codes follow the Easy Mind System (EMS code): ABY =

Abyssinian, BEN = Bengal, BSH = British shorthair, BUR = Burmese, HCS = House cat shorthair, HCL = House cat longhair, MAU = Egyptian mau, MCO = Maine coon, NFO = Norwegian forest cat, ORI = Oriental, PER = Persian, RAG = Ragdoll, SBI = Sacred Birman, SIA = Siamese, SIB = Siberian cat. The bars show the average score and standard error. The number above the breed code shows the number of cats within the breed, based on survey responses from owners. The red line marks the average across all the cats. (From Silja C.B. Eriksen, 2014) on many species – such as mice, rats, foxes, sheep, goats, chickens, salmon and humans – shows that if a pregnant female experiences severe stress during the last third of a pregnancy, this can have lasting consequences for hormonal regulation and behaviour of her offspring. This is called *prenatal stress* and it can cause the offspring to be more anxious, reacting more strongly and for longer to stressful

situations. Learning ability and sociability may be impaired, and the animal may be more nervous in general. In females, this anxiety may also impair the ability to provide consistent care for babies. Thus, stress in a mother can have long-term consequences, not only for offspring but for grandchildren as well. Research in mice shows that when a pregnant mother is severely stressed, this can cause chemical changes in the brain of the foetuses that block parts of their DNA code from being read. This so-called *epigenetic* effect can reduce the production of specific proteins that bind *cortisol*, an important stress hormone, to brain cells in the hippocampus. The hippocampus is a structure in the *limbic system* of the brain that plays an important role in learning, memory and regulation of emotions. The consequence is that, later, when the offspring are stressed and their body produces cortisol, there are fewer cortisol receptors in the hippocampus to mop up the cortisol and switch off the stress response. This results in over-reaction to stressful events, which may be a lifelong trait. Such research is not currently available for cats, but there is no reason to believe that the same mechanism does not apply to them also. The moral is to take good care of pregnant mothers!

Research on mice and rats during the last two decades suggests that we can, to some extent, remedy the effect of prenatal stress if we suspect that it has occurred. If we ensure that the kittens get plenty of opportunities for socialization with other cats and people during the socialization period, and continue with this training as they get older, this should affect their behavioural development in a favourable direction. An enriched environment with plenty of interesting things to do should also help, by enticing them to voluntarily come out of their hiding-places to explore and play. While much remains unclear about how this works at neuronal level, we do know that during the socialization period the brain continues to develop rapidly, hence its importance.

As cats grow older, they are affected by their own experiences, but there is variation in the age when different behaviours are most affected by experience. For example, hunting skills can differ between kittens at two to three months of age, but such differences diminish when they all get more experience. The opposite can occur for social characteristics in a litter where the kittens have different fathers. If a queen mates with two or three tomcats, each of the males may father some of the kittens. Around eight weeks of age, all the kittens may be similarly friendly towards unfamiliar people, especially if their mother is friendly to strangers. However, by 20 weeks of age, the genetic influence of paternity appears, resulting in differences between the kittens in how they respond to strangers.

Sometimes it is important not to judge cats too soon. For example, cats that have stayed in quarantine for some months can be more tame and friendly when they finally arrive at their new home. But if the separation from their owner while in quarantine was a traumatic experience, then after three months in their new home, some of them may start showing nervousness and miaowing when they feel alone. For other traits, differences seen between kittens at an early age do not change so easily. This applies, for example, to activity level, curiosity, boldness and competitiveness, indicating stronger genetic influences on such traits.

The Cat's Language – Communication

The cat's language signals may be the most important aspect of the cat's behaviour, which you must understand in order to develop a harmonious relationship with your cat. Cats expect that we understand the signals they send, and if we misinterpret them we may risk the cat becoming severely frustrated resulting in bites and scratches. Interpreting the cat's language is not as difficult as many think; it is just a matter of knowing what to look for. The signals are made up of many elements and each of them may represent a whole sentence in human language. Understanding your cat is easier if you have some general knowledge about how animals communicate.

How Animals Communicate

Cats and other animals do not communicate in the way that humans do, in that they do not use words. Nevertheless, cats have many ways to communicate so that other cats can understand what they mean at that moment. They communicate the way they are feeling – their emotions and their intentions – what they want to do and what they want from other individuals. In this way, they can influence the behaviour of others in a preferable direction.

The *signal* is the basic unit of communication. A signal is a stimulus sent from one animal and perceived by another that can alter the behaviour of the recipient in a manner that benefits the signaller. It could be a particular vocalization, a tail movement or a urine mark. If the signal is not perceived by the other party, no communication has occurred. Therefore, during evolution, animal signals have evolved to become simple and distinct, so they stand out from ordinary behaviour.

Cat signals are used in communication between a queen and her kittens, regulation of social relationships, competition for resources and courtship. Signals are used when one cat is uncomfortable being close to another cat. We call such signals *agonistic* signals. They can either be part of *offensive aggression*, where the animal is threatening that 'If you do not leave, I shall attack you', or *defensive aggression*, where the animal is instead threatening that 'Although I don't want to fight, if you attack me, I can defend myself with teeth and claws' (see Fig. 4.1). Defensive signals imply that the animal is experiencing fear for its safety. As the subordinate cat displays its defence weapons, these are not signals of submission but of readiness to fight if provoked. If a subordinate cat finds a dominant cat too troublesome, it will run away or even emigrate to another area, as we shall see in Chapter 6. *Flight* is a component of agonistic behaviour, but it is usually not necessary to escape that far to get away from the threat.

Offensive signals are typically given by cats with high social status due to their strong competitive ability, while low-status individuals more often display defensive signals. Such signals minimize

serious fights. Giving defensive signals counteracts attacks by the opponent. There would be no point in attacking the subordinate individual, as such attacks would unnecessarily risk getting hurt. By using offensive signals, a high-status cat can also prevent an attack by a young upstart with little chance of winning a fight. Fights occur most frequently between individuals who have comparable competitive ability, where neither party manages to repel the other with threat signals.

The African wildcat, the ancestor of domestic cats, defends a territory against neighbouring wildcats using agonistic signals. The domestic cat has more flexible social behaviour, as described in Chapter 5, involving more varied use of communication signals. Domestic cats miaow more to other cats than the wildcats, and towards people after separation from their mother. They use signals in adulthood that wildcats only use as kittens towards their mother. The domestic kitten thus transfers its use of communication from the mother to people. Therefore, it is no surprise that cats miaow to communicate their needs. Continuing to perform juvenile behaviour in adulthood is a common phenomenon in domesticated animals called *neoteny*.

It is useful to be aware of what animals usually *do not* communicate. Animals are not likely to signal that they are sick or injured. In nature, this would reveal a vulnerability that could attract predators. Instead, they try to hide such disabilities. We must look for signs of illness or injury in another way. If the animal is unusually passive and there is a change in how much it eats or drinks (less or more) than before, this may indicate a disease. If the animal reacts with aggression or withdrawal when we touch a certain part of its body, this may indicate that the animal has an injury or disease that hurts at this spot. If you notice this more than once, you should take the cat to a vet.

Cats can use sounds, body postures, facial expressions, movements, scents, and touch to make themselves understood. They often use several types of communication signals simultaneously, making their intentions clearer. It is therefore important for the cat owner to listen carefully to the vocalizations and at the same time note the visual signals. We are not able to detect all the different scent signals used by cats, but the odour of urine marking by an intact male will be unmistakable. Some cats are more communicative than others. We must therefore get to know that individual to interpret its intention or emotion correctly. Some may be more vocal and miaow at all hours. For cats who are less vocal in general, even their weak signals may be informative.

Sound Signals - Acoustic Communication

Cats use many types of sounds in their communication with others – purring, miaowing, yowling, growling and hissing. These sounds vary depending on the situation and the individual cat. Most sounds are made using the vocal cords. But cats do not shape the sound with the tongue tip like humans do. Instead, they produce different ‘vowel’ sounds by varying the muscle tension of their larynx, mouth, lips and face. They produce ‘consonants’ by closing or shaping the mouth in different ways that change the resonance. Muscle tensions and the shape of the mouth can be varied on a continuous scale. In this way, they can fine-tune a signal and how strongly it is

expressed, whereas people choose different words or stronger adjectives to adjust their meaning.

Purring

Soundtrack no. 1: purring

www.cabi.org/the-cat-behaviour-and-welfare/

Soundtrack no. 1: purring

www.cabi.org/the-cat-behaviour-and-welfare/

For cat lovers, a cat's purring is usually a relaxing sound. You are happy when you relax on the sofa with a purring cat against your chest. But what is purring really, and why does the cat purr?

Purring is a deep sound produced by muscles of the larynx and diaphragm. The entire chest region of the cat vibrates at low frequency with fundamental frequencies of about 25 and 50 Hz but including vibrations up to 150 Hz. It is thought that a neural oscillator controls these muscle vibrations, allowing purring to continue during both inhalation and exhalation.

Purring is a sound that kittens give when suckling their mother's milk. It signals the mother to keep calm and provide care, which includes giving milk, grooming, warmth and protection. Purring helps to maintain the bond with the mother and is usually associated with comfort and relaxed pleasure. Mother cats also purr when providing care to their kittens in the nest. When very young, the kittens feel the vibrations from the purring and stay close to her even though they don't hear them, as their ears are not yet open. The mother is signalling her desire to give them care.

When kittens and adult cats purr towards people, the meaning is usually the same. The cat expresses that it wishes to relax in close contact with us, whether in our lap or on the sofa next to us. 'Here I shall remain for some time, so keep calm and show me you care,' the cat says. While we don't produce milk, lick the cat or purr, we can provide a safe haven for resting, share our warmth, groom the cat and whisper sweet nothings. The cat has learned to accept our gentle strokes as the equivalent of being licked and our gentle words as the equivalent of purring. The relationship is mutually rewarding. It is not just about taking care from us but also giving care. The cat shows its care for us by purring, presenting its warm belly, and grooming us with its raspy tongue if allowed. The stronger the purring, the more intense is the cat's pleasure. You can notice this while you gently stroke a resting cat.

Although purring is usually associated with pleasurable situations, there is another form of purring that is louder and higher-pitched. Air is pressed through the vocal cords resulting in a higher sound frequency, creating strong sounds around 200–500 Hz. This more demanding purring is not relaxing to humans, but rather to the contrary – it sounds a bit annoying and cannot be ignored. It is a begging vocalization expressed when the cat is frustrated because it wants something it can't get by itself, or feels a more urgent need for care. Some cats direct these 'solicitation' purrs towards us when they have sniffed that there is inaccessible food nearby, or when we have slept in and they want us to wake up and feed them. They usually have the desired effect of cajoling us

into action.

Solicitation purrs can also occur when cats are frightened, ill or in pain. Occasionally, vets experience this. In such situations, purring is not an indication of well-being, but instead indicates that the cat seeks help. Cats that purr in a veterinary clinic are familiar with people and use the purring as needy kittens would when begging for care from their mother. So such purring means 'I need care'. If your cat has been ill and starts purring like this, don't be fooled into thinking that the cat has recovered.

Interestingly, regular purring corresponds to the vibration frequency of medical instruments used for healing injuries and promoting bone density. Since purring is also associated with the release of endorphins - the body's natural soothing, pain relieving hormones - it has been suggested that purring may aid cats in self-recovery from injuries. This may be a positive side-effect, though it is hardly the primary function of purring given that purring is a communication signal used in social contexts and cats rarely purr when alone. Gentle purring by the mother and littermates may contribute to kitten growth and bone density, though this has not been studied.

Miaowing

The cat's miaow is another well-known vocalization of cats. It mainly occurs in kittenhood, in the communication between kittens and their mother. The miaow can be expressed in an incredible variety of ways. Research shows that people who are familiar with cats recognize the meaning of different miaows better than those lacking experience with cats. To understand miaows, we must listen carefully to how they are pronounced by each individual. Fortunately, there are some general rules that can guide us. The American behaviourist Mildred Moelk has contributed to this knowledge through her extensive study of cat vocalizations.

M-I-A-OW - the miaow consists of four syllables. To interpret the miaow, we must listen to which of the four syllables the cat emphasizes - which one is loudest or the most long-lasting - and note if any are missing. Some of these differences are shown in Fig. 4.2.

Mrrr, trill

Soundtrack no. 2: mrrr

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Soundtrack no. 2: mrrr

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The trill, or chirrup, is mainly an *m* sound, the first letter of the M-I-A-O, often without any of the following vocals. This may sound like *mrrr* or *mhrn* and may vary in duration from a short *mr* to a *mhrrrrrn*. It is given with closed mouth. If it starts abruptly, a phoneticist will write it like this: '*mhrn*'. This sound can be heard from a distance of about 12 metres and is much more powerful than regular purring. It is used by confident cats when initiating contact with a social partner. It simply means 'hello'. When the cat wakes up from its chair and approaches us, it can greet us with a *mhrn*

. When returning to her kittens, a cat mother uses this sound to announce her presence.

When the sound starts more abruptly and vigorously, '*mhrn*', it is a short-distance call sound. Then it is often repeated. Not only 'Hello, here I am' but 'Hello, I want contact with you'. The same applies if the *mhrn* sound goes up in pitch at the end. We can indicate this by writing the raised notes as superscripts: *mhrⁿn*. If a cat mother gives this

(m) - i - o - o

mhrn' -a-o-a (purr)

m-i - i - i - a - ou

(c) kHz

6

(d)

(e)

1 sec

4

2

0

m - i - i - o

m-i - a - a - ou

m - i - a - o - o - o - ou

kHz

6

4

2

0

(m) - i - o - o

mhrn' -a-o-a (purr)

m-i - i - i - a - ou

(c) kHz

6

(d)

(e)

1 sec

4

2

0

m - i - i - o

m-i - a - a - ou

m - i - a - o - o - o - ou

Fig. 4.2. Spectrographic images of different miaow types. (a) a mioo or meoo from a lonely, worried kitten, followed by the reassuring response of its mother, a mhrn'-aoa and purring. This is like the mother saying 'Hello, I'm back again; now we can have a nice time together'; (b) a miiiaou or meeeaaow from a cat experiencing an unpleasant or painful situation; (c) a miio or meeo from a lonely or otherwise distressed kitten; (d) a miaaou or meaaow from a demanding cat; and (e) a miaooou or meaaooow from a frustrated cat. The horizontal axis denotes time (the length of *one* second is illustrated) while the vertical axis shows the pitch tone in kilohertz (kHz). Note that miaowing sounds occur in several harmonic series, one octave apart, and can reach a pitch of 50-60 kHz in the ultrasonic range beyond human hearing. sound to her kittens, she may be inviting them to suckle from her.

The cat can also give a stronger 'Hello!!!' by adding vowels to the *mrr* sound. Then it sounds like *mhrraow*. In Fig. 4.2a we can see an example of such use at the beginning of the mother's response; a *mhrrn-ao* where the mother responds to reassure a lonely, worried kitten. Exactly what the cat aims to express in addition to 'Hello!' depends on whether the cat uses a long *a* or *ow* sound (see *miaaao*, *miaoow* and call sounds below).

Miiao

Soundtrack no. 3: miiao

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Soundtrack no. 3: miiao

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A long *e* syllable in the *miaow*, *miiao* or *meeeeo*, gives a whining sound. It can indicate that the cat is experiencing discomfort or pain, meaning 'Ouch! Help me!'. If we accidentally step on the cat's tail, or the cat gets stuck, we may hear this sound. The longer or stronger the sound, the stronger is the discomfort. See an example in Fig. 4.2b.

Young kittens, only a few weeks of age, do not manage to miaow with a diphthong, the *ouw* part of the sound. Instead, they say *miiy*, *miio* or *meeeeo*. This is not necessarily a pain signal. The small kit-ten can also give a marked *e* sound in situations when a juvenile or adult cat would use a marked *a* sound (see below). You can see an example of this in Fig. 4.2c, where a kitten has been briefly separated from its mother and seeks contact with her.

Miaaao

Soundtrack no. 4: miaaao

www.cabi.org/the-cat-behaviour-and-welfare/

Soundtrack no. 4: miaaao

www.cabi.org/the-cat-behaviour-and-welfare/

A long *a* sound in the *miaow* is probably the most typical *miaow* sound, *miaaao*. See an example in

Fig. 4.2d. A long-lasting *miaow* with a marked *a* sound indicates that the cat desires something. It is saying, 'I want something now!'. The *miaow* does not tell us what the cat wants. We must infer this from the context in which the sound is given. If a cat is sitting by the food bowl expressing a *miaaao*, we can understand that it is begging for food – even if there is food in the bowl, it may want something better. Perhaps the canned food is starting to spoil. Cats will naturally avoid food that does not smell fresh. This is a mechanism that prevents them from ingesting harmful bacteria.

In other cases, the cat may *miaaaao* at the front door indicating that it wants to be let out, or in front of us when we sit on the sofa, asking to sit on our lap. It may *miaaaao* while standing by the litterbox, indicating that it wants it cleaned. The longer the *a* syllable in the miaow, the stronger the request. The cat typically starts with a short *miaow*, then *miaaow* and eventually *miaaaow* if the desired goal is not yet reached. If your cat is miaowing with a long *a* sound quite often, and you are sure that it has everything it really needs, this could be because your cat has learned that this is an effective way of getting you to respond to its slightest whims. For example, if you find yourself frequently giving treats or opening the door several times in short succession, you may be pandering to your cat's demands too much, an issue to which we shall return in Chapter 11.

Miaooww

Soundtrack no. 5: miaooww

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Soundtrack no. 5: miaooww

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If your cat begins to lose faith that its wishes will be fulfilled, it will start getting frustrated. The cat signals this by dragging out the closing end of the miaow and we can hear a *miaooww*, as shown in

Fig. 4.2e. This usually drops in pitch – *miaooww*. The longer the *ow*-sound, the stronger the frustration. The cat may have begged for food with a *miaaaao*

without success and now becomes more and more frustrated, and we can hear that the miaow transforms from *miaao* to *miaaaao*, *miaooww*, and finally a long *miaoouuu* – ‘I was expecting food, but it seems that I won't get any this time’. Kittens extend their isolation cries when worried that their mother has not returned, as seen in Fig. 4.2a.

Mngaow

Occasionally, we can hear that the cat puts a *ng* element into the miaow, which then sounds like *mngaow*. This signals a protest over a result the cat is not satisfied with. For example, perhaps the cat has been begging for food and we put down a bowl of freshly boiled fish. We quickly remember that the cat cannot eat scorching hot food and remove the bowl to allow the food to cool down. The cat does not understand this and expresses its *mngaow*. ‘Hello, put the food down again immediately. It's mine!’

Calling miaows

Calling vocalizations typically increase in pitch at the end in an invigorating, expectant way. Such calling miaows can have both short and long *a* sounds, depending on the strength of the cat's motivation to attract another. Male cats use such miaows when they call females in heat, sounding more like a *mowl*. If they have difficulty finding females, they may add a *mrr* sound and make the *a* sound long and deep, yet with an increase in pitch at the end like the typimuch that causes more

complaints about cats than the yowling of tomcats during the mating season (Fig. 4.3). If accidentally coming too close to another male opponent, a tomcat may make a short howl starting with a loud *a* sound followed by a brief closed-mouth murmur. If finding himself facing another intact male of similar size – and visual threat signals do not have the desired effect – a yowling competition will start. It's all about who can make the longest, most powerful yowl. Since the yowl is energy-intensive, it displays the strength and vigour of each cat. The yowl is a type of miaow, where the *an* and *ouw* syllables are drawn out to the extreme and can last for many seconds. The yowl sounds like *miaaaaaaaaaaoooooooooooouw*. The extended *a* sounds in the yowl mark a strong desire for something, namely that the opposing party will go away. The *ouw* sound in the yowl shows frustration when the other does not comply.

If the yowling becomes very strong, the competition may escalate into a fight resulting in scratches or damage to the ears and paws, so this is clearly a type of offensive aggression. Fighting is always a last resort, but this can happen if neither visual signals nor yowling identify a winner. During yowling, the cats can approach and keep their heads just a few centimetres apart. Great courage is needed to tolerate such close-up yowling, but the males are competing for access to females in heat. Mating is a cat male mating call. We can write this as *mhrr ou aaa* priority for a fertile tomcat, so he will not give up others, such as calling males when they are in heat. All cats can use a calling miaow when calling social partners, whether cats or humans. In both wild and domestic cats, cat mothers use a calling miaow when attracting kittens who have got lost. At short distances, a *mhrrn* (greeting) that goes up at the end, *mhrrn*, can also indicate a desire for contact – 'I would love to see you, but where are you?'.

Yowling

Soundtrack no. 6: yowling

www.cabi.org/the-cat-behaviour-and-welfare/

Soundtrack no. 6: yowling

www.cabi.org/the-cat-behaviour-and-welfare/

Whilst both male and female cats yowl as part of their communication with an opponent, there is not until his health and safety are seriously threatened.

Growling

A cat can growl almost like a dog, with a deep murmur with almost closed mouth. Growling

Fig. 4.3. A tomcat expresses his offensive attitude by vigorous yowling while holding his ears slightly backwards. (Photo: Audun Braastad, 2019) implies a warning, and can be directed to cats, other animal species and people. It happens when a cat has a resource to defend, such as its food, or wants to be left in peace for other reasons. It is therefore a type of defensive aggression. The cat says 'Stay away, this is mine' or 'Stay away, I feel uncomfortable when you are so close'. If the cat needs to make this point even stronger, the growling can grow into a powerful miaow: *grrrrraao*. If

the recipient does not respect this growl, the cat may attack as a defensive response. People can only blame themselves if they get bitten when not respecting the cat's desire to be left in peace.

Hissing and spitting

Hissing consists of air pressed out of an open mouth without use of the vocal cords. It is typical of snakes and cats. Hissing is used as a defensive signal, especially among cats that are cornered and cannot escape. Never touch a cat that is howling, growling or hissing. If you do, you can experience powerful bites and scratches as the cat tries to defend itself. The cat has warned you and you are responsible if you do not heed the warning. Slight hissing can already be seen in newborn kittens when picked up by people. They open their mouth abruptly and repeatedly, as is the case in hissing by adult cats, but are unable to blow out any air.

Spitting occurs when a cat suddenly opens its mouth and blows a loud noise, again without using the vocal cords. It may sound like an abrupt *the*. It is a quick defensive warning that the cat gives if startled by the sudden appearance of an unexpected opponent. The intruder may also be startled by this abrupt sound.

Chatters and chirps

The chatter is a staccato, rattling sound, like a rapidly repeated *ke-ke-ke*. Cats make this sound by clacking their teeth, but chatters can be accompanied by voiced elements as well, such as chirps. Cats occasionally chatter and chirp when they see prey at a rather short distance. The most typical situation is a cat who sees a bird sitting on the other side of the window. It appears that these sounds may lure prey by mimicking their sounds, or that of insects the birds eat. Perhaps the cat thinks if the bird came even closer, it would be able to catch it. Outdoors, these sounds may be given as a 'Come hither!' when a potential prey is just out of reach. If the sound attracts a bird to hop a little closer or, at least, relax its vigilance and wander closer, the waiting cat could launch a successful attack. A cat does not vocalize to other cats when hunting. Hearing those types of sounds would alert prey to the danger. Chattering may also indicate the cat is feeling a degree of frustration (see Chapter 8).

Body Language – Visual Communication

The body language, or visual communication, of cats was thoroughly explored by the German ethologist Paul Leyhausen. His classic book about wild and domestic cat behaviour has been translated into English and is well worth reading for those interested in detailed descriptions and explanations of cat body language. Leyhausen found that cats can simultaneously show signs of two opposing behavioural tendencies by displaying both defensive and offensive signals at the same time. These signals involve body postures (including the tail), which provide general information about the cat's mood and behavioural tendencies, and facial expressions (including the ears), which provide finely tuned, rapid information about moment-to-moment changes in motivation. Therefore, to correctly interpret your cat's intentions, you must note the body posture and tail movements while directing your main attention to the head and eyes, and especially the ears.

Facial expressions

The famous Austrian ethologist Konrad Lorenz once wrote that 'few animals show their moods by means of facial expressions as markedly as cats do'. In Fig. 4.4, you can see what different facial expressions mean. The most non-aggressive cat face is shown in the top left. The diagram has two axes – a horizontal, offensive, axis and a vertical, defensive, axis. If we go to the right of the chart, we see faces showing a gradually increasing *offensive tendency*, that is increasing motivation to attack if necessary to repel an opponent. What do we see then? The ears are swivelled around until they point backwards. Displaying the backs of the ears is a strong offensive signal that shows that the cat is ready to attack. In lynx and tigers, the back of each ear has a bright white spot surrounded by a dark border, making it easy for an opponent to notice that the ears are back even at night.

Increasing offensive tendency

Fig. 4.4. Facial expressions, showing different combinations of increasingly offensive signals (towards the right column) and defensive signals (towards the bottom row). See the text for further explanation. (After Paul Leyhausen, *Verhaltensstudien an Katzen*, Verlag Paul Parey, Berlin, 1956)

Domestic cats almost always have single-coloured ears, but the 'ears back' signal nevertheless means the same: 'There is a great chance that I will attack you if you do not go away right now'.

If we go *down* the chart, we see faces with a gradually increasing *defensive tendency*. Now we can see that the ears are more and more flattened towards the skull. The more the ears are folded down, the stronger is the motivation to defend the body from attack. The cat at the bottom left has flattened its ears so much that they are almost invisible. When cats flatten their ears, their defensive signals cannot be interpreted mistakenly as offensive. This reduces the risk of provoking a dominant cat to attack them unnecessarily. A highly defensive cat will also open its mouth, signalling its readiness to bite if attacked.

Also note the size of the pupils. The most defensive face, shown in the bottom left, has the widest pupils. This is a sign that the sympathetic nervous system has been activated, with excretion of adrenaline from the adrenal glands. This stress response means that the cat is alert, scared and mobilizing energy to defend itself if this becomes necessary. At the same time, we usually see that the hair rises on the back of the neck, called *piloerection*. In a shorthaired cat, this makes the cat look bigger, which may help to deter an attack. In contrast, the purely offensive cat at the top right is confident and does not need adrenaline to claim its interests. Be aware, however, that the pupils of all cats will open more widely at night, as this allows them to see better in the dark – this is a reflex unrelated to adrenaline release. The pupils may also widen in other situations, such as when a cat is playing or hunting a bird. The four drawings in the lower right part of Fig. 4.4 show intermediates between offensive and defensive signals. These cats are partly offensive and

Increasing defensive tendency partly defensive, and are in doubt, or conflict, about whether to attack or defend themselves. By looking at how turned backwards the ears are, and how flattened down they are, we can see the relative balance between offensive and defensive tendencies. The cat at the bottom right is the most conflicted. In this state, it might do something unpredictable, or

perhaps attempt to calm itself by doing something irrelevant to the situation – a displacement activity (see Chapter 8).

Lip licking

A clear indication that a cat is worried or anxious can be seen when it quickly licks its lips two or three times, while closely watching another animal, person or object of concern. This suggests that the cat's mouth has become dry out of fear, as happens also to people when stressed. Normal licking of the mouth, as seen after the cat has eaten, is much calmer and more carefully directed.

Body postures

Increasing defensive tendency body postures using a diagram with an offensive axis and a defensive axis. The drawings in Fig. 4.5 show cats exhibiting offensive and defensive tendencies to varying degrees. We see a non-aggressive, relatively relaxed body posture at the top left, with increasingly offensive tendencies towards the right column and increasingly defensive tendencies towards the bottom row.

When assessing the cat's intentions, pay attention to the distance between the body and the ground. The more offensive a cat is, the more upright the cat will be. On the other hand, the more defensive the cat, the lower it will crouch. The head, particularly, will be held low. On the bottom left, we see a purely defensive cat. It is close to the ground, with its tail tightly tucked between its legs and flattened ears. The confident cat at the top right shows pure offensive signals, with raised body, straight legs, the tail down and the ears back. Such a cat will display the side of its body to the opponent rather than just the front. This lateral display shows off its big body: 'Look at me! I'm huge and strong. You should go away for your own safety.' Note how this visual communication signal to another cat differs from the body posture of an alert cat engaged in a non-social type of offense, the hunt (Fig. 4.6).

Increasing offensive tendency

Fig. 4.5. Body positions, showing different combinations of offensive signals (to the right) and defensive signals (downwards). (After Paul Leyhausen, *Verhaltensstudien an Katzen*, Verlag Paul Parey, Berlin, 1956)

In a social contest, a somewhat arched back and partially raised tail indicates mild conflict between approach and withdrawal. The conflicted cat on the bottom right of Fig. 4.5 has the most arched back, showing that the tendencies to attack and defend are both strong. Leyhausen describes what is happening as a conflict between the front half and the back half of the cat. The cat has a fighting spirit, but the front end of the body closest to the opponent is retracted for safety. The centre of gravity moves backwards, making it easier to escape from the opponent if suddenly needed, bending the spine into an arch (Fig. 4.7). Suppose a mother cat with kittens nearby is facing a scary dog. She would love to chase away the dog but does not dare. Escape is out of the question, as she does not want to desert her offspring, so she stays and makes the best of it. She may also raise her tail, showing that she doesn't want to fight. Below, we explain other social contexts

involving a raised tail.

Great boldness is required to launch an attack because it is easy to get wounded in the heat of battle. When two similarly matched cats are in a dispute, each cat carefully evaluates the resolve of the other, watching for tell-tale visual signals from the face, ears, eyes, tail and overall body posture. They are also evaluating the sound signals, especially the yowl, as described earlier. In this battle of nerves, the balance of power is on a knife-edge and a moment's loss of concentration, or an impulsive signal, can cause the other to attack. All movements are very slow to avoid provoking an unnecessary attack. From time to time, the hindquarters of one or both cats may slowly sink down (see Fig. 4.8). This seems to act as a signal of ceasefire, giving the cats a much-needed thinking break. If one cat exposes its teeth, it becomes clear that it is more defensive than the other. Usually, defensive signals are respected, and the more confident cat will not attack. This cat's dominance has been recognized and it can proceed to other important tasks.

Fig. 4.7. This cat arches its back, displaying conflict between offensive and defence motivations. The ears are erect, showing that the cat is not very frightened at the moment. (Photo: Maria Myrland, 2019)

Fig. 4.8. Two equally matched cats in a ceasefire. Both have their ears turned somewhat backwards and lowered hindquarters. (Photo: Bjarne O. Braastad, 2011)

Rearing

Fortunately, the cat uses its body language not only in conflict situations but also when approaching a friend. It may then lift both front paws up off the ground for a couple of seconds, assuming a more vertical posture, and then put them back down again. If greeting a person, the cat may also rest the front paws briefly against the person's legs while rearing.

Lifted paw

You sometimes see that a cat suddenly stops and lifts a forepaw, the paw hanging in a relaxed way. The cat looks like it is concentrating, perhaps attending to a sound or odour that has caught its interest. A dog will do the same. This is referred to as an *intention movement*. The animal shows its intention to move on but pauses to evaluate if this is wise. It is saying 'Hey, what was that?'. It indicates mild conflict over what to do next.

Exposing the belly

If you stroke an unfamiliar cat on its belly, you can quickly get a scratch. The cat aggressively defends its belly using its claws if it does not feel completely safe with those nearby. This is an important survival response that protects the body's most vulnerable region. The abdomen is not covered by bones and an injury here could fatally expose vital organs. The chest has some protection from the ribs, and the head is well protected by the skull, so cats more easily accept strokes there.

However, when a cat has full trust in you, it may roll over on its back and present its belly, like a mother cat presenting her udder for suckling by her kittens. This is an invitation to gently caress the belly. If the cat is unknown to you, be careful not to reach for the belly if it rolls on its back as it is probably doing so just to scratch its back.

Tail signals

Tail up

A 'tail up' signal involves a stiff upward motion that lifts the tail quickly until it is more or less straight up. This is a greeting signal that can be addressed to both cats and people. It is usually accompanied by a slightly curved back and a greeting sound *mrrrt* or *mhrrrn*, that rises in pitch at the end. The cat can use this as a short greeting even if it is just passing by. Then we see the tail go up and down again after a couple of seconds, without any sounds. This is a 'Hi' in passing. The cat has seen us but is not seeking to make close contact at the moment.

The 'tail up' is a signal used by kittens when greeting their mother, and adult cats use the same towards people and other friends. It can be the start of a more elaborate greeting in which the nose is rubbed against the cheek or body of the one being greeted. Kittens do this to their mother when they are hungry. Adult cats direct this greeting to cats of higher social status, signalling their friendly intentions.

Tail over the head

Sometimes you can see a male cat walking with lifted tail, but with the tip of the tail tilting forward towards the head. This is a sign of high self-confidence. It may be a signal to females that it is high-ranking, and a signal to less confident males that they should stay away. At a lower degree of self-confidence, a cat can hold the tail partially lifted. In juveniles, when the tail is tilted forward, it shows that they feel safe in their surroundings and may be playful.

Lashing tail

This is a common tail signal and means something completely different from the dog's tail wagging. It consists of rapid jerks of the tail from side to side and shows that the cat is annoyed. The stronger the lashes, the stronger the irritation. Often, this signal is accompanied by other body signals that indicate irritation, or growling. The cat wants to be at peace and if we do not respect this, the cat may suddenly bite.

Slight tail movements

When resting, if something disturbs a cat, or if it does not feel completely safe, we may see small twitches of the tip of the tail. This is a warning that, while the cat looks relaxed, it is alert and ready to react if necessary. If the cat becomes drowsy or falls asleep, these tail movements will stop. But if the cat is in our lap wanting to sleep and we keep touching it in ways that keep it awake, the tail

movements can become stronger, and may even develop into tail lashes. In the end, the cat may suddenly bite our hand, not hard, but as a warning. The cat has had enough and is telling us, 'Stop! Don't you understand that I want to sleep?'. This can be startling if we thought the cat was resting contentedly. From the cat's perspective, the cat asked us to stop when it was twitching its tail and we ignored the signal, so it gave a stronger signal.

Tail rub

Sometimes you can feel that the cat swings its tail against you, perhaps twisting it partly around your leg or cheek. The cat uses its tail to caress you. Occasionally, this friendly signal will be followed by rubbing its cheek against you. In addition to the visual signal, this behaviour can involve scent and touch signalling (see below). The cat usually gives such signals only to close social partners, so we must regard this behaviour as a statement of great trust and desire to maintain a close relationship with us.

Odour Language – Olfactory Communication

Like many mammals, cats use their sharp sense of smell to receive important messages. The odour language, or olfactory communication, involves production of specialized chemical signals, called *pheromones*, which are perceived by other cats and influence their behaviour. Whereas hormones convey chemical messages within the body, pheromones take chemical messages out into the environment where they can be detected by other cats. They can be delivered via urine, faeces, footprints, udder or by rubbing their head and body against objects. When odour molecules are sniffed by other cats, they attach to cells in the nose. From there, the signal is passed along nerves to the olfactory bulbs of the brain for processing. However, unlike us, cats also have a whole other system for processing pheromones, which we describe in the next section.

Urine marking

A cat can urinate in two ways: using the regular squatting posture or standing upright with elevated tail to send small squirts of urine straight backwards. The first method is for eliminating waste products from the body, and cats usually cover this urine. It is the second method that is mainly used for olfactory communication. It is termed *urine marking*, or *spraying*, and we notice it only too well when an intact tomcat has been urine marking. The strong odour comes from glands located by the urinary opening. The secretions from these glands are released into the urine stream during urine marking and in intact males, they have a particularly pungent odour. Urine marks are usually directed towards prominent vertical objects such as trees and walls, making it more likely that other cats will find them. While they can smell them from a distance through their nose, close-up investigation allows cats to use another odour-processing system to learn more about the cats who produced them.

One can see that after carefully sniffing another cat's urine mark, a cat will partially open its mouth, raise its head and lift its upper lip. This is called a *flehmen response*. The movement of lifting the lip causes two tiny ducts to open in the roof of the mouth, allowing the odour cocktail to enter a specialized organ called the *vomer nasal organ*. During flehmen, the cat may also flick its tongue to direct the odour into this organ. The vomer nasal organ contains nerve cells that transmit signals to the accessory olfactory bulbs of the brain. This part of the brain works like a chemical laboratory to process pheromones. Horses and cows have the same mechanism. However, while we may screw up our nose when we smell something unpleasant or breathe in deeply a pleasant smell, we do not have a functional vomer nasal organ.

Both males and females can urine mark and show flehmen, though these behaviours are more commonly seen in males. Tomcats often urine mark when they are courting a female cat in heat. Their urine has a high content of the amino acid felinin, a substance that smells strongly and is believed to signal the male's skill in finding high-quality food. Therefore, the urine marking behaviour is probably sending a message about how successful he is – the tomcat's way to boast to the females and convince them to mate with him. Males also show flehmen when sniffing the urine of females, which contains pheromones telling males when they are in heat. It is *not* common for males to urine mark or perform flehmen as part of a face-to-face confrontation with another male.

Faeces can also be used as a scent mark. Then cats deposit faeces in open places where the odour signal can spread well. When cats want to conceal their presence, they carefully cover both urine and faeces with soil or litter. If none is available, they may scrape the floor for an extended period in an unsuccessful attempt to bury the excreta.

In many animal species, individuals use olfactory communication to mark the boundaries of their territories, but in cats, urine marking acts more like a business card. Cats do not treat scent marks as territorial boundaries. By sniffing the mark and performing flehmen, the cat can identify *who* was there and how long ago the mark was deposited. The scent contains distinctive characteristics of the individual cat. While cats may still be able to detect a scent mark seven days later or even more, Jaap de Boer in Amsterdam showed that fresh urine marks deposited within the last four hours receive the most sniffing and flehmen responses. Because different substances in urine break down at different rates, the chemical composition of a mark changes over time, providing information about how long ago it was deposited.

Pheromones play an important role in the social system of cats. As soon as a cat goes outdoors, it will sniff around to check if other cats have been there. Then it will probably know both who and when, so the cat becomes updated about the cat traffic in its neighbourhood. In Chapter 5, on social behaviour, we shall see how cats use such knowledge in regulating their movements. Some insecure cats may even use urine marking in an attempt to attract an owner who has been away for a longer time than usual, though this is futile as well as being unwelcomed by people.

Scents from skin glands

Cats have many other ways to send olfactory signals besides urine marking. When they scratch on a post, they are depositing pheromones from glands between their toes, called interdigital glands (Fig. 4.9). Rubbing against objects such as poles, trees, chair legs or trousers results in transfer of

pheromones from glands in the corner of their mouth, cheeks, mid-forehead and the root of the tail. Sweat glands around the teats of nursing mothers produce a pheromone that appears to have a calming effect on kittens. Synthetic versions of some cat pheromones can be used to calm down cats, which could be helpful when addressing problems with tension and conflict between cats in the household. (Read more about how to solve behaviour problems in Chapter 11.)

The composition of odours produced by the body is influenced by genetics and by diet. Therefore, closely-related cats and cats eating the same type of food have similarities in odours that cause them to seem somewhat familiar to each other even if they have never met before. They may be quicker to accept such cats as friends than other strangers that smell more different. In addition, cats learn to recognize the odours of the other members of their group and distinguish them from strangers. They pay particular attention to the scent marks of unfamiliar cats, especially intact males, presumably attempting to learn as much as possible about them before encountering them face-to-face. When two cats first meet and eventually dare to approach each other, they want to sniff each other, first at the mouth, then the cheek, body and back. Sniffing the hindquarters is often not allowed, as it feels unsafe to have a stranger behind them. The smell of close group members often seems comforting to cats. This may explain why they love lying on clothes that belong to their owner, especially when the owner is out.

There is still much we don't yet know about cats' scent language. As we do not distinguish the differences between their scents in the sophisticated way that they can, it is not easy to investigate this topic. We do not know if the different glands around the head give the same signal, or if rubbing the cheek sends a different signal to rubbing other parts of the body. Cats often deposit scents from several glands in succession, such as when rubbing with their mouth, cheeks, head and tail, and some suggest that they just use the most accessible part of the body for scent marks from skin glands. This would imply that the information is more-or-less the same: 'This is how I smell'. However, the cheek glands alone may include several components, each with a slightly different meaning.

Fig. 4.9. When a cat scratches with its claws, it deposits pheromones from glands between the toes. (Photo: Nina Svendsrud, 2019)

Touch Language – Tactile Communication

When a cat rubs itself against another cat or person, touch language is involved. This is called *tactile communication* by ethologists. Among cats, rubbing is probably a means of ingratiating themselves with other cats. Kittens rub more against adult cats than *vice versa*, and female cats rub more against male cats than *vice versa*. They are saying: 'Be nice! I want to be with you'. When a cat rubs against us and we respond by gently stroking it, we are accepting the invitation. Through this tactile contact, both parties are depositing scent on each other. The mixture of individual scents shared between group members creates a familiar group scent that cats perceive as showing that they belong together.

Another important form of touch comes through *social licking*. In contrast to rubbing, it is usually a more dominant cat that directs licking towards a more subordinate one. Licking signals care. When

the mother cat returns from a hunting trip, she informs her kittens of her presence. If the kittens are younger than five days and the ear canals are not yet open, she cannot give them *mhrn* or miaow sounds even if the kittens give distress calls, *miiiy*, because they are cold or hungry. The queen licks the kittens before lying down to nurse them. They associate this licking with milk and comfort as the queen also grooms them while nursing, and they quickly settle down to suckle. Similarly, if a cat hesitates to accept the food we offer, it is more likely to start eating if we gently stroke it. We can avoid interrupting the feeding session by only continuing the stroking for a short while as it eats, before slowly withdrawing our hand. In this way, we use the touch language of cats to achieve our goal.

Communicating with Cats

In the sections above, we have pointed out several cases where we can use our knowledge of cat signals to communicate with cats in their own language. We must consider the message we want to give and ask ourselves how the cat would convey the same message. We can call our cat with a *mhrn* or miaow, increasing the pitch at the end. We can 'smile' with half-closed eyes and accept its presence with gentle stroking. Of course, we cannot have detailed conversations with cats using human words. Nevertheless, cats can learn to understand specific words, such as their name. They can learn how we want them to respond when we give a specific signal as long as we train them appropriately, as we explain in Chapters 10 and 11.

When we encounter an unfamiliar cat with whom we wish to make contact, we should not just go straight up to it and touch it. Many cats will perceive this as a threatening situation and run away. You must first *greet* the cat and announce that you have no aggressive intentions. Sit down to get closer to the cat's height, slowly extend a paw (hand) towards the cat and let the cat sniff it while you talk with a welcoming sound that goes up in pitch at the end. If the cat shows defensive signals, be particularly patient. Let the cat approach you when it feels safe enough to do so. Then you can stroke it gently on the cheek (Fig. 4.11), on the head and eventually on the flank, but avoid its back and hindquarters until it knows you better.

When looking at a cat's eyes, it is not only the size of the pupils that can provide useful information;

Fig. 4.11. Then you can gently stroke the cat on its cheek. This baby has already understood this. (Photo: Agnethe-Irén Sandem, 2019)

Fig. 4.12. When a cat approaches you with half-closed eyes, you can rest assured that it has good intentions. (Photo: Audun Braastad, 2019) the position of the eyelids is also important. If a cat stares at you with wide-open eyes, its head slightly lowered and back slightly arched, it is sending you a threat signal. This means 'Do not try something stupid or you'll be in trouble'. Halfclosed eyes, on the other hand, send a friendly signal showing that the cat accepts your close presence (Fig. 4.12). Therefore, when you meet an unfamiliar cat, it is important not to stare. First, look slowly away from the cat before turning your gaze back towards its face. While doing this, close your eyes halfway before making eye contact. When you are looking at each other, blink your eyes repeatedly but slowly; keep your eyes shut for a second each time and only half open your eyes

between every blink, sometimes moving your gaze away to the side. If the cat responds with the same eye signal, it has calmed down and accepted your presence. Now you can go one step further and offer your hand for sniffing.

The *blink signal* can be used when talking to your own cat as well. It will help strengthen the bond between you. You can use this signal, blinking markedly a few times, if your cat becomes anxious for some reason, for example due to sudden loud sounds or lightning. It will serve as a calming signal and show the cat that you do not detect any danger. This can work well with other animal species, too, such as dogs and cattle.

Bjarne has observed that both his previous cat and the present one seem to react instinctively to a smooth whistle tone of around 440 Hz (an A note in music). As he calmly gives a long whistle at this pitch, the cat stands up and approaches him as if in a trance. It seems to be a calling signal. Perhaps the kitten's *miao* to attract its mother is most effective if it has a fundamental tone around A, possibly with higher octaves. You can try this on your cat. You may need to vary the tone somewhat, as the optimal pitch may vary between cats.

If we provide signals that our cat does not understand, we have not communicated with the cat.

All too often, animal owners scold their cat or provide other signals that are not recognized by the cat. The result is a confused or insecure cat. To signal to a cat that a particular behaviour is unacceptable, we must use the principles of proximity in time and space during training. Our reaction must come immediately after the cat's unacceptable behaviour, and the cat must still be in the same place. The cat can then make the connection between its behaviour and our reaction. If the cat has defecated on the carpet in the living room and you come home an hour later and scold the cat as it approaches you to greet you, you will be punishing the cat's approach and not its actions an hour previously. Your cat may interpret your behaviour as social rejection. Is it strange that the cat then gets confused? However, it is better not to punish your cat as this is not a very effective training method and places your social relationship at risk. You will learn more about this in Chapter 10.

Social Behaviour of Cats

It is a common belief that the dog is a social animal while the cat is an unsocial, selfish animal that prefers to walk on its own. This is only partially correct and applies best to wild-living cats in areas with a low-density cat population. If cats were unable to live socially, they would not be successful as companion animals. In fact, all animals are selfish to some extent. When they co-operate in a group, it is because the benefits they receive outweigh the costs. This chapter considers how cats can live in a community of cats – outdoors or in the home. The English ethologist David W. Macdonald and co-workers have conducted a particularly nice, longterm study of cats living in social groups in the English countryside. Both this and other research helps us to understand how owned cats respond to others they meet outdoors and how it is possible to have more than one cat in the same household without frequent aggression between them. In Chapter 12, you will learn how cats adapt to a social life with people to the benefit of both parties.

Basics of Social Behaviour

We must first explain three ethological concepts: territory, home range and personal space, to better understand the dynamics of cat social behaviour. These terms apply to animals in general, including cats.

Territory

Some animals establish and live within a territory. A territory is an area used almost exclusively by a particular animal or social group and defended against intruders of the same species. The territory contains all the necessary resources for living, such as food and water, and safe locations for resting and giving birth to offspring. Territories usually don't overlap, and territory holders regularly patrol their territorial boundaries to check that no intruders are trespassing or watch their territory from a lookout (Fig. 5.1). They may also deposit scent marks along the boundaries warning others to stay out. A territory is vigorously defended, and any foreigners who enter the territory are chased away. Territory holders usually succeed in this defence. They have the most to lose and are familiar with the area, which boosts their self-confidence. Confidence declines with increasing distance from their own territory and great boldness is needed to enter the territory of another.

Cats can be territorial, but they do not generally defend the whole area in which they roam or specifically mark territorial boundaries. Instead, they deposit scent marks in places they habitually use, such as urination and defecation sites, sleeping sites and along pathways (see Chapter 4). In areas with a low cat population, free-roaming cats sometimes have non-overlapping living areas, which do not need to be defended as territories. In areas with a higher density of cats, the residents may defend a small territory but share more peripheral hunting grounds with others. At even higher densities, they tolerate the presence of others throughout their living area but may

defend specific resources such as a food bowl or nest site. This is called *local resource defence*. Intact, free-roaming tomcats move over larger distances than do females, covering an area that can include the living areas of multiple females. They may defend a small territory during winter but spend too much time away to defend one during the breeding season. Then, they engage in local resource defence, with the resource in this case being females in heat.

Home range

A home range is the total area used by an animal over the course of an entire year, regardless of whether it is a defended area or not. For owned cats that are allowed outdoors, this is not just their owner's home but also includes the whole outdoor area over which they roam. For cats that share parts of their home range, the home range is larger than their territory. Cats that only show local resource defence have a home range without a territory; that is, they defend resources in their immediate vicinity such as the food they are eating or the place where they are currently resting.

Rather than being a particular shape or size, a cat's home range may be a somewhat fragmented space, including areas that are used only during part of the year. For example, tomcats with outdoor access will use more of their home range during the breeding season than in winter. In contrast, in the first few weeks after giving birth, a mother cat will use less of her home range as she needs to return to the nest regularly and frequently to nurse the kittens. An outdoor cat's home range contains a network of trails leading to good hunting areas and several safe resting spots. Cats do not always go back to a single location to rest. It is more efficient to rest near where they are currently hunting. Even mother cats take naps away from their kittens, especially once the kittens are a few weeks old. An owned cat probably does not imagine that its owner is becoming worried when its return to the house is delayed because it decided to stop for a nap.

The core area of a home range is the area where an animal spends the most time, what we might consider 'home'. This is the area most likely to be defended as a territory. For breeding females, this area is centred on the concealed nest site where they keep their kittens. The core area will usually include concealed resting places, areas with loose soil or litter used for elimination, safe places to sunbathe, lookouts for monitoring the surrounding area and access to some food and water. Cats living in social groups have overlapping home ranges with a common group core area that they may defend from non-group members. For owned cats, the apartment or house and garden is their core area, shared with humans and any other cats in the household.

Personal space

Most animals prefer to maintain a certain minimum distance from other individuals, termed an *inter-individual distance*. This results in a *personal space* around the individual, often oval in shape and largest in front of the head. The personal space is like a mobile mini-territory around the animal. If another enters this personal space, the individual will feel uncomfortable and may retreat or threaten the other, thereby freeing up this buffer zone. In humans, this space is typically about 0.5–1 metre, explaining why many do not feel comfortable close to strangers on a crowded train or bus. In cats, a confident individual is likely to send threatening signals on the close approach of an intruder, causing the intruder to steer clear, whereas an anxious individual would rather move away itself than risk conflict. If kept in a confined area where they are unable to regulate the

distance between them, cats may live in a state of heightened social stress.

A personal space does not have fixed dimensions. Its size depends heavily on who is nearby and what they are doing. With social partners and off-spring, the inter-individual distance may well be zero when resting without causing any problem. Cats who do not have a particularly close relationship with another cat or a person prefer to stay at least 1–3 metres away. They may attack by leaping upon another cat or your hand if it comes closer than this. When hunting outdoors, a cat will usually keep many metres away from unfamiliar cats, not only avoiding direct attacks but also avoiding threat signals. In a multi-cat house with cats that tolerate each other but who are not best friends, the cats are usually careful to maintain an inter-individual distance of at least one metre.

Do cats prefer a single or a social life?

The biologist and author Desmond Morris once stated: 'A lonely dog is a miserable, unhappy creature. A lonely cat is often just relieved to be left in peace.' This implies that adult cats prefer a solitary life over group living. In fact, for free-living cats, the local ecological conditions are crucial in influencing which option a cat chooses. In areas with a high population density of cats and variability in the distribution of prey – that is, having some areas with an abundance of prey and other areas where prey animals are scarce – cats are likely to be found living with others in a social group. The group can collaborate on maintaining a common group territory and keeping other cats away from their rich hunting areas. David Macdonald showed that such group-living cats tend to be healthier than the solitary cats that are excluded from such areas and forced to live in marginal areas with limited food. On the other hand, if the density of cats is low and they are hunting small prey that are relatively evenly spread out, most cats prefer to live apart from other adult cats. In dense urban environments containing many cats, they hardly have a choice. They must try to adapt to the close proximity of other cats. Flexibility is a keyword for cat social behaviour.

When people feed a cat and provide it with a place to live, the cat may settle down and establish social contact with the people living in the household. If socialized to people as a kitten, it will continue to seek care from people in adulthood. When let outdoors, however, the cat will behave similarly to free-living cats.

Traffic-handling among cats

When a well-fed owned cat uses an outdoor area where cats from neighbouring households are present, their scent marks regulate the 'cat traffic'. These do not prevent others from using the same area but minimize face-to-face encounters. Cats can be quite careful to avoid each other, and they use both sight and smell to check when the coast is clear. Since the scent marks inform them about who was at a certain place and how long ago (see Chapter 4), they can establish a kind of shift schedule for the use of a popular area. If Jasper finds that Oliver typically hunts in a particular area in the early morning, Jasper may hunt there in the evening. If Luna finds that Bella uses a particular resting place in the afternoon, she can use the same place in the morning. In this way, they avoid conflict. This is the cat form of a shared economy.

If two cats should find themselves walking towards each other along the same path, it is normal for one to sit down and wait for the other to pass. There is no reason to attack another that makes no

threat. If two more competitive cats meet, maybe at short distance, they do not fight for the right to use the path but instead sit down and threaten each other by staring. Eventually one will give up and carefully take a different direction. Perhaps it is safest to return from whence it came.

Indoors, it is common for group-living cats to respect each other's first right to a particular place. If a cat arrives first at a food bowl and there is no room for additional cats, a latecomer is likely to wait until the first one has finished eating. If a cat has occupied a resting place, another cat will usually not chase it away but, instead, find another place to sleep. This 'courtesy' depends upon the cats perceiving that resources are plentiful and that they can get enough of what they want (see Chapter 11).

Rank order

The social system that these 'traffic rules' reveal has been termed a *relative hierarchy* because an animal's social rank is influenced by time and place. This concept was developed in the early 1950s by the famous cat ethologist Paul Leyhausen. A cat can be said to have a higher relative rank the closer it is to its core area, where it feels more confident and determined to stay. If a cat meets another somewhere else during the time of day when it habitually uses that area, this also adds to its confidence, and it is more likely to prevail in a staring competition. An *absolute hierarchy*, on the other hand, follows the well-known peck order described in the 1920s by the Norwegian biologist Thorleif Schjelderup-Ebbe, based on his studies of the social behaviour of domestic chickens. An absolute rank order applies regardless of time and place, and determines who has priority of access to resources based on the relative competitive ability of each individual. A hierarchy emerges within a group based on the dominance relationship between each animal and each other animal in the group. One individual dominates another individual, which typically dominates a third, and so on, in what is called a linear rank order. It may also occur that this third individual in fact dominates the first one, and this is an example of a triangular ranking.

To a certain extent, dominance relationships between cats are decided based on body size, which is in turn influenced by age and sex. If body sizes are very different, the difference in competitive ability is obvious and there is no need for a competition to decide who is dominant. Thus, adult males will usually have a higher rank than adult females based on their larger body size. It is the individuals who are close to each other in apparent competitive ability that show the most conflict with each other. Once the ranks have been settled, though, it is rare for them to change.

Leyhausen found that it is particularly in very dense populations of adult cats that an absolute hierarchy can emerge. There may be too many cats for social regulation based solely on relative ranks. More dominant cats regularly exhibit threatening signals that remind others of their priority of access to resources. This can happen in laboratory colonies of cats or when there are many cats in a household. A simple type of absolute rank order can be seen within litters of kittens, where certain kittens have priority of access to the milkiest teats. These kittens were perhaps the biggest and boldest at birth, and with access to the best teats they grow faster. This is also termed a *teat order*.

Since female and male cats mostly live separately in nature, we shall describe their social behaviour separately.

The Female Cat's Social Behaviour

Adult females can have a home range varying in size from a quarter of an acre to about 500 acres (2 km²). Food availability plays the main role in determining the size of the area needed by an adult female cat. When nursing kittens, this is especially important. As the kittens grow bigger and demand more milk, she will need to find two or three times as much food as usual. It is common that the female's home range overlaps with others, even though she is not living in a group. This is particularly true in an area rich in small prey scattered in unpredictable locations where it is not practical to defend the whole area from intrusions by others.

A female cat living singly can be quite territorial; that is, defending her territory against other cats of both sexes. But when she is in heat, she may tolerate males nearby. She is most aggressive towards other cats when she has kittens. This is partly due to the need to defend her kittens and partly to the need for a larger hunting area when nursing her increasingly demanding growing kittens.

Cats living in groups

The density of cats living outdoors can range from less than 300 m² to over 1 km² per cat. This variation results in differences in social organization. The prerequisite for cats to be able to form a social group is a concentrated food source. This is often associated with human activity – people feeding free roaming cats, cats exploiting landfill or rubbish bins, and cats on farms where they find an abundance of small rodents or steal food intended for the farm animals. Mink farms are popular with cats, as the nutritional needs of mink and cats are very similar.

An accumulation of cats in one area does not always constitute a social group. Instead, it is possible to talk about a colony of cats that stays in the same place for the same reason, but without real co-operation. In such cases, this is considered an *aggregation* of single cats rather than a social group. Such cats frequently snarl if they get too close to one another while dining on scavenged food.

The most basic social unit in cats is a female cat with her offspring. This is termed a *core group*. It does not include the father of the kittens, who may be far away and the father of offspring in several such core groups. Larger social groups of cats usually consist of several female cats with their off-spring, that is several core groups. The adult female group members are called *central females*. Such groups can include juvenile daughters and sons of the adult females in the group. In addition, a few adult tomcats may be associated with the group. These have contact with the adult females especially when mating during the breeding season, but otherwise stay on their own. Usually, these males are not closely related to the adult females, as adult males emigrate away from the area where they were born, a mechanism that reduces the likelihood of inbreeding. There are rarely more than ten individuals in a social group, but groups of more than 50 cats may occur if there is a large enough, predictable food supply, as reported by Macdonald and colleagues in England. In other regions, colonies with several dozen free-living cats are found in cities with large populations of homeless cats.

The central females of a social group may attack intruders of both sexes. Apart from this central group and their young offspring, other females and males live alone. These are called *peripheral cats* when living on the periphery of a social group, usually under harsher living conditions. Peripheral cats may, nevertheless, hunt for prey within the core area used by cats in the social group, so this is not a watertight territory where intruders are completely shut out. The social dynamics can vary widely between such groups, related to the group size, ecological factors and personality characteristics of the individuals within the group. Small colonies of cats in the countryside can consist of two or three core groups, where the cats have more contact with those within their own core group than with cats from other core groups.

Collaboration on kitten care

Females living in a social group can be very friendly towards one another. In naturally forming groups, they have usually remained in the group from birth, and rarely move over to another group. Since they hunt alone, their home range sizes can differ, but the group has a common core area where they give birth to kittens and where their main food sources can be found. Here they can have a common nest and help each other with the care of the kittens. They tend to have synchronized heat cycles and give birth around the same time, and their kittens may have the same father or fathers. David Macdonald has observed that a female cat can help another female by biting the umbilical cord of a newborn kitten. It is not unusual for them to nurse each other's kittens. This is called *communal nursing*. Sometimes a female brings prey to another nursing cat. Nevertheless, the females regularly stay closer to their own kittens than to those of the other cats. It appears that they recognize and preferentially care for their own offspring.

Female cats living in social groups can produce larger litter sizes than solitary females. In Macdonald's study of a large colony of farm cats, females that co-operated in kitten care and joined forces to defend food resources had lower offspring mortality than those living alone. Communal nursing is a type of *helper system*, or what we could call *unting behaviour* among humans. The females in cat social groups are usually closely related—mothers, daughters, sisters and half-sisters, and perhaps grandmothers. Therefore, in evolutionary terms, such helping also benefits those who help. Genetically, a female cat is 50% related to her full sister or mother and 25% related to her half-sister. If she helps her full sister to produce two more weaned offspring than she would have been able to raise by herself, the helper will have contributed as many of her own genes to the next generation as if she had weaned one kitten herself. This phenomenon is termed *kin selection* and is thought to play an important role in the evolution of social behaviour.

The Male Cat's Social Behaviour

The home ranges of intact male cats are, on average, 3.5 times larger than those of females. In extreme cases they can reach up to 2000 acres, or 8 km². More commonly, a male's rural home range area is 2–3 km². The males obviously do not need such a large area to catch food. The reason for roaming over such a large area is the tomcat's urge to seek out females in heat. Therefore, a tomcat's home range often overlaps with the core areas of several females. At the same time, this means that they also overlap with the home ranges of other males. Outside the mating season, however, the overlap can be small. High-ranking tomcats usually have larger home

ranges than males with lower ranks, probably because they can roam more freely without being threatened by other males. In more densely populated areas, both females and males have smaller home ranges. These cats usually receive food from humans, and uncastrated males can have good access to fertile females nearby. However, when many female cats are spayed or kept indoors, it becomes harder for tomcats to find females accessible for mating.

When male cats quarrel

Kittens are usually tolerated by adult males. When young males reach around 10–12 months of age, older males can invite them to battle using special call sounds. Initially, the fights are trivial and usually playful. Only in the second year of life does male rivalry become more serious. Then the young tomcat must show his competitive ability. After sniffing each other, both males show aggressive signals, where the body posture, ear position and sounds inform the other one how bold he is currently feeling. Sometimes it seems that the competition is all about making the largest yowling noise. If two males are quite evenly matched and neither exhibits pronounced defensive signals, there may eventually be a fight. This is a last resort, however. The cats can easily incur bad bite injuries, and they try to win the contest using offensive threat signals. Therefore, we should put up with the loud sounds of competing tomcats that wake us from our nightly slumber during early spring.

When one of the males finally accepts the dominance of the other, he will show his defensive attitude by crouching down, hissing and maybe lifting his paw if the opponent gets too close. Cats do not show submission like dogs, exposing their vulnerable neck or belly. As noted in Chapter 4, a defensive cat informs his opponent that he will defend himself if attacked. Usually, the dominant male will accept such signals and end the dispute. At subsequent meetings, the conflicts will become shorter. Both now, and later, the dominant male will urine mark, and scratch and rub against tree trunks and other prominent objects. These actions send visual signals of dominance, and the scent marks provide a reminder.

Among lions, a small coalition of adult males lives together with the lionesses and their offspring continuously until, after a few years, they are chased away by a new coalition of younger, stronger male lions. The main difference in free-living cats is that males generally live alone rather than within the female group. Unlike lions, they do not need to co-operate during hunting because their prey is much smaller and can be caught by a single individual. We shall say more about this in Chapter 6. They also do not need to co-operate to gain access to females. Not surprisingly, then, tom-cats do not appear to form co-operative alliances. In dense populations, adult males are rarely friendly towards one another. However, where they live more spaced out, adult males that have clarified their dominance relationships can coexist peacefully and share overlapping home ranges. The most dominant males are rarely tyrants, although bullying may occasionally occur depending on the individual personalities involved.

What is the function of conflicts between males?

The most aggressive tomcat rarely has priority of access to important resources such as food and mating of females. Males can be surprisingly tolerant of one another. A cat that eats is rarely disturbed by a more dominant cat. The last one waits his turn, at least so long as there is enough

food for all. In the same way, the 'first come, first served' rule may apply to popular resting places as well as to the opportunity to mate with a female cat. The latter is more likely in larger than smaller cat colonies. In larger colonies it is too difficult for one dominant male to chase away all other males. The queuing system means several males can mate with the same female, and she can give birth to a litter where the kittens have different fathers. Since all these males can be fathers, this probably reduces the risk of infanticide of young kittens by males, unlike in lions.

In small colonies, it is not unusual for one tomcat to be the father of almost all kittens born. In this case, a dominant tomcat manages to threaten other males to stay at a good distance from female cats in heat. However, the female cat herself decides whether she wants to mate with a particular male or not. She will not necessarily accept the most dominant male cat. As with some other mammals, and birds, if you had excellent reproductive success during the last season, why take the risk of substituting your partner? 'Never change a winning team' can be a good rule for animals, too. Bjarne has even known a wonderful and huge male cat that was rather lazy and not very interested in courting females. Instead, the females were queuing up to solicit his attention.

Perhaps the most important reason why male cats fight is related to the struggle for access to a habitat rich in food resources. A young male cat who is clearly lower-ranking than his neighbours will often emigrate from the area and settle in a less favourable area, with less food and few females. Here he can live in relative peace until he becomes older and stronger, and more likely to succeed in competition with other males. This may be the reason why some two-to three-year-old males suddenly disappear from home (see Chapter 7). Even though they have had a good relationship with their owners, competition from other males encountered in the neighbourhood may have led them to seek a new living area. At this age, it is natural for male cats to leave the social group of their mother. Biologically, this is an important mechanism for preventing inbreeding.

The male cat can be a good father

It is a common belief that male cats may be dangerous to small kittens. Occasionally, a tomcat may kill kittens he comes across. Perhaps he considers them as regular prey. In lions, males can kill cubs that are not their own offspring, leading the lionesses to come into heat more quickly. The males can then mate with these lionesses and father off-spring themselves. It is possible that such a reproduction strategy may also be found in some domestic cats, but it appears to be rare.

In Norway, there are many stories about male cats who gave care to kittens. In Trondheim, a large male cat carried, in his mouth, a kitten that had been hit by a car. Unfortunately, the kitten had to be euthanized, but the male did what he could. In another case in Trondheim, a homeless female cat was shot. Her young kittens, who were born outdoors, were fed by a tomcat. He collected food and brought it to the kittens. At Nes, in Hedmark county, on the farm where Bjarne was born, a female died some weeks after giving birth to kittens in the barn. The resident tomcat, who might have been their father, carried the kittens, one by one, from the barn into the kitchen of the farmhouse. He knew that food was available there. Another story from Trondheim is about a cat family where the cat mother and her offspring were killed. It turned out that one of the kittens had escaped and was hiding outdoors. The tomcat took food in his mouth and ran outdoors, where he was thought to be giving it to the kitten. Eventually the kitten became so sick and cold that she

entered the house. Here she was cared for and cleaned by the tomcat. It was thought that the tomcat was probably the kitten's father. Much later, when the kitten had her own kittens in a completely different home, far away, one of the kittens looked very similar to this male, suggesting that he was the kitten's grandfather.

In the 1980s, in the research cattery of the University of Trondheim, Bjarne saw that some male cats were particularly adept at taking care of kittens. After the kittens were weaned and separated from their mothers, they were placed in a separate room. Here an old male was used as a 'kindergarten teacher'. He carefully licked the kittens, and it was obvious that they appreciated his presence.

Such stories indicate that there are relicts of paternal instinct in domestic cats. This is another sign of their descent from the African wildcat, *Felis lybica* (see Chapter 1). In this species, the male and female sometimes live together in monogamy. In such cases, the female is probably dependent on the male helping her to provide enough food to raise kittens in the barren semideserts where they live.

Castrated male cats

A high rate of neutering is practised in many countries. For example, in Norway, about 85% of owned male cats are castrated, or sometimes chemically sterilized, especially those living in densely populated areas. These males do not have the same motivation to compete with others as seen in intact males. Rather, they may live in social groups with females and other castrated males and, like females, co-operate to chase away intruders from the group's core area. When a castrated male seems to be bolder within its territory than elsewhere, this is a sign that he has more to defend in that area.

Multiple Cats in the Same Residence

Many people are unsure whether it is possible to have two cats in an apartment, especially if they have one cat already and now would like an additional cat. Will they become comrades or feud for evermore? There are large individual differences in social behaviour among cats. This has a lot to do with the personalities of the different cats, and whether they will be compatible can be unpredictable. A cat may accept one newcomer but be aggressive towards another. Often, it is more successful to keep a female and a male together rather than two females, unless the females are closely related (e.g. sisters or mother and daughter) or the newcomer is a kitten. In an American study of 60 homes with two neutered indoor cats, two male cats were closer to each other, on average, than two females or one female and one male. Aggression between the cats was most frequent during the first two years and became less frequent the longer the cats lived together. Another study indicated that, in half of the cases, the newcomer was accepted before one month has passed. In England, the ethologist John Bradshaw showed that two adult cats from the same litter spent more time together than two cats from different litters did. Littermates more often ate together and groomed each other's fur. If you wish to have two cats, it is therefore a good idea to obtain two from the same litter.

People with four cats in their household often believe that they have one social group consisting of four cats. They might instead have four cats that would rather live alone. In such cases, the cats must establish a kind of balance of power, staying by themselves and finding ways to avoid provoking the other cats. However, many people have multiple cats living together in harmony. Like in nature, the most important means for achieving this is that the cats do not have to compete for resources. There must be enough food for everyone, with a separate food bowl and litter tray for each cat, and possibly extra ones. There must be plenty of resting places. Finally, yet importantly, each cat must get the same amount of friendly contact and petting by people in the household.

It is difficult to predict the outcome when introducing a new cat. The easiest advice is just to try. If you are unsure how it will be received by your existing cat, ask for a two-to four-week trial period from the seller with the option to return the cat if the introduction is unsuccessful. A person who is selling or giving away a cat should take an interest in ensuring that it will thrive in its new home.

When the new cat arrives it is normal that the two cats will initially want to stay apart. The existing cat has something to defend and is likely to hiss at the intruder if it comes too close. The newcomer feels insecure in the unfamiliar environment. It is best to keep the newcomer in a separate room (such as the bathroom) for the first few days. Once it is relaxed in that room, eating well and willing to play with you, you can open the door. By then, the existing cat has also got more used to the smell and sound of the new one. Leave the new cat's food bowl and litterbox in the original room (the bathroom in this example) for another week or more until both cats are comfortable being together in the same room. Do not expect them to become friends in the first two weeks, even if some cats become friendly more quickly. Make sure that there are separate places for them to retreat to. Do not force them to come closer together than they are comfortable with. Playing with each cat using a toy dangling from a wand may be helpful in placing both in a playful mood and encouraging them to come closer to each other. Eventually, the cats should accept each other, but it takes time, so be patient. They may never do so completely. In that case, the best you can hope for is that they will respect each other without frequent threats or fights, or one always feeling it must run away if the other is around. If they share space through mutual avoidance, this is often acceptable to the cat owner.

A Cat and Dog Together

Many people find it easy to have both cats and dogs (Fig. 5.6). The Israeli ethologists Feuerstein and Terkel examined this systematically in 2007, with behavioural observations on dogs and cats kept together in 170 homes, and questionnaire responses from the owners. They concluded that both animal species were equally inclined to enter into a friendly relationship. This is easiest to achieve if you get the cat before the dog, so that the cat has the psychological advantage of established residence before the arrival of the, probably larger, dog. It is advantageous if the cat is younger than six months and the dog is younger than one year when they meet for the first time. The researchers found that dogs and cats living together largely understood each other. The younger they are when they first meet, the easier they will learn to understand each other's body language and avoid misunderstandings. Further advice on introducing cats and dogs is given in Chapter 2.