



LIFE  
DINALP  
BEAR



# A Fieldguide for Investigating Damages Caused by Carnivores

**Brown  
Bear**

**Grey  
Wolf**

**Golden  
Jackal**

**Red  
Fox**

**Eurasian  
Lynx**



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## INTRODUCTION

The purpose of this guidebook is to provide detailed information for field investigations for identifying the cause of death of livestock when suspected by carnivora. The guidebook was initially prepared within the LIFE+ SloWolf project, and was later updated within LIFE DINALP BEAR project. New chapters were added to the guidebook and it was also translated into several languages.

Hopefully the guidebook will assist damage inspectors, agricultural advisors, and others in determining the species of wildlife that cause damage. Additionally, this guide will help users recognize wildlife sign near prey, at damage sites, and for collecting evidence for further analysis. This guide will also help users to protect themselves against zoonoses, which might infect people when being in contact with carcasses.

When using this guidebook to determine which animal caused the damage, it is important to note the following facts:

1. When determining the predator, we have to take into account that the carnivorans in this guidebook can be scavengers and could have been eating the prey after it had already been killed by another animal or died from other causes that include natural one. Therefore, it is important to find the cause of death regardless of the presence signs of a single carnivora on the carcass or its surrounding area. In order to determine the cause of death, we need basic knowledge of pathology, which will briefly touch on in this guidebook.
2. The user should be aware that the guidebook presents the typical presence signs and signs of predation, which are very different in practice and can differ from case to case. When determining the predator, all the signs found on the carcass and its surrounding area have to be taken into account.



*The causes of death can vary greatly. This is a picture of a dead roe deer that was hit by a car. (Photo: Paolo Molinari)*

# RULES TO BE FOLLOWED WHEN EXAMINING DAMAGE CASES AND DETERMINING THE CAUSE OF DEATH

## General rules

Various provisions have to be taken into account when determining the cause of death. First, the area needs to be secured so that no presence signs of the predator or other facts, which help determine the cause of death, are destroyed. The owner of the livestock is primarily responsible for securing the area where the carcass was found. Upon the arrival of the competent damage inspector, they share the responsibility for securing the area. When determining the predator, the following should be considered: the carnivoran's hunting habits, killing technique, handling and feeding on the carcass. In most cases the cause of death can be determined on the basis of the aforementioned factors. If the predator cannot be identified, guessing is not an option and it should be put on record that the predator could not be identified and additional expertise from the qualified institutions (e.g. Veterinary Faculty) should be sought out.

When determining the cause of death on the prey itself, the signs of the predator should be distinguished from signs of scavengers. The scavenging signs are not connected to the cause of death. The reliability in the determination of the cause of death depends on the state of the carcass, presence of scavengers, fly larvae and the level of decay, which is heavily influenced by the time of death. These factors can easily hide clues and make the cause of death impossible to determine. When only bones of the prey remain, determining the cause of death is very difficult if not impossible. Therefore, it is important to examine the carcass as soon as possible to lower the chance of a misidentification or even no identification of predator.



*If only bones are found, it is extremely difficult to determine the exact cause of death.  
(Photo: Rok Černe)*

When determining the cause of death, it is unreliable to depend on a single presence sign of the carnivora. As much evidence as possible must be gathered to then determine cause of death. This includes all signs that can confirm or deny a cause of death. When examining the causes of death at the scene, the examination process begins from the outside toward the inside of the area.

First, the presence signs of a carnivora in the area of attack should be examined, then the external signs of predation on the prey and lastly, a partial skinning of the carcass is done to determine any subcutaneous signs and possible causes of death. The order of the examination is very important because if done in the opposite order, some signs can be destroyed before they are recorded.

## **Examining the area where the carcass is found**

Based on the examination of the area, it can be determined if the animal was killed in a fight. If a scene of the attack can be determined, it is obvious that the animal was killed by a predator. Caution is important during the examination, because some signs can appear after the event. Another possibility is that the animal was killed so fast that there are no signs of a fight. Damaged plants, scratch marks on the ground, traces in the snow, mud or sand, hair, blood, traces of the prey and the predator are indicators of the scene of the fight. There the balance of strength between the victim and the attacker (more signs of a fight if the prey and predator are of similar strength) can be identified. Attack signs typical for a species can also be identified. For example:

- The scene of the attack of the »surprise attacker” – the lynx – is only a few square meters big even if he attacks a bigger animal (e.g. red deer hind).
- A sheep is a large sized prey for a fox and thus harder to contain, which usually makes the area of the fight larger.
- Dogs are often unexperienced hunters. They catch their prey, but often cannot handle it and the prey escapes. The area of the fight is thus much larger and there are traces of blood and hair.
- Wolves and dogs hunt in packs and leave more traces behind. The opposite can be said for the lynx that hunts alone and leaves few traces.
- The bear rarely attacks adult wild ungulates, but more often poorly protected livestock, mainly sheep and goats. After a short chase, the area of attack is usually small, but due to the force of the predator clearly visible.

The second thing to keep in mind when examining the area of attack is the relocation of the carcass after the initial kill. Some carnivorans eat the carcass at the scene of the kill others drag it into cover. If a small animal was killed, it can be carried away without any signs of dragging. Nevertheless, certain signs can be determined based on the killing technique and the new location of the carcass.



*The scene of a long and hard fight between a fox and a roe deer. (Photo: Centre for Fish and Wildlife Health – Bern)*



*The lynx dragged the carcass to a hidden place, but the scene of the fight is clearly visible. (Photo: Paolo Molinari)*

For example, the lynx usually eats the prey at the scene of the attack, but sometimes it moves the dead animal into cover by dragging it a few or up to approximately 100 m, even uphill. The fox typically drags its prey downhill, dismembers it and removes the head. If the prey is large (e.g. fully grown red deer), only a wolf, a large dog or a bear can move such a carcass.

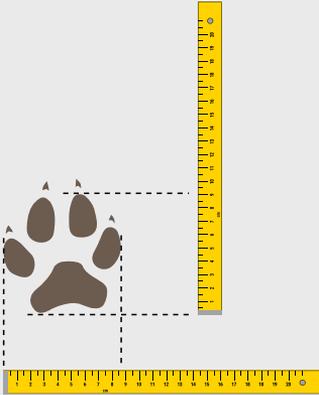


*Fox's prey. The head was removed. (Photo: Miha Krofel)*



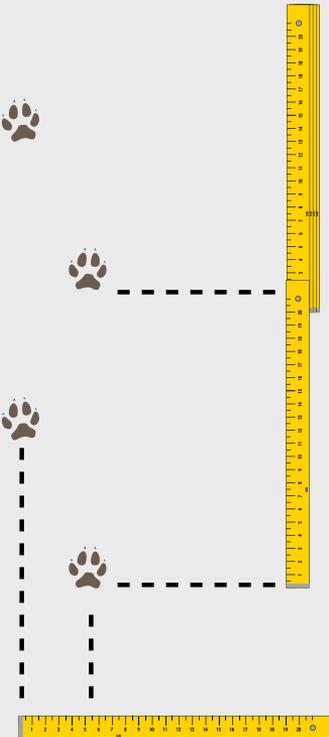
## Questions to consider when examining the area of the attack:

- Is it possible that animal died of other causes (e.g. disease) and carcass was damaged/ consumed by secondary consumers?
- Does a particular predator live in the area where damage was found?



- What is the distance to the nearest forest edge and to human activity/settlement(s)?
- Is there clear presence or sign of a carnivore?
- What are the signs at the entrance point of the carnivore (if damage occurred inside the fence, barn, enclosure or some other object):

– Search for **traces** of the predator. They can often be found at the place where the carnivora entered a pasture or on muddy/snowy surrounding areas of the attack. Signs that are found should be photographed, then the width and length of the footprint should be measured, and if possible, measure the distance between footprints. Additional footprints may have to be examined, because it is hard to determine the predator solely on the basis of a single footprint.



– **Feces and urine** can often be found in the area of the attack, as the predator marks its territory with them, or just defecates around the site of feeding. In case of uncertainty, DNA can be extracted from the feces and urine in the snow to determine the species.

– **Hair** samples are additional indicators of predators. They can be identified by pieces of hair or by the DNA extracted from it. A piece of hair can be found on the wire where the carnivora entered the pasture.

• Was the carcass buried or covered? Covering the carcass is typical for lynx, sometimes also for a bear. But this is not enough to pinpoint to one species as the predator.

*How to measure a footprint and length of a footstep.  
(Drawing: Igor Pičulin)*



*Examining the entrance point can be very helpful when identifying the predator. That is where hair is often found. The fence on this photo could have only been damaged by a bear. (Photo: Slovenia Forest Service archive)*

## **Examining the carcass**

The most important question when examining the carcass is whether a carnivora killed the animal or whether scavengers have been eating an animal after it died from other causes (disease, old age, stroke and etc.). Even if this question can be answered only after skinning the carcass, it cannot be neglected when examining the surrounding area and the external signs. Presence signs of a certain animal do not necessarily mean that it killed the animal which it was feeding on.

When scavengers are feeding on animals that have already been dead (but not killed by them), traces of teeth, claws or beaks can be found on the carcass, but there is no bleeding or bruising. The most important principle when examining a carcass is: Bruising and bleeding can occur only on an animal that is alive or has just been killed. They are the primary proof of a violent death. A typical wound inflicted prior to the death of an animal has: visible bruises, the edges of the wound are wrinkled, irregular, swollen and red, and the blood is hard to wash



*The most important question when examining the carcass is, whether a carnivore killed the animal or whether scavengers have been eating an animal after it died. Photo of a lynx's prey that was eaten by birds. (Photo: Miha Krofel)*

out of the wound. A typical wound inflicted after the death of an animal has: straight, sharp, regular and white edges, with no blood nor blood pigment.

In order to identify the attacker, it is important to know whether the animal bled out or was suffocated. Most carnivorans kill their prey with a bite to the neck. The death can be a result of a bite in the area of the carotid artery/jugular vein and trachea and subsequent suffocation (lynx) or as a result of torn veins and subsequent bleeding out of the victim (wolf). The symptoms of bleeding out are major damages to the tissue, lacerations, large amounts of blood at the scene of the fight and extremely pale (porcelain like) mucous membrane (most visible on the conjunctiva under the eye lids or on the oral mucosa if it is not pigmented). In case of suffocation, the neck tissue is less damaged. Only smaller wound are usually visible on the outside where the teeth pierced the skin. Smaller hemorrhages and bruises are present in the subcutaneous tissue causing suffocation and blockage of the air flow to lungs. The typical signs of that are foam in the airway, suffused and petechial bleeding in the mucosa of trachea. Petechiae on the mucosa in the oral cavity and epiglottis are possible. The teeth can pierce through the trachea causing hemorrhages in the pierced areas.



*Typical antemortem wounds have bruises visible on the skin and tissue. There are no bruises or bleeding in postmortem wounds. (Photo: Andrej Sila)*

*Bruises are visible on the skin, located in the area of the bite that points to an experienced predator. (Photo: Centre for Fish and Wildlife Health – Bern)*

The chances to determine the cause of death of the examined animal depend on how much of the carcass is left. The age of the carcass is extremely important – the examination of a fresh body is much easier than of an old one that could be partially or completely decayed and/or eaten. It is possible to examine the details of a fresh carcass, such as the distance between

canine marks on the prey, scratches on the body etc. Signs of an attack have to be searched for on the entire body. The most important signs when examining the carcass are the killing technique, distribution of lethal wounds and the way the prey was consumed. Signs include injuries on the skin (scratches, holes), the number, size and distance between canine holes and pierced parts of the skin, the amount of subcutaneous hemorrhaging, muscle damage and broken bones. Different predators prefer to eat certain parts of the body and avoid others – this can point towards or exclude a specific species. It has to be determined which internal organs were eaten by the predator, how the carcass was opened, where and how the muscles were eaten and whether bones were crushed and eaten. It also has to be examined whether certain parts of the body are missing (e.g. a scavenger can remove a head, foot, etc.).



*In summer, fly larvae can infest a merely two days old carcass and hide traces of the predator. (Photo: Rok Černe)*



*Suffocation is a consequence of a strong bite to the neck, which is identified by a swollen and vascularized tracheal mucosa, and often by foam in the airway. There may be the possibility of hemorrhages, if the teeth pierce the trachea. (Photo: Anja Molinari - Jobin)*

When determining the cause of death, all signs of predation and consumption on the entire body and the surrounding area have to be considered, since one sign by itself cannot be reliable. For example, only a single footprint in the mud where there are no visible claws can be mistaken for a lynx even though the damage was in reality caused by a dog. The right conclusion is only possible when we examine several clearly visible footprints and all other signs. The measured distance between canines of the predator, is also very important, but can at the same time be very misleading. Errors can occur due to the differences within the species (male or female, young or old, etc.), but it is often hard to pair two holes of teeth from the same (upper or lower) jaw. This is especially visible with species that often bite their prey multiple times in (fox, jackal and dog). If the distance between the canine teeth is determined, it can greatly improve the certainty of the identification, despite the problems mentioned above.



*It is hard to measure the distance between the canine teeth where there are multiple bites, but it is a typical sign for some attacker (fox, jackal, dog). (Photo: Paolo Molinari)*



*The distance between canine bite marks can help identify the predator. (Photo: Josip Kusak)*

During the examination of the damage the first thought should be, whether the animal died due to a disease or any other reason (starvation, poisoning, lightning, fall etc.) and whether the protected species came to feed on the carcass after the animal died. Caution is very important, because livestock can also die of dangerous zoonosis, such as anthrax or tuberculosis (see chapter: Zoonoses and personal protection). If there is a suspicion that the animal died of a disease (no signs of a fight, no typical lethal wounds that would point to a large carnivora) the carcass should be touched as little as possible and a veterinarian should be called immediately.

Even if there are no signs that the animal died of a disease, caution is warranted to objectively assess the situation and to anticipate that the cause of death may not be from a predator. For example, in certain areas, sheep are often hunted by wolves. When examining the carcass, it has to be considered that the death could have been caused by a lynx, bear, jackal or dog and with new born animals, also ravens. The important question at this point is whether the animal was injured or sick prior to the attack. Many injured or sick animals, including a fully grown chamois or doe, can be killed by a fox or a large bird of prey.

It also has to be taken into account that a wide range of animals, such as foxes, bears, badgers, martens, weasels, different kinds of birds, especially birds of prey and crows, and numerous others, could have been feeding on the carcass, not only the predator. The signs of attack are in most cases distinguished between large specialized predators, such as the lynx and the wolf, smaller predators, such as the fox and the cat, birds that mainly feed on carcasses and heavily unspecialized predators, such as the bear. Especially during the warmer periods of the year, numerous insects and their larvae infest the carcass causing it to decay quickly due to their large numbers and as a result, the signs of the predator are no longer visible.

The entire carcass has to be examined for signs of the predator. These signs can often be identified only after the removal of the skin. Usually the most information can be gathered if we flay the skin from the neck, the bottom side and the back side of the animal. An inexperienced damage inspector for the examination of damage case should not flay the animal alone, because he can destroy important signs of the predator.

The most important criteria for recognizing the predator are; the type and distribution of lethal wounds, and the way the prey was eaten. Damage to the skin (scratches and bite wound), the number, size, distribution and depth of the wound, the distribution and severity of bruises, the type of damage to the muscle tissue and possible broken bones.



*The pecked out eyes are a typical sign of crows or birds of prey eating the animal after it died. (Photo: Rok Černe)*



*The signs of the attacker are best visible if the skin is removed and the entire subcutaneous tissue examined. Here, a buck was killed by a lynx and a goat that was killed by dogs. (Left photo: Paolo Molinari, right photo: Andrej Sila).*

Predators typically eat the prey or start feeding on the body parts. When the carcass is found, it is important to determine which body parts or internal organs have been eaten, how the body was opened, where the muscles were eaten and whether also the bones were eaten.

## Examining the external signs on the carcass:

- **Signs of an attack and a fight:**
  1. presence of blood,
  2. potential relocation of the carcass after the initial kill,
  3. antemortem and postmortem wounds (detailed examination when flaying individual body parts).
- **Killing technique:**
  1. area of bites,
  2. number of bites,
  3. strength of the bite,
  4. distance between canines
  5. scratches (clearly visible only when the carcass is shaved or skinned),
  6. broken bones, bruises.
- **Consumption the prey:**
  1. how much of the carcass was eaten,
  2. which body parts were eaten – flesh, internal organs, bones, skin,
  3. missing body parts (legs, head etc.),
  4. relocation or burying of the carcass.
- **Who was the predator and who else was feeding on the carcass?**

## Flaying:

- **Holes in the skin:**
  1. Number of holes,
  2. Distribution of holes,
  3. Gap between the left and right canine,
  4. Form of the holes,
  5. Diameter of the holes.
- **Are there extensive lacerations and hemorrhages in the subcutaneous tissue or are there only a few visible bite holes?**
- **Are there few bite marks (1–3) and are they on the bottom side or are more visible on the entire neck (and possibly on the head, chest, back, etc.)?**
- **Is there foam in the trachea?**
- **If scratches are visible – did they pierce the skin?**
- **Are there hemorrhages in the subcutaneous tissue?**
- **Hemorrhages in muscle?**
- **Are there any broken bones?**

## Collecting DNA samples (saliva, scats, urine, hairs, blood)

In many cases it may happen that it is not possible to recognize and clearly determine the species which caused the damage. In such cases DNA-based methods can help us with identification. If the DNA is preserved enough, the species can be determined and even the individual animal since each has its own genotype, which we can »read« from its DNA sample). This is helpful if we determine that a specific individual has become problematic and repeatedly causes damages.

To obtain DNA results, it is crucial to collect DNA samples of good quality and store them in appropriate way. When organic matter is decaying, the DNA in it is decaying too. Some factors increase decay (moisture, heat), others decrease it (dry and cold conditions, ethanol and other fixatives). Where there is plenty of DNA (e.g. tissue of a dead animal), DNA will be preserved for longer periods, compared to saliva or scat where DNA is scarcer.

In order to successfully collect and store DNA samples, we need appropriate sampling equipment (flasks with fixative, zip-bags with silica gel, etc.). It is also important to prevent contamination of samples with the DNA from other samples. When taking samples, tools like tweezers have to be regularly cleaned or single-use wooden sticks have to be used.



*DNA sampling kit for collecting and storing saliva, hair, tissue, urine and scats.  
(Photo: Matej Bartol)*

Typically, the next types of DNA samples are collected at damage case locations:

### Saliva samples

Saliva is the most common type of DNA samples collected at damage scenes caused by large carnivores. A sample of saliva can be taken from the area where the prey was bitten. The

best area for sampling is the neck, where the predator typically grabs its prey. Try to avoid areas where secondary consumers (eg. fox) have been feeding and choose areas touched by only one animal (e.g. wolf) to avoid mixed DNA samples. Saliva samples are collected using self-drying swabs (evidence collection tubes). Dip the swab into the ethanol before collecting the sample. It is important that the sample remains dry, because the DNA is very sensitive to a humid environment. Use the tape to prevent the entrance of moisture into the tube.

## **Scat samples**

Animals causing damage often leave their scats in the vicinity of the damaged object (e.g. prey). When large carnivores are suspected, damage inspector should distinguish between the scats of potential predators and scavengers (e.g. fox) based on the size and shape of scats. When taking DNA samples from scats it is important to: a) have flasks with fixative – usually alcohol or EDTA when going to the damage case; b) use single-use (wooden) sticks for taking samples; c) take samples mostly on the surface of the scat (mucus) and less of the inner content; d) never mix several samples and e) avoid taking samples from old scats.

## **Urine samples**

Urine samples can be collected in snowy conditions. Usually flasks filled with fixative are used. When filling flasks with “yellow snow”, it is important to take the sample on the spot where only one animal has been urinating and not to spill the fixative.

## **Blood samples**

Blood samples can only rarely be collected on damage cases, but they are valuable source of DNA. Sometimes e.g. bears cut themselves when trying to break into the stable or apiary and their blood can be found around damaged objects. Blood samples are taken and stored following the same procedures as for saliva samples.

## **Hair samples**

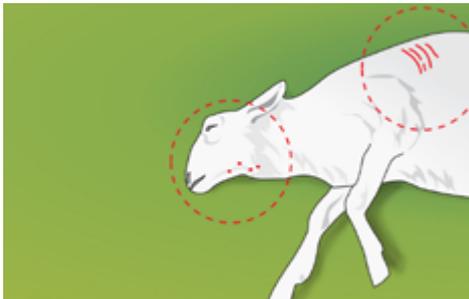
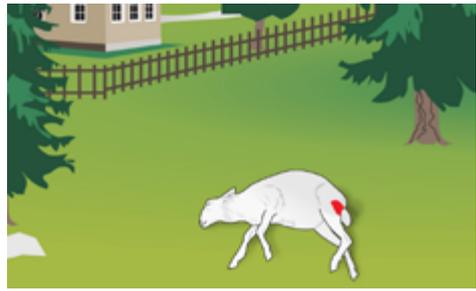
Often hairs can be found in the close vicinity of the damaged object (e.g. on electric fence, barbed wire, barn) or on the object itself (e.g. beehive). In many cases it is possible to determine the species just by the morphology of the hair, but we can also use them to extract DNA. Collected hairs shouldn't be old and they need to have hair follicles attached. It is important to keep the hair sample in a dry place (e.g. paper envelope with silica gel). Flask filled with alcohol will work as well.

DNA samples should be stored in a cool, dark and dry place (refrigerator) before they are sent in a laboratory to be analyzed. In any case, try to avoid storing samples on sunny and warm places, e.g. behind the windscreen of a car.

# Photo documentation of a damage case

## Things to be aware of when taking photos

- All findings that could help identify the attacker should be photo documented.
- Photos of the carcass should be taken from various angles and distances (sketches below).
- Signs of presence such as tracks or feces, are photographed with a meter or an object to compare the size to.
- Tracks in mud or snow are photographed from behind, because the claws are often not visible when photographed from above.
- Time and place should be included when processing the photos.



*The photo documentation of the prey should include the area of the attack, bite and feeding details on the carcass. (Drawing: Igor Pičulin)*



*The photo has to be taken at a right angle, because a photo taken vertically can obscure important details. (Photo: Paolo Molinari)*

## ZOOSES AND PERSONAL PROTECTION

### Zoonoses

Zoonoses are diseases transmitted from animals to humans. Zoonoses can be caused by viruses, bacteria, fungi and parasites. When humans infect animals, it is called reverse zoonosis or anthroponosis. Transmission of infections requires three elements: a source of pathogens, a susceptible host, and a means of transmission for the microorganism.

**Sources** include animals or environments contaminated by animals. Pathogens may be transmitted to humans directly from the animal via blood or other body substances during diagnostic or treatment procedures, or indirectly from the animal's environment.

**Susceptible hosts** include animals which may be clinically ill, asymptomatic carriers of an infectious agent, harbour endogenous flora that are pathogenic to humans, or in the incubation period of an infectious disease. Pathogens may also be transmitted indirectly from walls, floors, counters, equipment, supplies, animal feed, and water. Host resistance to pathogenic microorganisms varies greatly. Some people may be immune to infection or may be able to resist colonisation by an infectious agent. Others exposed to the same agent may become asymptomatic carriers while still others may develop clinical disease. Factors such as age, underlying diseases, immunosuppression, irradiation, pregnancy, and breaks in the body's first-line of defence mechanisms (intact skin, cough reflex, stomach acid) may render people more susceptible to infection. Conversely, vaccination may reduce susceptibility to infection.

**Transmission** occurs through five main mechanisms: direct contact, indirect contact, aerosol and through vectors (vectorborne diseases) and food (foodborne diseases). The same agent may be transmitted by more than one route. Transmission is largely influenced by the stability of the pathogen, its virulence, and the routes by which it leaves the infected host. Different agents vary in their degree of infectivity through the various routes. **Direct contact** happens by the contact with the saliva, blood, urine, nasal secretions, feces or other body fluids of an infected animal. **Indirect contact** includes contact with areas where animals live and roam, or objects or surfaces that have been contaminated with germs. **Aerosol transmission** occurs when pathogens from animals or their environments travel via the air and enter the human host through inhalation and/or mucous membranes. The probability of infection increases with proximity to the source and the length of exposure. Certain pathogens may remain infective over long distances. However, defining the infective distance is difficult because it depends on particle size, the nature of the pathogen, and environmental factors. Some pathogens (like *Coxiella burnetii* (Q Fever) and *Mycobacterium bovis* (bovine tuberculosis)) are known to be transmitted over longer distances. **Vector-borne** diseases are transmitted by a vector like mosquito, tick, flea or other vectors. **Food-borne** diseases are transmitted by eating or drinking something unsafe (such as unpasteurized milk, undercooked meat or eggs or unwashed fruits and vegetables that are contaminated with feces from an infected animal).

In the next section, zoonoses will be described that can be transmitted by direct contact, indirect contact and by aerosol transmission, i.e. only those to which a person doing the examination of suspected predatory attack should apply protection measures. Vector-borne zoonoses will be briefly listed, with only basic information, since damage inspectors should be aware that they can be bitten by a disease vector (tick, mosquito etc.) during the course of their work. Other zoonoses like food-borne zoonoses (**campylobacteriosis, salmonellosis**), are beyond the scope of this manual. The cause, symptoms in humans, pathways of transmission and prevention will be described for each disease.

### **Vector-borne zoonoses**

Vector-borne diseases are infections transmitted by the bite of infected arthropod species, such as mosquitoes, ticks, triatomine bugs, sandflies, and blackflies. Climate is an important geographic determinant of vectors, but the data do not conclusively demonstrate that recent climatic changes have resulted in increased disease vector-borne disease incidence on a pan-European level. However, the reports indicate that under climate change scenarios of the last decades, ticks have progressively spread into higher latitudes in Sweden and higher elevations in the Czech Republic. They have become more prevalent in many other places and intensified the transmission season.

**West Nile fever** is caused by the West Nile virus, a virus of the family Flaviviridae which is part of the Japanese encephalitis antigenic group. West Nile fever mainly infects birds and infrequently human beings through the bite of an infected *Culex* mosquito.

**Malaria** is caused by one of four species of the *Plasmodium* parasite transmitted by female *Anopheles spp.* mosquitoes. Historically malaria was endemic in Europe, including Scandinavia, but it was eventually eliminated in 1975 through a number of factors related to socio-economic development.

**Leishmaniasis** is a protozoan parasitic infection caused by *Leishmania infantum* that is transmitted to human beings through the bite of an infected female sandfly.



*Leishmaniasis on a wolf.*  
(Photo: Josip Kusak)

**Tick-borne encephalitis (TBE)** is caused by an arbovirus of the family Flaviviridae and is transmitted by ticks (predominantly *Ixodes ricinus*) that act both as vectors and as reservoirs.

**Lyme Borreliosis** is caused by infection with the bacterial spirochete *Borrelia burgdorferi* which is transmitted to human beings during the blood feeding of hard ticks of the genus *Ixodes*. In Europe, the primary vector is *I. ricinus*, also known as deer tick, as well as *I. persulcatus* from Estonia to far eastern Russia.

**Crimean-Congo hemorrhagic fever (CCHF)** is caused by an RNA virus of the Bunyaviridae family and transmitted by *Hyalomma spp.* ticks from domestic and wild animals. The virus is the most widespread tick-borne arbovirus and is found in the Eastern Mediterranean where there have been a series of outbreaks in Bulgaria in 2002 and 2003, in Albania and in Kosovo in 2001. Milder weather conditions, favouring tick reproduction may influence CCHF distribution.

## ***Zoonoses transmitted by direct, indirect contact and by aerosol***

### **Anthrax**

Anthrax is caused by the bacterium *Bacillus anthracis*, which produces spores that are extremely resilient. Contact is by breathing, eating, or through an area of broken skin. It does not typically spread directly between people. It can occur in three forms: skin, inhalation, intestinal. Symptoms begin between one day and two months after the infection. Anthrax occurs somewhat regularly in Southern Europe, but is uncommon in Northern Europe and North America. Skin infections represent more than 95% of cases. Without treatment the risk of death from skin anthrax is 24%. For intestinal infection the risk of death is 25% to 75% while in inhaled anthrax despite treatment it is around 50% to 80%. In plant-eating animals, infection occurs when they eat or breathe in the spores while grazing. Carnivores may become infected by eating infected animals. Anthrax spores are able to survive in harsh conditions for decades or even centuries. It is extremely important NOT to do a necropsy if anthrax is suspected (non-coagulated dark (almost black) blood, lots of subcutaneous hematoma, lack of rigor mortis).

**The skin anthrax** is typically with a small blister with surrounding swelling that often turns into a painless ulcer with a black center. Skin infections form within the site of spore penetration between two and five days after exposure. Unlike bruises or most other lesions, skin anthrax infections normally do not cause pain. Cutaneous anthrax is typically caused when *B. anthracis* spores enter through cuts on the skin. This form is found most commonly when humans handle infected animals and/or animal products. Skin anthrax is rarely fatal if treated. Without treatment, about 20% of cutaneous skin infection cases progress to toxemia and death.

**The inhalation form** symptoms are fever, chest pain, and shortness of breath. This form in humans is relatively rare. It starts with cold or flu-like symptoms for several days, followed by pneumonia and severe (and often fatal) respiratory collapse. Historic mortality rates were over 85%, but, when treated early, case fatality rate drops to 45%. Distinguishing pulmonary

anthrax from more common causes of respiratory illness is essential to avoiding delays in diagnosis and thereby improving outcomes.

**The intestinal form** presents with nausea, vomiting, diarrhea, or abdominal pain. Infection in humans is most often caused by consuming anthrax-infected meat and is characterized by serious symptoms: vomiting of blood, severe diarrhea, acute inflammation of the intestinal tract, and loss of appetite. Lesions have been found in the intestines and in the mouth and throat. Infections can be treated, but usually result in fatality rates of 25% to 60%, depending upon how quickly treatment commences. This form of anthrax is the rarest form.

Anthrax vaccination is recommended for people who are at high risk. Risk factors include people who work with animals or animal products.

## Avian influenza

Bird flu is an illness caused by any of many different strains of influenza viruses that have adapted to a specific host. Of the three types of influenza viruses (A, B, and C), influenza A virus is a zoonotic infection with a natural reservoir almost entirely in birds. Avian influenza, for most purposes, refers to the influenza A virus. Though influenza A is adapted to birds, it can also stably adapt and sustain person-to-person transmission. Avian influenza strains are divided into two types based on their pathogenicity: high pathogenicity (HP) or low pathogenicity (LP).

Manmade conditions have contributed to modern avian influenza virus ecology and spreading: indoor commercial poultry, outdoor commercial poultry, live poultry markets, backyard and hobby flocks, and bird collection and trading systems. Indoor commercial poultry has the largest impact on the spread of HPAI.

Avian influenza is most often spread by contact between infected and healthy birds, though can also be spread indirectly through contaminated equipment. The virus is found in secretions from the nostrils, mouth, and eyes of infected birds as well as their droppings. HPAI infection is spread to people often through direct contact with infected poultry, such as during slaughter or plucking. Though the virus can spread through airborne secretions, the disease itself is not an airborne disease. Highly pathogenic strains spread quickly among flocks and can destroy a flock within 28 hours; the less pathogenic strains may affect egg production but are much less deadly.

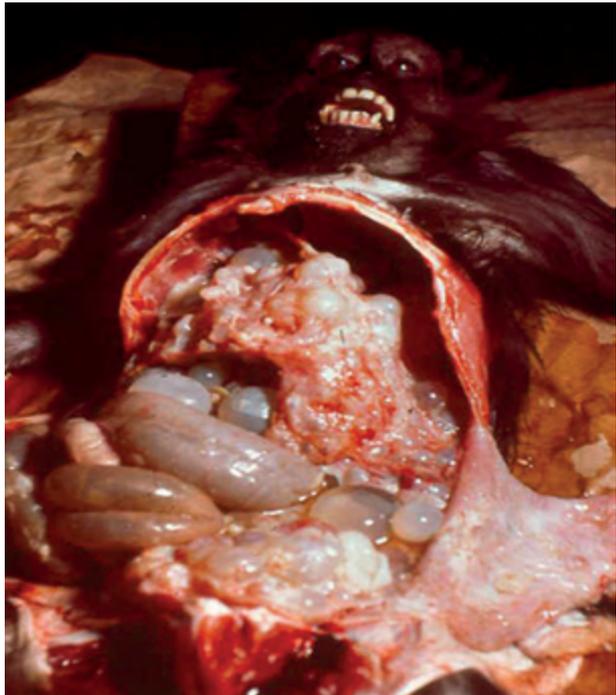
People who do not regularly come into contact with birds are not at high risk for getting avian influenza. Those at high risk include poultry farm workers, animal control workers, wildlife biologists, and ornithologists who handle live birds. With proper infection control and use of personal protective equipment (PPE), the chance for infection is low. **Protecting** the eyes, nose, mouth, and hands is important for prevention because these are the most common ways for the virus to enter the body. Appropriate personal protective equipment includes aprons or coveralls, gloves, boots or boot covers, and a head cover or hair cover. Disposable PPE is recommended. A respirator and unvented/indirectly vented safety goggles are also part of appropriate PPE.

## Echinococcosis

Echinococcosis is a parasitic disease caused by tapeworms of the Echinococcus type (*E. granulosus*, *E. multilocularis*, *E. oligarthrus* and *E. vogeli*). The disease often starts without symptoms and this may last for years. The symptoms and signs that occur depend on the cyst's location and size. Disease usually begins in the liver but can spread to other parts of the body, such as the lungs or brain. When the liver is affected the person may have abdominal pain, weight loss, and turn slightly yellow from jaundice. Lung disease may cause pain in the chest, shortness of breath and coughing. In the patients who are infected with *E. granulosus* and therefore have cystic echinococcosis, the disease develops as a slow-growing mass in the body.

Diagnosis is usually by ultrasound though computer tomography (CT) or magnetic resonance imaging (MRI) may also be used. Blood tests to detect antibodies against the parasite may be helpful as may biopsy.

The worm has a life cycle that requires definitive hosts and intermediate hosts. Definitive hosts are normally carnivores such as dogs or wolves, while intermediate hosts are usually herbivores such as sheep and cattle. Humans function as accidental hosts, because they are usually a dead end for the parasitic infection cycle. The disease is spread when food or water that contains the eggs of the parasite is eaten or by close contact with an infected animal. The eggs are released in the stool of meat-eating animals that are infected by the parasite. Commonly infected animals include dogs, foxes and wolves. For these animals to become infected they must eat the organs of an animal that contains the cysts such as sheep or rodents.



*E. granulosus* cysts in a monkey. (Photo: Duro Huber)

Since humans often come into contact with *Echinococcus* eggs via touching contaminated soil, animal feces and animal hair, improved hygiene is a recommended prevention strategy. In addition to targeting risk factors and transmission, control and prevention strategies of cystic echinococcosis also aim at intervening at certain points of the parasite's life cycle, in particular, the infection of hosts (i.e. especially dogs) that reside with or near humans. This includes implementation of programs geared at de-worming dogs and vaccinating dogs.

Proper disposal of carcasses and offal after home slaughter is difficult in poor and remote communities and therefore dogs readily have access to offal from livestock, thus completing the parasite cycle of *Echinococcus granulosus* and putting communities at risk of cystic echinococcosis. Boiling livers and lungs that contain hydatid cysts for 30 minutes has been proposed as a simple, efficient and energy- and time-saving way to kill the infectious larvae.

## Leptospirosis

Leptospirosis is an infection caused by up to 13 genetic types of bacteria from the genus *Leptospira*. It is transmitted by both wild and domestic animals. The most common animals that spread the disease are rodents. It is often transmitted by animal urine or by water or soil containing animal urine coming into contact with breaks in the skin, eyes, mouth, or nose.

Leptospiral infection in humans causes a range of symptoms. Some infected persons may have no symptoms at all. Leptospirosis is a two-phase disease that begins suddenly with fever accompanied by chills, intense headache, severe muscle pain, abdominal pain, conjunctival suffusion (red eye), and occasionally a skin rash. The symptoms appear after an incubation period of 7-12 days. The first phase (acute or septic phase) ends after 3-7 days of illness. The disappearance of symptoms coincides with the appearance of antibodies against *Leptospira* and the disappearance of all the bacteria from the bloodstream. The second phase begins 3-4



*Leptospirosis on a wolf. (Photo: Josipa Habuš)*

days after the disappearance of first-phase symptoms, with another episode of fever, but the main event of the second phase is meningitis.

Effective rat control and avoidance of urine contaminated water sources are essential preventive measures. Human vaccines are available only in a few countries.

## Rabies

Rabies is caused by viruses called lyssaviruses. Viruses cause the inflammation of the brain in humans and other mammals. Early symptoms can include fever and tingling at the site of exposure. These symptoms are followed by one or more of the symptoms: violent movements, uncontrolled excitement, and fear of water, an inability to move parts of the body, confusion, and loss of consciousness. Once symptoms appear, the result is nearly always death. The time period between infection and the start of symptoms is usually one to three months; however, this time period can vary from less than one week to more than one year. The time is dependent on the distance the virus must travel to reach the central nervous system.

Rabies is spread when an infected animal scratches or bites another animal or human. Saliva from an infected animal can also transmit rabies if the saliva comes into contact with the eyes, mouth, or nose. Globally, dogs are the most common animal involved. More than 99% of rabies cases in countries where dogs commonly have the disease are caused by dog bites.

Immunization (vaccination) before exposure has been used in both human and nonhuman populations, where, as in many jurisdictions, domesticated animals are required to be vaccinated, while people who are at high risk of infection, should be vaccinated too.



*Rabid wolf: main rabies vectors are canids.  
(Photo: Duro Huber)*

## Q fever

Q fever is a disease, caused by the *Coxiella burnetii* bacterium, affecting animals and humans. It has been reported to be present in a wide range of species, including cattle, sheep and goats as well as birds and arthropods. Human infection mainly results from the inhalation of dust contaminated with bacteria from the placenta and birth fluids or feces from infected animals. Other modes of transmission, such as through contaminated water or the feces of infected arthropods are rare.

The most common manifestation is flu-like symptoms with abrupt onset of fever, profuse perspiration, severe headache, muscle pain, joint pain, loss of appetite, upper respiratory problems, dry cough, chills, confusion, and gastrointestinal symptoms, such as nausea, vomiting,

and diarrhea. About half of infected individuals exhibit no symptoms. The disease can progress to an atypical pneumonia, which can result in a life-threatening acute respiratory distress syndrome. The chronic form of Q fever is virtually identical to inflammation of the inner lining of the heart (endocarditis), which can occur months or decades following the infection. It is usually fatal if untreated.

Protection is possible by the use of, a whole-cell, inactivated vaccine. Skin and blood tests should be done before vaccination to identify pre-existing immunity, because vaccinating people who already have an immunity can result in a severe local reaction. After a single dose of vaccine, protective immunity lasts for many years. Revaccination is not generally required.

## Personal protection

Many animal diseases are zoonotic and it is important to protect the operator and any people in the vicinity from these hazards. Necropsy procedures pose the greatest risk of transferring infectious agents to humans because of the large amount of tissues and body fluids exposed during dissection. Protection of the person doing the necropsy and protection of other animals in the vicinity are important. Proper use of personal protection equipment (PPE) is a critical component of a complete infection control program. Effective use of PPE is dependent on appropriate education and compliance of all staff. PPE should be considered an essential line of defence for hazards that cannot be overcome with other preventative measures.



Wear personal protective equipment - gloves, apron, and boots. For some diseases (such as rabies, echinococcosis, and avian influenza) a respirator or face mask is recommended as well. Wear rubber boots during necropsy, and sanitize the boots by washing in disinfectant so as not to spread infectious agents beyond the site of the necropsy. Protective outerwear should be changed after handling an animal with a known or suspected infectious disease, after working in an isolation room, after performing a necropsy or other high-risk procedures.



*Always wear gloves when touching dead animals. (Photo: Đuro Huber)*

Impermeable outwear should be worn during necropsies, and whenever substantial splashes or large quantities of body fluids may be encountered. Shoes or boots should have thick soles and closed toes and be impermeable to water and easily cleaned. Disposable shoe covers or washable boots should be worn when heavy quantities of infectious materials are expected. Garments should be changed and laundered daily, and whenever they become visibly soiled or contaminated. Protective outerwear should not be worn outside of the work environment. Keep clean outer garments available at all times. Encourage those not adequately protected to keep a distance from the carcass.

Wear gloves when touching dead animals, feces, body fluids, vomitus, exudates, and non-intact skin. Wear gloves if you have wounds or compromised skin integrity of the hands. Gloves should be removed promptly and disposed of after use. Disposable gloves should not be washed and reused. Hands should be washed immediately after glove removal. Use a face shield, or goggles worn with a surgical mask whenever splashes or sprays are likely to occur during necropsies. Intact skin is a natural defence against infection.

Perform hand hygiene after contact with feces, body fluids, vomitus, exudates, and items contaminated by these substances. Perform hand hygiene before eating, drinking, or smoking, after using the toilet, after contact with environmental surfaces in animal areas, after removing gloves; and whenever hands are visibly soiled. Keep fingernails short. Do not wear artificial nails or hand jewelry when handling animals. Keep hand-hygiene supplies handy and ready at all times.

**The basic hand washing technique is:**

- Wet hands thoroughly and lather vigorously using neutral pH liquid handwash;
- Rinse under running water;
- Do not touch taps with clean hands – if elbow or foot controls are not available, use paper towel to turn taps off.

Examiners' vehicles should be equipped with alcohol-based hand rub and water for hand washing. After field examination of animals, use clean water (1,5-2 l bottle), liquid soap and paper towel to wash hands at the animal examination/necropsy site. The help of another person may be needed for effective hand washing in the field.

For some diseases, such as rabies, a vaccine is available for humans and only those people who are vaccinated should be opening the carcass and sampling tissues. This should be followed by periodic titer checks and rabies vaccine boosters, in accordance with the recommendations. Tetanus immunizations are also recommended and if done, they must be up-to-date. Report and record puncture wounds, animal bites, and other animal-related trauma. Consult a health-care provider regarding the need for a tetanus booster. Pregnant and immunocompromised persons are at increased risk from zoonotic diseases.

Use sharp instruments when performing necropsies. Take your time, do not rush. Be sure your knife is sharp. Most accidents with knives happen because the knife is dull. Take only what is needed for the necropsy, so that unused equipment will not be contaminated.

Dispose of carcasses appropriately, away from scavengers that might find and drag animal parts to other locations and inadvertently expose people. Burial is a method of disposal that can be used for all species. Incineration may also be an option. Composting has been shown to work for poultry, sheep and goat carcasses. Which method you choose depends on environmental regulations, familiarization with procedures, weather conditions, and location of site in relationship to human settlements.

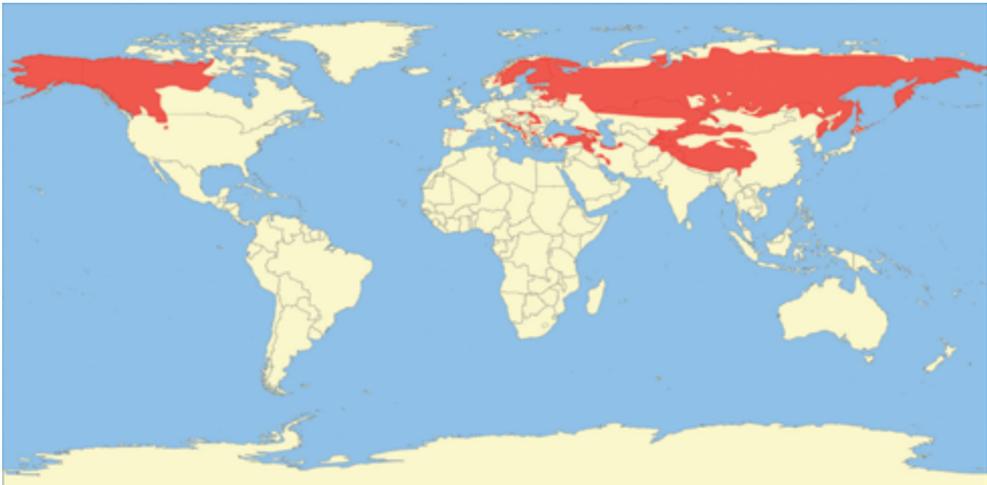
Decontaminate instruments before cleaning them. Clean and disinfect all work surfaces. Decontaminate self (e.g., disinfect and remove boots, gloves, and coveralls).

# BROWN BEAR (*Ursus arctos* L.)

## *Species overview*

### **Systematics**

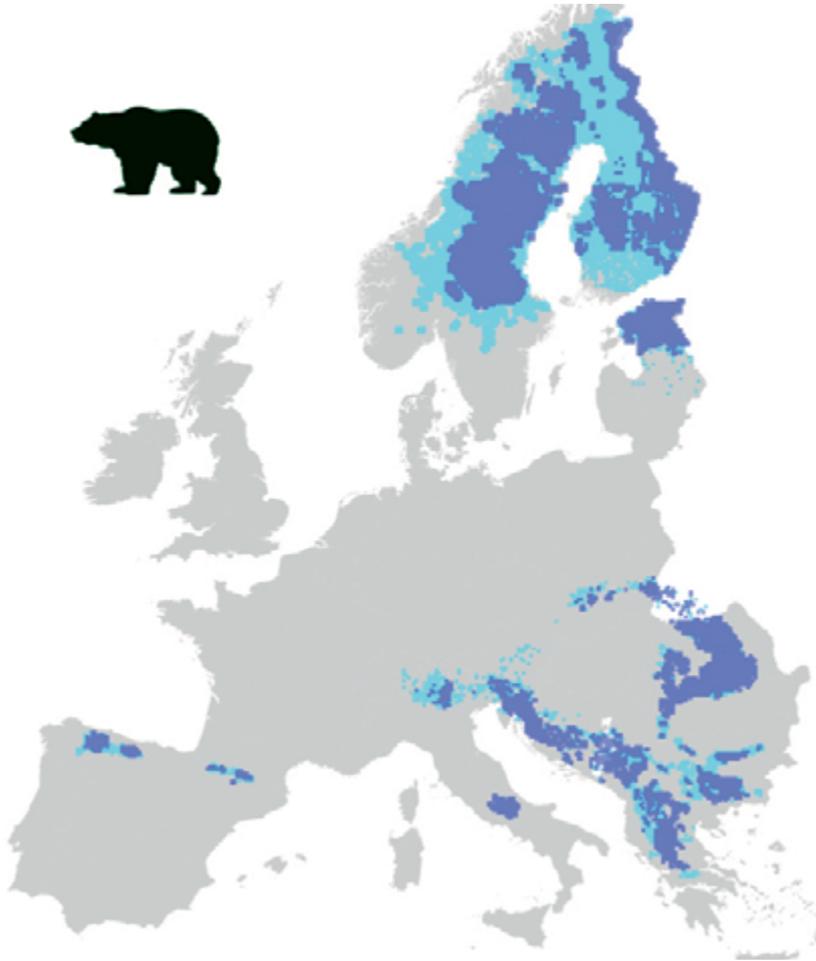
The brown bear (*Ursus arctos* L.) is a representative of the class of mammals (Mammalia), order of carnivorans (Carnivora), family of bears (Ursidae) and is the most widely distributed species of bear. There are seven additional bear species still living today; beside the brown bear also the polar bear, Asian and American black bear, sun bear, sloth bear, spectacled bear and the giant panda.



*Brown bear distribution in the world. (Source: Wikipedia, 2019)*

### **Distribution in Europe**

In the past the brown bear has populated the area of Central Europe, but has disappeared or has been exterminated from most of the area in recent times. The increase in human population has caused deforestation and the subsequent change to agricultural lands. In addition to this the brown bear has been extensively hunted. The whole Europe has around 17.000 to 18.000 brown bears (around 15.000 to 16.000 in EU).



*Distribution of the brown bear in Europe. (Source: Large Carnivore Initiative for Europe, 2019)*

The population density varies and depends on food availability, bear mortality, and other demographic parameters of the population. The greatest density of brown bears (100–200 bears per 1000 km<sup>2</sup>) is in Romania and in countries of the Dinaric Mountains, while a substantial smaller density (0.5–1 bear per 1000 km<sup>2</sup>) lives in the area of Finland and Norway. The European brown bear population survived in mostly isolated “bear islands”: the Cantabrian Mountains, the Pyrenes, Apennine Mountains, Alps near Trento, the Shar-Pindus Mountains, Rhodope Mountains, the Balkan Mountain range, Carpathian Mountains and Scandinavia.

## Main characteristics of this species

### Physical characteristics

The bear is the largest member of the carnivorans. It has a strong body, and a massive head and neck. It walks on its toes and metatarsals flat on the ground, which makes him a plantigrade. The eyes are small and in the front part of the skull, the ears are short and round, the tail is also short and hidden in the fur, which is usually brown, but has many different shades. It can be bright with a yellow color tone or dark brown or black. The males (body length can be over 250 cm) are bigger than the females (can be over 200 cm). The adult brown bear males weigh up to 300 kg, sometimes even more, while the mature females weigh up to 180 kg. Cubs (up to two-years-old) are the easiest way to distinguish females from males, since they only follow their mother.

### Diet

The brown bear is omnivorous in practice, like most representatives of the family of bears. Only one “relative” – the polar bear – is due to the environment where it lives, primarily a carnivore. The diet of the brown bear consists mostly of plant matter (in some seasons up to 95%), but it still needs a certain amount of protein, such as insects (ants, bees, wasps, etc.) and their larvae and pupae, other invertebrates, rodents and carcasses. Sometimes it hunts bigger animals e.g. young ungulates (rarely adult animals), occasionally livestock, mostly sheep and goats. It also finds food in unprotected human garbage. Protein based foods are mostly consumed in spring months, while plant life is mostly eaten from early summer to winter. The diet in fall, when it is bulking up for the winter (the body mass can increase up to 20 %), consists mostly of fruit, forest mast (acorns, beechnuts, chestnuts), and also corn from feeding places. Its teeth and digestive tract are adapted for omnivory.

### Reproduction

The male can mate with multiple females and vice versa in the period from mid-April to mid-August. The reproductive rates of bears is relatively low, since the females mature at the age of 4 and usually give birth every second year. The female is known to be a very caring mother and will defend her cubs in case of danger. The cubs (1–3, rarely more) are generally born in a den from December to February and weigh only a few hundred grams. Based on the studies and analysis made in Slovenia the survival rate of bear cubs is high.



## Denning

The bear usually sleeps during the winter period (December-April), although this is not a full winter hibernation. In late fall it finds a suitable dwelling, called a den, which is usually a natural cave. It can also hibernate under larger felled trees or rock shelters. The start of hibernation depends mostly on constant low temperatures and less of the amount of fallen snow (causally related). The end of the denning period is caused by a longer period of warmer temperatures. Females with cubs born that winter leave the den relatively late, some even in the second half of May. If there is constantly enough food, some bears stay active through the whole winter.



## Activity

Bears are active mostly at night, but can also be active during the day depending on the conditions in the area, the amount of food and human activity. Bears typically walk a few dozen kilometers per day, but the home range size can be very different. Adult females in Central Europe have a home range of 100 square kilometers, while adult males can cover an area a few times that size. It is typical that the home ranges of individual bears overlap. Younger females can be active in their “mother’s area”, while young males leave their parental area, due to the expanding strategy and to avoid mating with relatives.



## Habitat needs

To meet the basic needs (space, food, reproduction, etc.) a bear needs a big enough living environment, meaning a habitat with adequate characteristics. These are: a dense forest area with the higher proportion of deciduous trees, an adequate proportion of an old and young forest (especially for daily cover), an adequate proportion of forest clearing and crossroads with forest fruits (raspberry, cranberry, etc.) and denning areas that are enough removed from human activity.

## Presence signs

### Footprints

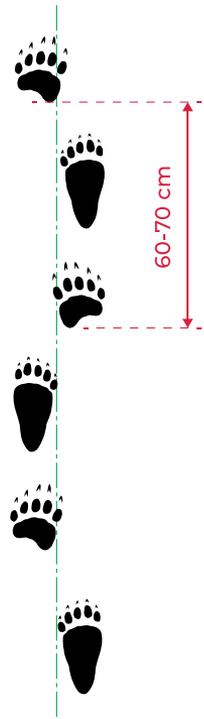
The bear footprints are very distinct and are almost impossible to mistake with footprints of any other species.

The size of the paw depends on the age of the bear. The forepaws have a short and wide print and are similar to the human palm. The length and width is usually 10–15 cm. The hindpaws footprint (the whole sole is usually is visible) is 16–23 cm long and 10–13 cm wide.

Five fingers with claws are visible on the footprint of the forepaw. The footprints in the trace are parallel on both sides of the imaginary line that shows the direction of the movement.



Bear footprints in mud. (Photo: Matej Bartol)

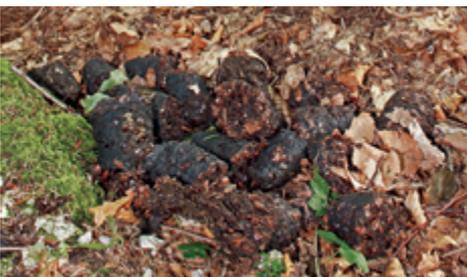


Bear trail – distance between the footsteps. (Drawings: Igor Pičulin)

The badger's trail is similar to the bear's, although a lot smaller, lengthier (the length is twice the width) and there is a relatively larger gap between the digital pads and the rest of the sole. Near the trail of a young bear (can be mistaken for a badger's) are usually footprints of the mother bear. Problems can occur in snow with older footprints, because the melting of snow enlarges or alters the original form. But nonetheless, the bear footprints in melting snow mostly have clearly visible prints of the 5 claws that disappear later, as the print becomes some kind of round dent. A possible misidentification with humans is possible, but human footprints are usually one after the other, while the bear walks on both sides of the imaginary line. It is problematic if only one footprint is found. A misidentification on mud is only possible, if the footprint is deformed due to a slide.

## Feces

The bear diet mainly consists of plants. The bear is an omnivore and cannot digest plants as well as herbivores. The feces therefore contains undigested or partially digested plants (fruit, nuts, berries, corn, etc.), parts of insects and hair if the bear was scavenging. Different color and firmness of the feces is a direct result of the various eating habits. Consumed grass causes the feces to oxidize and turns it black. The undigested plant particles enable the determination of the consumed food. This is not possible with other plant eaters. Bear feces are typically the size of cattle and horse feces. It is shaped like a dumpling and can be solid or liquid. The diameter of a pile of feces is usually 6 or 7 cm. The smell is not that unpleasant (unless the bear was scavenging), though somewhat sour, but it greatly depends on the type of food consumed.



*These are all feces from brown bear and the shape, color, smell and firmness of the feces depends on the type of diet.  
(Photo: Miha Krofel)*

## Hair/Fur

The bear changes its fur once a year (June-August) and the chances of finding pieces of hair increases greatly during this period. Hair can be found in narrow passages, where the bear rubs the fur, when a bear has climbed fences or on trunks of coniferous trees, where it rubs against them (rub trees). There is a high possibility that hair will be found on the following bushes: blackthorn, blackberry, juniper and quince.



*Pieces of hair are an important indicator of the predator. (Photo: Matej Bartol)*

The fur of hoofed animals is shorter, completely straight, different color, thicker, more fragile and slightly curly. This type of hair is rarely found on trunks and bushes. The bear fur is similar to wool; it is longer and slightly curly and could be mistaken with fox or dog hair. Special caution is advised here, but the bear fur is curlier and often has a brighter tip.

## Resting places and the den

When not in hibernation the bear spends his days lying around on open, quiet and difficult to access resting places. They are often on rocky terrain and in places with dense vegetation. The shape of the resting place (day bed) is mostly irregular and oval, and similar to the deer's. It is 70–130 cm long and does not draw much attention.

In warm weather these are simple and shallow holes. A bear resting place can also be identified by feces in the surrounding area (20–100 cm away of the resting place). If the resting place is thoroughly examined pieces of hair can be found.



A suitable shelter – the den – is found for hibernation. The den is usually a cave or a rock shelter and the bear fills it with dry grass and small branches. It can hibernate under a felled tree or in a dense bush, which is also prepared with dry grass and small branches.

*Bear resting place with feces around it. (Photo: Miha Krofel)*



*Bear dens are very different. The bear usually chooses a cave, but sometimes also a rock shelter, fallen tree or a thick bush. (Photo: Miha Krofel)*



*The bear makes a bed inside. It is usually made out of moss, leaves and needles, but sometimes a hole is dug. (Photo: Miha Krofel)*



*Bear scratches on tree trunks. (Photo: Miha Krofel)*

## Marking

In areas with a high density of bears certain trees have traces of claws and bites. Bears also use these trees to rub against them, which is why they are called rub trees or scratching trees and serve predominantly as recognizable signs from different bears.

Bears usually rub against rough trunks (spruce, pine, etc.), where hair pieces can be found. Scratches are usually found on deciduous trees, about one meter of the ground and at an angle (rarely vertically to the tree axis). Although the paw has five claws only three or four are visible.

If the trunk is bitten, the teeth marks are horizontally in regards to the tree axis. Red and roe deer also bite tree trunks, but the diameter is usually smaller than 10 cm and trunk is completely bare.



*The trees that bears rub against can be used for gathering genetic material, since hairs are often left on them. (Photo: Rok Černe)*

## Vocalization

Bears roar during mating and during fights against other males (May-August). Sometimes they roar if they are surprised or feel threatened (female with cubs). Typically, bears are fairly quiet animals, only the occasional humming or growling is heard. When bears eat, they also can make a loud munching sound.

## Traces left behind, when searching for food

When bears search for food they leave traces and signs behind. But only these signs – without other presence signs (feces, pieces of hair, footprints) – are not enough to prove its presence. These signs include:

- **Remains of the prey**

The bear is omnivore in practice and only 10% of its diet consists of animal protein. These are mainly invertebrates, small rodents and carcasses. The bear rarely kills an adult roe or red deer, but this does occur occasionally, during early spring, with heavy snow. The young ungulates are common prey in the ungulate calving period.

- **Relocated or turned over stones**

Turning over stones is typical for other animals as well (badger, wild boar), not only for the bear. But other animals do not have the strength to move bigger stones.

- **Damaged trees and bushes**

When eating fruit-bearing forest plants, the bear breaks the branches and tips.

- **Dug out anthills, damaged beehives and tree stumps**

While looking for insects, the bear digs out places, when a large number of insects are present (e.g. wasp's nests or anthills). Honeycombs and bee broods are the reason bears damage beehives. But this alone does not prove the presence of a bear.



*Dug out anthills, damaged beehives and tree stumps are typical presence signs of bear.  
(Photo: Miha Krofel)*

### ***Signs of predation***

Bears typically use their powerful forepaws to hit their prey. Prey are typically left with scratch marks (visible on the head, neck and back) and bruises (under the hits). The tissue is severely damaged and crushed. The skull and spine can be cracked or broken, while blood is often found in the oral cavity. When killing larger prey (calf and foal), the bear usually bites the back and neck area. An adult bear has 6–9 cm between the canine teeth. In the case of a bear attack severe injuries can be seen.



*An adult bear has 6–9 cm between the canine teeth.  
(Photo: Rok Černe)*



*The bear can dig under the fence to get to the prey. (Photo: Miran Bartol)*



*The prey has often a broken neck, back or other bones. (Photo: Andrej Sila)*



*The bear starts eating at the abdominal cavity. (Photo: Andrej Sila)*



*A powerful forepaw hits kill the prey. Large bruises occur at the hit site. (Photo: Andrej Sila)*



*Large bruises occur on spots where the bear hit the prey. (Photo: Andrej Sila)*



*Bears typically tear the carcass apart and do not eat the skin. (Photo: Andrej Sila)*

Bears typically start eating at the abdominal cavity. The nutritious internal organs are eaten first and then the muscles. The carcass is torn apart, but the skin and bones are not eaten. The skin is removed, but usually stays together in one piece. If the bear is not chased away and does not feel threatened it usually eats the entire prey. A bear can eat up to 10 kg of meat in one day. The prey or parts of it can be dragged away (over 100 m from the scene of the kill) if the bear does not feel safe. Sometimes the prey is covered with the surrounding material (soil, stones, leaves, etc.).



*Not all bear attacks are successful. Often large bodied animals are only injured. (Photo: Andrej Sila)*



*Prey are often killed with powerful forepaw hits directed at the head of prey. (Photo: Andrej Sila)*



*In certain cases, bears will move their prey to a secluded or protected area and then consume their prey. (Photo: Andrej Sila)*



*The bear is the only carnivoran in Central Europe that, in order to get to food, breaks into a building. (Photo: Georg Rauer)*



*Sometimes the bear (similar to the lynx) buries its prey. (Photo: Andrej Sila)*

## **Other types of damage**

### **Fruit trees**

The bear often visit fruit trees and other fruit-bearing plants when fruit are ripe. Tree branches are often broken or scratched when bears climb to access fruit. Vineyards are also an attractant to bears who will eat grapes when ripe.



*Scratch marks are often found on trunks of broken trees. (Photo: Andrej Sila)*



*The bear breaks the branches, which he uses to climb to reach the food. (Photo: Miran Bartol)*

## Beehives

A bear favorite is honeycomb, rich with honey and bee brood (larvae). Since bee brood, and honey is a rich source of carbohydrates and protein, the bear often enters unprotected or poorly protected beehives. It is not difficult to recognize its presence, because a mess is often left behind. Signs of bears at beehives include: scratches on the hives, footprints on the ground and often feces in the area.



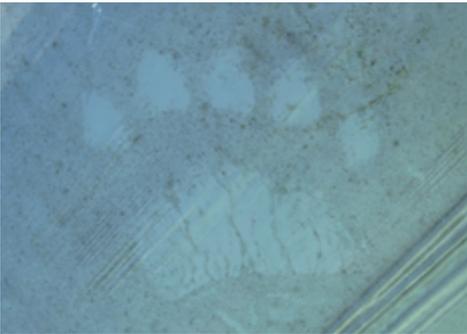
*The bear leaves a real mess braking into beehives.  
(Photo: Andrej Sila)*



*Scratches and paw marks identify the bear. (Left photo: Miran Bartol, right photo: Andrej Sila)*

## Silage bales

Bears often tear the plastic foil of silage bales, which are left in fields or near forest edges by farmers. The reason for this behavior is not yet fully known. The most probable reason is the smell of the bales (formic acid) or the smell of fermentation, but the bear can also be attracted to the plastic that covers the bale. The silage is pulled out, but generally not eaten. Bears are known to bite plastic materials (e.g. foil around the bale, plastic oil containers for the chainsaw lubrication). The presence of the bear is clear due to the traces on the bales, but can also be determined by footprints (tracks) in the soft ground or by feces around the bales.



*The bales were torn apart by a bear. (Photo: Andrej Sila)*

## Vegetables and field crops (corn, potatoes, carrots, etc.)

Bear damage to corn is common when the corn is young or fully ripened. When the corn is young, bears will peel the corn and eat the entire cob. When corn is mature, it is also peeled but the cobs are left. Bears tend to leave circular patterns in corn fields when foraging. Additional presence signs (tracks, feces, hair) are needed to definitely identify that a bear was present. Similar signs occur in red carrot and potato gardens or fields. Tuber crops are dug up or completely eaten and there are numerous bear footprints in the area.



*Bears tend to leave circular patterns in cornfields when foraging. (Photo: Slovenia Forest Service archive)*



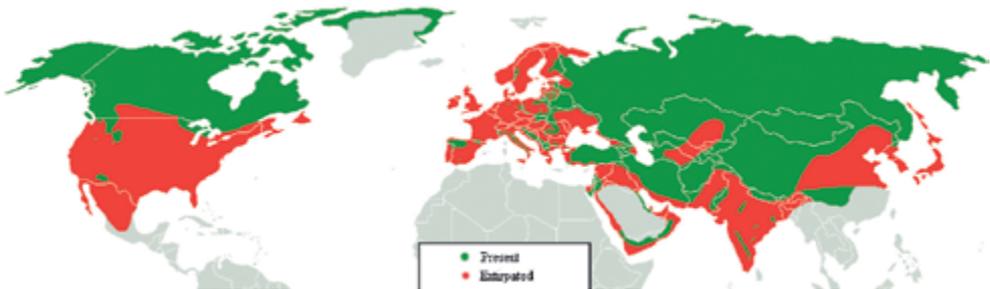
*Carrots that have been excavated by a bear, which may choose other vegetables as well. (Photo: Slovenia Forest Service archive)*

# GREY WOLF (*Canis lupus* L.)

## Species overview

### Systematics

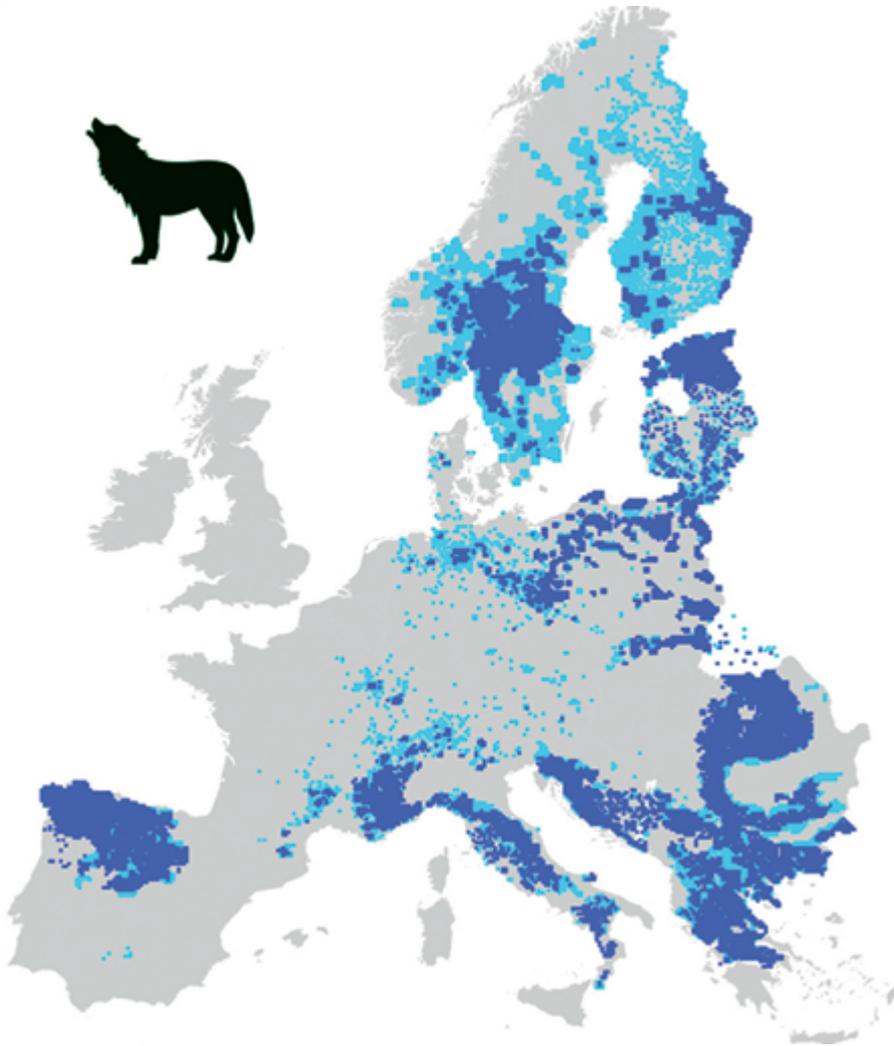
The grey wolf (*Canis lupus*) is a representative of the class of mammals (Mammalia), order of carnivorans (Carnivora) and family of dogs (Canidae). The subspecies that lives in Europe is *Canis lupus lupus*, and several other subspecies are known across the world.



*Grey wolf distribution in the world. (Source: Wikipedia, 2019)*

### Distribution in Europe

For centuries the grey wolf has been persecuted in various ways throughout Europe. In the last two centuries the grey wolf was nearly exterminated in Northern, Central and Eastern Europe. Wolves have survived in only a few isolated areas (the Iberian peninsula, the Apennine peninsula, the Balkans, the Dinarides, the Carpathians, Scandinavia) and Eastern Europe. The wolf population dropped to its lowest levels during 1940-1960. The last two decades have seen an increase in population and the grey wolf is reinhabiting areas, where it was previously exterminated (France, Sweden, Norway, Finland, Denmark, Germany and Switzerland).



*Wolf distribution in Europe. (Source: Large Carnivore Initiative for Europe, 2019)*

## Main characteristics of this species

### Physical characteristics

The wolf is the largest member of the canidae family. The height of an adult wolf is 110–140 cm, the shoulder height is 75–80 cm. Males weigh in average  $38.9 \pm 7.4$  kg and are heavier than females who on average weigh approximately  $34.2 \pm 5.7$  kg. The head is pointy, the eyes are slanted and the ears are relatively large. The lifespan can be longer than 13 years. As the members of the canidae family the wolves are mainly carnivores and reside at the top of the

food chain. The skull has a typical shape for a carnivore with eyes facing forward, a strong jaw and sharp teeth. The skeleton is adapted for fast movements and efficient hunting. The wolf can achieve speeds of 55–70 km/h, and can run at 8 km/h for an extensive periods. Wolves are also excellent swimmers. The neck and chest are strong and wolves walk on their toes (a digitigrade). Wolves have four toes on their hind legs and five on their forelegs, but only four reach the ground so all the footprints have only four visible toes. The wolf has scent glands between his toes, on the base of the tail and his head. They play a vital role when mating and marking territory. Wolves have highly evolved senses, particularly their olfactory (smell) and auditory (hearing) ability. Wolves are shortsighted, but can see moving objects very well and have good vision at night.



### Diet

Wolves are opportunists and sometimes supplement their diet with fruits and vegetables. The size and type of the prey depends on the wolf population and season. A fully grown adult wolf requires approximately 3.8 kg of food daily. Their main food consists of even-toed ungulates and occasionally, livestock. They also eat small mammals as a supplement to their diets, mainly in the summer. The main prey of the wolves in Slovenia are red deer, but they feed on all available even-toed ungulates: roe deer, wild boar and chamois. Wolves also scavage and sometimes feed on livestock, especially if not properly protected. Cases of cannibalism are also known. Wolves often do not eat for up to 4 to 5 days, depending on prey availability, but can eat up to 9 kg of food at once when hungry.



### Reproduction

Wolves mate from January to mid-March and after  $63 \pm 2$  days (usually in April) the pups are born. Three weeks or at least 10 to 24 hours before the birth, the female does not leave the den area. The time depends on the type of the den, which can be hidden under big trees, dense bushes, and fallen trunk, in a hole in the ground, a wider badger's sett, fox lair or crack in stone. The female remains in den from approximately from 49 to 64 days and may change up to 3 different dens during this period. On average she uses one den for 27 days, though some are used for several years. The number of pups (blind at birth) can vary from 1 to 11, but is on average five. Pups begin to see after 11–15 days and first teeth start to show after 20 days. When the pups get bigger, the mother leads them to their pack, where they join the other wolves. The pups drink the fatty milk for 6–8 weeks. The male provides food and older members of the pack help look after their younger siblings. If the pack is bigger and has enough food, other wolves bring the food to the pups, which then have more chances of surviving. The pups first start exploring outside the den after 2–3 weeks and leave it at the age 4–14 weeks. In May, June and July the pups reside for approximately 20 days on each “rendez-vous” location, which are in the range of 1.5 km. They stay only 7 days on similar locations in August and September in the range of 3 km.

In fall, the pups go on their first hunt with their pack. They are fully grown after 10–12 months, but less than 50 % survive the first year. They socially and sexually mature at the age of 2 years.



### Activity

Territories are areas that animals actively defend, mainly from other animals of the same species. The edges of that area are regularly marked with sounds and urine (pheromones) that is left on special places – boundary markers. Where the wolf population is small, the territories of wolf packs are not right next to each other and there is no man's land between them. Some studies have shown that the number of even-toed ungulates in these areas increases, because in order to avoid other packs the wolves do not hunt there. This no man's land is often home to lone wolves. They are defeated wolves that were high in the hierarchy or younger wolves that moved out of their pack's territory. If the population is bigger, the territories are closer together or even overlap and the boundaries are constantly moving. The territories are smaller if there is enough prey, and larger when prey availability decreases. They have to be large enough to constantly feed all the members of the pack. Sometimes a pack accepts a dispersing wolf, usually when the pack loses its alpha male or female. In such cases, the newcomer becomes a reproductive member and/or starts leading the pack. Wolves often use forest roads or skid trails, and even ordinary roads. They are mainly active at night.



### Habitat needs

The wolf is a habitat generalist and can survive in many different habitats where there is enough protein food (free roaming animals, carcasses, livestock and somewhere even human waste). It is a generalist and its adaptability has enabled the survival even in areas with human presence. It roams the tundra, prairies, mountains, semi deserts and the northern forests of North America, and the tundra, taiga, steppe, semideserts and higher altitudes (over 5500 m) in Asia. In Europe it lives predominantly in the forest, therefore it is considered a forest animal, though not a typical one. The most suitable areas in Europa are mountain regions, where the geomorphological conditions are less suitable for human settlement there are fewer human disturbances, but more prey and forests. In Europe and other highly populated areas of the world, the wolf is bound to the forest, since it could not survive the long-lasting pressure of humans in the past.

## Presence signs

### Footprints

The footprint of an adult wolf is similar in size and shape to the one of a large dog. It consists of four smaller digital pads and one larger metacarpal pad. The footprint is usually 8–12 cm long (claws not included) and 7–10 cm wide, while the front print is a little larger than the back. The length of the footstep depends on the speed of the movement; while walking 80–90 cm, while running 110–140 cm, and up to 4 m when jumping. In winter, the paws of younger wolves reach the same size as the ones of adults. The age of the footprints and the conditions to which they were exposed have to be taken into account, when measuring and examining the size of a footprint in snow, since melting of snow can enlarge the footprint. In such conditions it can become twice as big as the fresh footprint. Claws are usually visible in front of the digital pads. This distinguishes the wolf from a lynx footprint, because the latter has retractable claws (just like a domestic cat or wildcat) and they are rarely visible. Sometimes numerous footprints have to be examined to find claw prints.

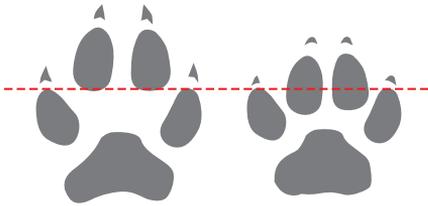
It is difficult to distinguish between the footprint of a dog and a wolf. The footprint of a dog is often rounder and smaller, but in some cases, it can almost be identical to a wolf. A general rule for determining a typical wolf track (that is different from a dog's) is the slightly oblong shape, because the middle digital pads are slightly more in the front. This creates more space between them and the middle pad. Additionally, the wolf's claws are long and pointy, while the dog's are shorter and often more blunt. With large dogs, these attributes can vary from dog to dog.



*The footprint of an adult wolf is 9–12 cm long. The claws are clearly visible.*

*Wolf trail  
– distance  
between steps.  
(Drawings: Igor  
Pičulin)*





*The line that connects the tips of the outer pads is running through (at most) the last third of the frontal pads or does not even touch them (wolf). The line usually runs through the half of the pad (dog). (Drawings: Igor Pičulin)*

The distinction based solely on the footprints is very unreliable or even impossible. The whole trail has to be examined at a greater length, preferably at least 1 km, to make a reliable distinction. This is only possible in the right snow conditions. In doing so, we must pay attention to certain signs:

1. If there are visible human footprints (about the same age) next to the wolf/dog trail, this suggests that possibly the tracks are from a dog.
2. Dog trails are often in zig zags, circles, loops, with frequent returns to the trail, jumping off the road and back, etc. The wolf usually moves in a straight line, but can sometimes change the type of movement; e.g. hunting or marking. When doing the latter they move to the edge of the road to mark the territory and then return to moving in a straight line.
3. If feces are found, the content should be checked. Wolf feces can usually be clearly distinguished from dog feces (chapter Feces).
4. Wolves often move in groups, but not always. In winter the footprints of adult and young wolves are similar in size, while groups of dogs usually have one smaller dog and the footprints are clearly different from the one of wolves.
5. Wolves rarely come close to villages and smaller towns, therefore the possibility that these are trail of dogs has to be taken into account.



*Sometimes front two digital pads are connected (similarly as the jackal's). (Photo: Matija Stergar)*

## Feces

Wolves like to leave their feces on visible places along the roads they often use when moving inside their territories. Most frequently they leave them next to or on footpaths, forest roads, skid trails and especially on the crossroads or places where they change direction. The feces contain a lot of hair (even parts of bones, skin or hooves), the intermediate amorphous substance is black or grey (rarely brown) and it depends of the amount of ingested meat, blood, internal organs and bones. A strong and unpleasant smell is also typical.



*Wolves leave their feces on visible places like forest roads and crossroads of forest roads and skid trails. (Photo: Miha Krofel)*



**Dog:** Usually there is no hair in dog feces, which is often brown, yellow or green like and has a less distinct smell. Remains of human food (briquettes, pasta, vegetables) that the dog eats are often visible.



*A lot of hair is in most cases typical for wolf feces. The best way to see the hair is to dissect the feces. (Photo: Rok Černe)*



*Dog feces are often yellowish or light brown, but generally with no hair. If dissected, the remains of briquettes or pasta are often visible. (Photo: Rok Černe)*

Wolf feces usually have a cylindrical shape; they are 10–15 cm long and 2.5–4 cm wide, with several separated parts. It contains little water and can dry out fast. The feces defecated right after a meal are an exception. These can be softer, can contain more water and are not cylindrical, but are slimy and black. The size of dog feces can be very different. From time to time, wolves and dogs mark the area around the feces by scratching the ground with their hind legs. The lynx, unlike the wolf, often buries his feces.

## Fur

It is hard to distinguish wolf hairs from similar dog hairs in the outdoors (macroscopic). It is also difficult to distinguish between wolf and fox hair. The wolf has yellow and brown-like shades, while the dominant color of the fox hair is reddish. Guard hairs can be determined microscopically. When hairs contains a hair follicle, genetic testing is the most reliable way to determine the species.



*Wolf hair. (Photo: Miha Krofel)*

## Resting places and the den

It is hard to identify resting places of wolves, because they do not prepare any special structures. They often choose remote places with dense vegetation or places in areas with a good overview (clear hillside), but this is not the rule. Pups are born in places that are remote and difficult to access. The female rarely chooses special structures. Usually it is a rock shelter, a pile of fallen trees or a shallow cave that is rocky and difficult to access. Sometimes pups are born in a deep hole or between the roots of a (fallen) tree. If the ground is soft (sand), the female can dig a den herself or she can enlarge a badger's sett or fox lair.



*Wolf's den. This is usually a rock shelter, a pile of fallen trees or a shallow cave that is usually located in rocky terrain that is difficult to access. (Photo: Miha Krofel)*

## Marking

It is known that wolves scratch the ground with their hind legs or (rarely) scratch trunks with their front legs to mark their territory. In doing so, the glands between the pads release an odor and these marks have at the same time a visual meaning for other pack members or wolves. Marking with urine and feces is often combined with scratching the ground.



*Wolves mark their territory with howling, scratches on the ground, feces and urine. Urine and scratches were used as marking in the photo.  
(Photo: Miha Krofel)*

## Vocalisation

Besides chemical and visual communication, wolves use sounds to communicate with each other. The loudest vocalization is howling, which they use to communicate within the pack (strengthening social bonds) and also other packs (marking the source they protect – prey, cubs, territory). They use howling to locate individual members of the pack after they were temporarily separated. It can most often be heard in summertime from July to September, when they are raising pups. The pups like to howl with the adults, but their vocalizations tend to be whines or wails. Wolves are often heard during their mating season (January–February). Besides howling, wolves communicate (especially when in direct contact) with growls (threatening, sign of superiority) and whines (sign of subordination).

## Signs of predation

Most wolves live and hunt in family groups called packs. Small or medium sized prey are usually hunted by one wolf or a smaller group. **Medium sized prey**, such as roe deer, red deer fawns or goats and sheep, are killed by a strong bite to the throat or neck. Clear lacerations and bruises are created in this area. The first bite is usually already on point, therefore there are only few holes of the canine teeth in the skin. The rest of the medium sized prey remains unharmed, except for a few blunt scratches. **Smaller prey**, such as a young wild boar or lambs, are sometimes killed with bites to the back. **Larger prey**, such as an adult red deer, donkey, horse or cattle, are attacked with repeating bites to the thigh, hip, and stomach area, which causes severe injuries. Small or large chunks of flesh can be torn away and can be found in the close and distant surroundings of the killed prey.



*The distance between wolf's canine teeth is 35–40 mm. (Photo: Rok Černe)*

**Dog:** Similar signs can be observed with dog predation, where these kinds of bites are more frequent, including with smaller prey. Due to shorter and blunter teeth, dogs often fail to pierce the skin and only crush the area. With some skilled dogs, which have learned how to kill an ungulate, the killing technique is practically identical to a wolf's. In some cases, a genetic analysis of the saliva in the area of the bite is needed to distinguish whether a dog or wolf was involved in the depredation.





*The wolf can grab smaller prey, such as lambs, over the body or head and can tear them in half. (Photo: Andrej Sila)*



*The wolf stops larger prey with bites to the thigh, hip and stomach area. (Photo: Slovenia Forest Service archive)*



*The dog follows his prey and bites almost every part of the body. Injuries are therefore visible on the entire carcass. Similar injuries can occur, when wolves teach their pups to hunt. (Photo: Centre for Fish and Wildlife Health – Bern)*

When a wolf's prey stops trying to escape, the wolf often grabs it by the nose and suffocates it or knocks down the animal and kills it with a bite to the neck. The wolf holds the prey until the animal suffocates or bleeds out. Sometimes the prey is killed immediately due to the bite in the carotid artery area.



**Dog:** It is typical that the dog shakes its head or entire body when holding the prey, causing severe injuries with large wounds in the throat and neck area. The trachea and the esophagus are often injured or torn apart. There are of course skilled dogs, which kill the medium sized prey, such as a sheep, with one single bite.

*The dog usually shakes its head or entire body when holding the prey, causing severe injuries with large wounds in the throat and neck area. (Photo: Andrej Sila)*



*The wolf kills its prey with a strong and precise bite to the neck. Occasionally ripping out the whole trachea. (Photo: Andrej Sila)*

Claws of the wolf, similar to the dog, are blunt enough to not pierce the skin, but can leave visible bruises and scratches on the surface. Animals that survive a wolf attack are typically badly injured.



**Dog:** Most dogs have little experience with killing animals; therefore they bite wherever they have a chance and leave numerous bites all over the body. As a result, several bruises are found after flaying.

Wolves, similar to dogs, open the abdominal cavity first, but they do not eat the digestive system right away. They start with internal organs (liver, spleen, heart, lungs, etc.) and udders, which are rich with vitamins and minerals, and sometimes finish with the bones. If not disturbed, wolves usually keep returning until they have eaten almost the entire prey. Only skin parts, larger bones, the rumen and the intestines remain in most situations. After feeding, wolves can take individual parts of the carcass, usually the limbs, which are then food for the cubs or other members of the pack or they bury these parts and save them for later.

**Dog:** Often dogs hunt their prey only because of their hunting instincts and not from hunger. But if they eat the prey, they open the abdominal cavity, pull out the udder and intestines and eat them.



*Dog and wolf scratches leave only superficial wounds that are not bloody, unlike lynx scratches. (Top left photo: Urs Breitenmoser, top right photo: Centre for Fish and Wildlife Health – Bern)*

*Left: Wolves generally open the abdominal cavity and start eating the internal organs and udders, which are the most nutritious. (Photo: Andrej Sila)*



*The prey is often eaten in several spots. A pack can eat a prey the size of a sheep or roe deer in one hour. (Top photo: Miha Krofel, left photo: Andrej Sila)*

## Possibility of misidentification

### Lynx

- The wolf has a stronger bite that causes lacerations of the neck muscles, hemorrhages on the neck, and it can crush the trachea or the esophagus.
- Wolves typically do not pierce the skin with their claws (e.g. there is no hold signs on the ribs and neck of the prey).
- The lynx almost never kills multiple animals at once.
- The wolf eats the innards; the lynx eats the meat (thigh area).



### Dog

- Many animals survive the attack.
- There are many uncontrolled bites to various parts of the body (neck, head, ears, tail, etc.).
- Shredded wool and hairs are found in the area of the carcass.
- Traces of paws are different sizes.
- Killed animals are usually not consumed.
- Young wolves cause similar injuries as dogs, but they attack more than one animal. Signs of older and more experienced wolves are visible on certain animals.



# GOLDEN JACKAL (*Canis aureus* L.)

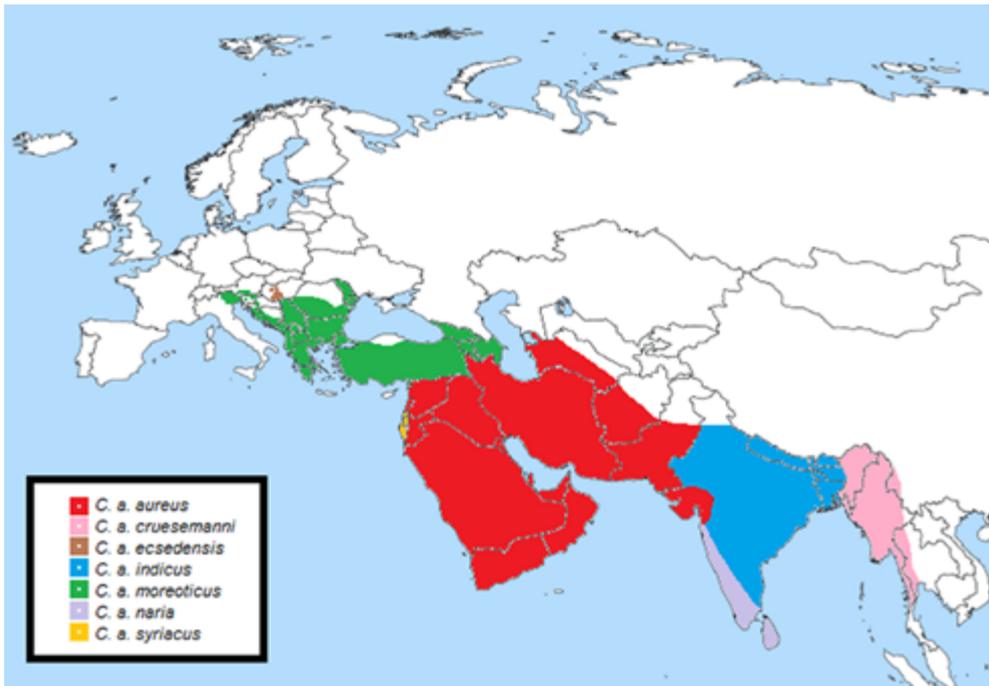
## Species overview

### Systematics

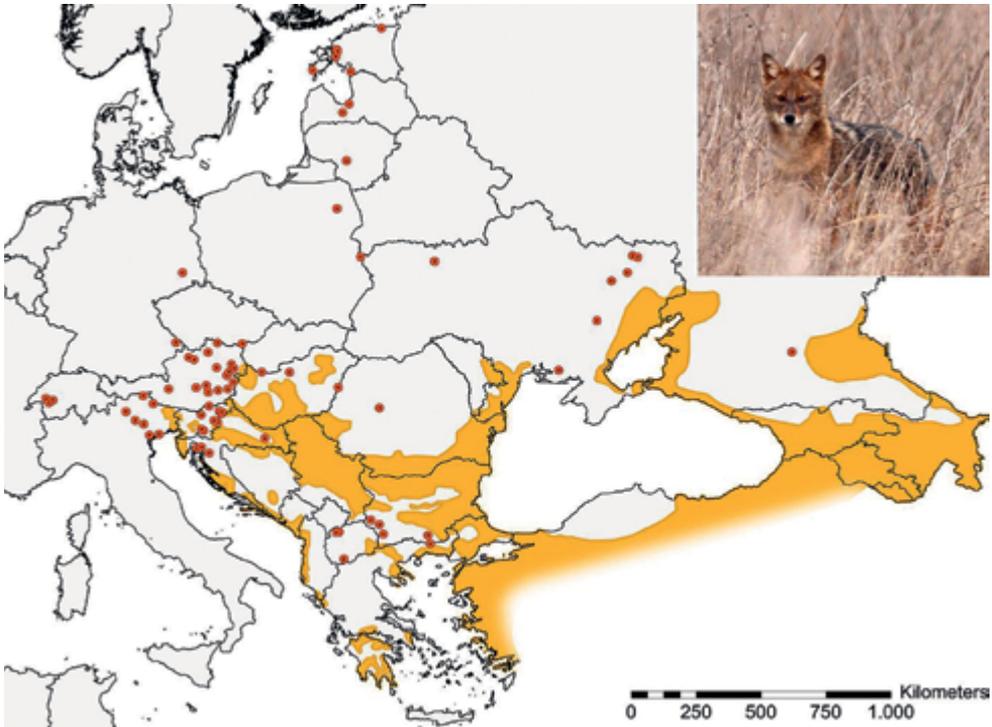
The golden jackal (*Canis aureus*) is a representative of the class of mammals (Mammalia), order of carnivorans (Carnivora) and family of dogs (Canidae). Beside the golden jackal, there are three additional known species: the side-striped, the black-backed jackal and the African golden wolf.

### Population

After the last ice age, the jackal spread from the Middle East to Southeastern Europe. In recent decades, the jackal that inhabits the Balkans started repopulating Central Europe, and also entering Northeastern Europe. It is common along the Adriatic coasts and Pannonian Basin. Jackals are good swimmers and are found on islands. Jackals are not dangerous to humans.



Distribution of golden jackal subspecies in the world. (Source: Wikipedia, 2019)



*Distribution of the golden jackal in Europe in 2015. Yellow areas represent permanent range and red circles are detected occurrences of individuals. (Source: Trouwborst et al., 2015)*

## Main characteristics of this species

### Physical characteristics

Male jackals are up to 130 cm long (including the tail), 50 cm high and weigh up to 15 kg. Females are usually slightly smaller. Jackal fur is typically grey, black and yellow, reddish or a golden color with two parallel white stripes on the chest. The tail of the jackal is short (compared to the fox) and dark-tipped.

### Diet

Jackals are opportunistic omnivores. They can be scavengers but also predators and they occasionally feed on plants. Their diet includes invertebrates, amphibians, birds, smaller mammals, rodents and other smaller mammals, roe deer and wild boar—mostly as scavenged remains left from hunters. Their long legs and curved canine teeth are adapted for hunting small mammals, birds and reptiles. When accessible, they also attack smaller livestock. Plant foods includes mostly

fruits, but they also eat seeds, grass, etc. Winegrowers in Dalmatia have reported issues with jackals since they feed on grapes.



### Reproduction

The male and female form a monogamous pair for life. In Central Europe, the jackal mating season is from January to early February. The gestation period is from 60 to 62 days and the female gives birth in the den, usually at the end of April or at the beginning of May. Pups leave the den after three months. Most jackal species have four pups on average, but they can have up to ten. Social organization among jackals is twofold: the solitary pair or a pair with helpers (who are close relatives of the pair). Studies made on related species (*C. lupaster*) showed that if only the parents take care of the litter, usually only one pup survives. When adult jackals are hunting, pups are often left alone. One helper alone can enable the survival of three cubs and with more helpers, the chances for survival are even higher. During nursing, the helpers bring the female food, which means more milk for the pups. The male and female therefore have more time for hunting together, which is more successful than hunting alone. The young leave their parents when they are two years old. At this time, they have already had experience raising the next litter of brothers and sisters.

### Activity



Jackals are crepuscular and are most active at dawn and dusk. Normally they live in pairs or smaller packs and usually hunt alone, sometimes in groups. The pair lives together in a territory of 0.5 to 2 km<sup>2</sup>. When there is abundant food, the territory of one jackal family can extend from 3 to 8 km<sup>2</sup>. Partners feed together, rest together, howl together and even mark their territory together. Partners share an equal role in defending their territory. The position of ears, body and snout play an important role in jackal communication. Typical jackal vocalizations important for communication include howling-like calls, yapping, barking and other similar sounds. Like all members of the dog family, jackals have a well developed sense of smell and hearing.

### Habitat needs



Jackals are habitat generalists. They inhabit forested areas and also make use of wetlands, bogs, and riparian areas along rivers that afford shelter. Jackals often forage near settlements where they make use of slaughterhouse-remains and garbage. Like all members of the dog family, jackal behavior is plastic and there are large individual differences in personality traits similar to wovles and domestic dogs.

## Presence signs

### Footprints

Jackals are digitigrades. Their pawprint is similar to that of a dog, wolf and fox. Jackals have four digital pads, one larger palmar pad and often leave claw prints in their tracks. The jackal's paw is similar to some dogs species in that their front two digital pads are connected in the back part. In certain tracking conditions, this can be noticed in a jackal's track. Each pawprint is usually from 5 to 6 cm long and 3 to 4 cm wide. A jackal moves like a fox or wolf, mainly in a trot and their tracks are left in a straight line. While hunting rodents, jackals often wait in place and ambush their prey.



*A jackal's pawprint. The two front digital pads are connected (not always visible) and claws are visible.*



*The connection of the first two digital pads can be clearly seen on a jackal's paw. (Photo: Rok Černe)*



*Jackal's trail – footstep distance. (Drawings: Igor Pičulin)*

### Feces

A jackal's feces is very similar to that of a fox or small dog. The fecal material consists of one or more parts and has a cylindrical shape that can be twisted at one end. The color varies, depending on the diet. The content of the feces is highly variable since jackals are opportunistic omnivores. Hair, bones of small rodents, feathers, reptile scales, remains of amphibians, insect skeletons, remains of larger mammals (mostly carrion), human garbage, slaughterhouse-remains, and plants (fruits, seeds, corn, grass and so on) can be found in jackal feces. Although jackal feces are on average larger than a fox, the size overlaps with both species and it is often difficult to distinguish between them.



*A jackal's feces with meat food. By the shape, size and content it is very similar to a fox's feces, but it is on average, somewhat larger. (Photo: Miha Krofel)*



*A jackal's feces with plant food. (Photo: Iztok Mlekuž)*

## Vocalization

Jackals typically communicate by high-pitched howling and yapping. Often multiple individuals vocalize concurrently. Howling can last up to several minutes, but typically takes for less than half a minute. Normally only territorial groups howl. Jackals howl and yap throughout the whole year, but intensifies during certain seasons, e.g. mating season (winter) and when raising pups (summer).

## Signs of predation

A jackal is primarily a scavenger and predator of small vertebrates (rodents, birds, reptiles and amphibians), therefore attacks on large mammals are rare and limited mostly to weak and sick animals and juveniles. In attacks on livestock, jackals mainly target smaller and weaker animals like lambs. The killing technique for larger prey is similar to that of a fox, but a fox bites more often. The distance between the jackal's left and right canine teeth is from 25 to 30 mm, which is larger than a fox (19-28 mm). A jackal first grabs its prey by the back and lower parts of the body and then tries to kill it with a bite to the neck (mainly from the side). Besides **the fatal bite in the neck there are typically additional bites to the stomach and legs**, possibly also on the snout. Smaller animals (e.g. newborn lambs, rabbits) can be killed with only a bite in the neck (no bites on the body). **The same killing technique by jackals is also used by small- to medium sized dogs** and therefore it is difficult and unreliable to distinguish a kill made by a jackal or dog without genetic analysis. Like other representatives of the dog family, jackals start to feed at the abdominal cavity. A jackal does not take the head away.



*The distance between jackal's canine teeth is 25–30 mm.  
(Photo: Matej Bartol)*



*Jackals start feeding on the entrails.  
(Photo: Dragan Marković)*



*Jackals kill their prey with repeated bites similar to foxes. (Photo: Paolo Molinari)*



*Jackals leave bite marks on the ears of their prey similar to foxes.  
(Photo: Dragan Marković)*



*A lamb with numerous bites to the neck. After it died, crows removed the eyes.  
(Photo: Dragan Marković)*

# RED FOX (*Vulpes vulpes* L.)

## Species overview

### Systematics

The red fox (*Vulpes vulpes* L.) is a representative of the class of mammals (Mammalia), order of carnivorans (Carnivora) and family of dogs (Canidae). The *Vulpes* genus includes twelve extant species; beside the red fox there is also the arctic fox, American swift fox, kit fox, the cape fox, corsac fox, Rueppell's fox, pale fox, Blandford's fox, the Bengal fox, the Tibetan sand fox and the fennec fox.

### Distribution of the species

Of all the free-living carnivorans, the red fox has the most widely distributed population in the world and is distributed throughout the entire northern hemisphere. In the north it lives everywhere up to the arctic frontier, where it joins with the habitat of the arctic fox, and in the south, it ranges to the Sudan in Africa. In the southern hemisphere, the fox was introduced to Australia, but it can also be found everywhere in Europe. The population in Central Europe ranges from the tree line to the sea.



Red fox distribution in the world. Green = native, blue = introduced, orange = presence uncertain. (Source: Wikipedia, 2019)

## Main characteristics of this species



### Physical characteristics

The fox has an elongated slim body with flexible and pointy ears and a narrow pointy snout with long thin hair. It has a long bushy tail with a white end. The fur is red-brown, with a white neck and belly. The lower part of its legs and the tips of its ears are dark colored. The body is 50–90 cm and the tail is 40–60 cm long. Adult animals can weigh up to 10 kg. Females are typically smaller and weigh less than than males.



### Diet

Foxes are omnivores with a very diverse diet. It includes over 300 known animal species and many plant species. Their primary diet consists of rodents, followed by birds and also smaller mammals, insects, reptiles, carrion, and soft fruit. Fox can attack the young of larger mammals, e.g. roe deer when they lie down to rest. In some areas, their diet during fruit ripening season can consist mostly of of fruits. Adult animals consume around 0.5 kg of food per day.



### Reproduction

The red fox is a monogamous animal that mates from January to May. In Slovenia, the peak of the mating season is January. The gestation period is  $52 \pm 3$  days and the female gives birth to 1–10 (usually from 4 to 7) naked and blind pups that weigh 60–150 g. The female weans the pups, when they are four weeks old and weigh 0.4–0.8 kg. When the pups are six months old, they are adults and they leave the den. In the fall of the same year, the pups become independent and sexually mature.



### Activity

Foxes are mostly nocturnal, because of the activity patterns of their prey, human activity and the activity of their predators. They are mainly active from around one hour after sundown and until one hour after sunrise. When the female takes care of her pups, she is often active during the day, because she needs to find additional food. Therefore, fox pups can found in front of the den at anytime of the day.

The fox is a territorial animal and the areas where related foxes are active may sometimes overlap. The population is stable in areas with plenty of food and in areas where the quantity of food varies. The density of the population and the size of the territory can also vary. Territories in areas with abundant food resources can be up to 40 ha and the largest territories can be up to 1500 ha. The fox is also familiar with double social organization (only the parents or close relatives without their own young take care of the cubs), mostly depending on the local population density.



## Habitat needs

Only rare mammal species are capable of such assimilation as the fox, which is an extremely “plastic” species and is highly capable of assimilating and forming different life patterns in different environments. It lives in forests, fields and suburban areas. The area that suits them the most is a combination of forests and open fields.

## Presence signs

### Footprints

The footprint of a fox is similar in shape to that of a small wolf or domestic dog. Digital pads (4) are relatively small, therefore there is usually a large space between the front two digital pads and the middle one. Similar to other representatives of the dog family, the fox also has non-retractable claws, which are long, pointy and normally visible. The footprint is elongated and around 5 cm long without claws. It is from 4 to 4.5 cm wide and the individual footprint is lengthwise distinctly symmetrical and therefore it is not possible to determine if the footprint is from the right or left foot. The forepaws are slightly bigger than the hind paws. Same sized dogs have footprints in a more circular and rounded shape, and the distinctiveness and length of the claw's prints (depending on the breed) is very different. A dog's pads are usually somewhat larger, therefore the space between the front digital pads and the middle one is normally smaller or there is no space at all.



*Footprint of a fox. Long and pointy claws are clearly visible.*



*Fox trail – distance between the steps.  
(Drawings: Igor Pičulin)*

A fox generally moves by walking and rarely trots or gallops. It often puts its hind paws in the footprints of the forepaws, especially in snow. When moving, it often uses linear structures in nature, for instance forest roads, paths, tractor roads, trails or forest edges. In deeper or slightly fluffy snow, a fox's tracks can be distinguished from a lynx's or wolf's, because of the short step distance, which measures while walking, 30–40 cm and when running, 70–80 cm.

## Feces

A fox likes to leave its feces in visible places, e.g. rocks, stumps or other exposed areas, mainly next to paths or on them, tractor roads, forest roads or in the direct vicinity of noticeable objects in the environment (e.g. feeding areas, forest houses, hayracks). The structure of a fox's feces is very different and depends on the available food during each season. It often contains short hair from smaller mammals, remains of fruits (pits, seeds, shells) or insects, feathers, claws, pits, hair and other harder to digest parts, which it consumes while eating carrion. A fresh fox's feces has a strong and typical fox's smell and can be black or almost white, while different fruits and berries can turn the feces to many other colors. The feces usually have a cylindrical shape and is 8–10 cm long and 1.5–2.5 cm in width. It can be divided in two or three parts and is frequently twisted and pointed at one end.



*Fox feces typically have a cylindrical shape and are approximately 8–10 cm long and 1.5–2.5 cm wide. The feces can be divided in two or three parts and is frequently twisted and pointed at one end. (Photo: Igor Pičulin)*

## Hair

It is difficult to distinguish between fox and dog hair found in the outdoors. (macroscopically). It is also difficult to distinguish between a fox and a wolf. Fox hair is normally light (white) at the follicle, the larger part first half of the hair is black and the other half can be dark red or orange, often with a black tip. It is possible to microscopically determine guard hair and genetic specification is the most reliable when the hair contains a follicle or a larger quantity of fat or other cells (saliva) that can be present on the hair.

## Resting places and the fox lair

Foxes only occasionally use lairs. They cannot built their own den and therefore they take it from other animals (badger) or they occupy an abandoned badger's sett or rock cracks, rock shelters and smaller dry water burrows in the Karst area. A fox can only make minor modifications to a lair by digging out small quantities of material. A fox's lair can be distinguished from

a badger's sett by having a strong fox odor and by many prey remains found nearby (bones, feathers). It is also typical for a badger's sett to have a deep tunnel that leads towards the entrance. Sometimes the tunnel can be used by a badger and a fox at the same time (inside, the tunnel splits and each has its own cave). It is difficult to identify other temporary resting places of foxes, because they do not make special structures. They often pick remote areas with dense vegetation as resting places.



*Remains of the prey can often be found outside a fox's lair. (Photo: Miha Krofel)*



*The entrance to a fox's lair. (Photo: Miha Krofel)*

## Vocalization

A fox yips (barks) throughout the whole year, but most often during mating season. It is possible to hear the mating call from December to end of February. Each individual stanza of the bark is a combination of a series of three to six sounds that change in a fast sequence and in some cases it can even turn into screeching. Somewhat louder is the warning call that sounds similar to a roe deer call, only lighter and more tightened. An adult vixen warns her pups in this if there is danger.

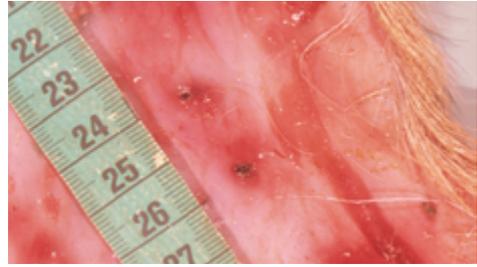
## Signs of predation

A fox mainly hunts and feeds on smaller mammals. In rare cases, a fox can catch and kill roe deer and small livestock, but in such cases in Central Europe, it attacks sick, very weak or very young animals, though the situation is different in Scandinavia. Under special conditions, e.g. very deep and crud snow that breaks under ungulates, a fox can also kill a healthy, adult roe deer, but this happens very rarely.

A fox can confront larger prey **with numerous repeated bites in the stomach, hip, thigh and leg area**. In these places, subcutaneous bleeding occurs. When it knocks the animal down, it kills it with repeated bites in the throat and neck. Long and sharp canine teeth cause **numerous deep punctured wounds** that are similar to those made by a shotgun. It is still possible to measure the distance between the canine teeth on the bite wound. They can be from 19 to 28 mm apart.



Recognizable marks for a fox's prey are similar to jackal's. Numerous small deep holes in the neck area and often in the thigh, belly and leg area. (Photo: Centre for Fish and Wildlife Health – Bern)



The distance between canine teeth of a fox is from 19 to 28 mm. (Photo: Anja Molinari - Jobin)



A fox usually takes away parts of its own or found prey, often the head. In the photo is a fox's prey without the head. (Photo: Miha Krofel)



Because it takes away parts of the body, only blood and hair are left. (Photo: Rok Černe)

Foxes typically begin to feed on the abdominal cavity and remove the digestive system and other internal organs. Foxes like to bite of some parts of the carcass' remains (its own prey or often the prey of other predators or dead animals), especially the head and take it away from the place where it was killed or eaten.



The skull of a fox. (Photo: Matej Bartol)

# EURASIAN LYNX (*Lynx lynx* L.)

## Species overview

### Systematics

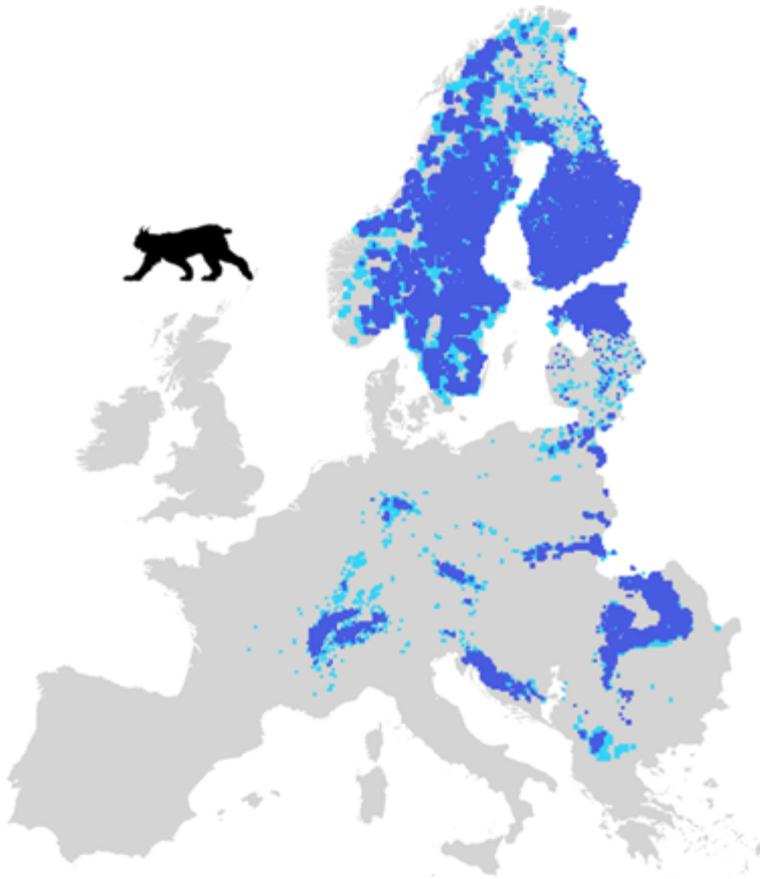
The Eurasian lynx (*Lynx lynx*) is a representative of the class of mammals (Mammalia), order of carnivorans (Carnivora), family of cats (Felinae) and lynx genus (*Lynx*). The lynx genus includes four species (the Eurasian, Iberian and Canadian lynx and the bobcat), which populate a large portion of the northern hemisphere.



*Distribution of Eurasian lynx in the world. (Source: Breitenmoser et al., 2015)*

### Distribution in Europe

In most parts of Central and Western Europe the lynx was eliminated in the 19<sup>th</sup> and early part of the 20<sup>th</sup> century or pushed to near extinction in the north of Europe. In the second half of the 20<sup>th</sup> century, lynx were legally protected, which helped to increase their number in Northern Europe. Reintroduction programs also helped to repopulate some areas in Central and Western Europe and are still continuing today. When this guidebook was written it was possible to distinguish the following populations: Carpathian (2100-2400 animals), Scandinavian (1300-1800 animals), Karelian (2500 animals), Baltic (1200-1500 animals), Dinaric (130 animals), Alpine (160 animals), Jura (140 animals), Bohemian-Bavarian (60-80 animals), Harz (40-50 animals), Balkan (20-40 animals) and Vosges-Palatinian (less than 10 animals). In comparison to the other two species of large carnivores in Central Europe, the grey wolf and the brown bear, the lynx is rather a mysterious and almost unknown species to the general public.



*Distribution of the Eurasian lynx in Europe. (Source: Large Carnivore Initiative for Europe, 2019)*

## Main characteristics of this species

### **f** Physical characteristics

The Eurasian lynx is the largest lynx species. The average weight is 20 (15–30) kg, the length is 80–130 cm and the height is 65 cm. The male is somewhat larger than the female. Lynx have a relatively short, typical cat head and a strong elongated body with strong, long legs and a 10–30 cm long black tail. They have triangular ears with black tufts of hair and side whiskers, which enlarge the size of the head. The pattern of spots and the color of the fur are highly variable. The primary color of fur is greyish with different shades of brown, yellow and red. The pattern has spots or stripes, but the fur can also be without any noticeable pattern. When walking, it steps on its toes with retractable claws. It has extremely good eyesight, well developed hearing and a somewhat less developed sense of smell.



## Diet

The lynx, like all cats, is a highly specialized predator and exclusively a carnivore. The main prey are smaller ungulates, mostly roe deer but also young red deer and chamois. Important components of the typical lynx diet include: hares, foxes, birds, etc. and occasionally, lynx also feed on carion or consumes plant food. A lynx has two hunting techniques: stalking its prey and ambushing it. It catches the prey with fast jumps, rams it to the ground and kills it. When it catches the animal, a lynx usually jumps on it from the side, grabs it with its teeth and forepaws and tries to knock it down to the ground. The attacked animal can carry the lynx for several meters.



## Reproduction

Lynx mate from middle February to end of March. At this time, they communicate by typical “meow”-like sounds. The females are sexually mature in their second year and the males in their third. Usually the female give birth to kittens (2–3) in the second half of May, after a gestation period of 70–76 days. The young are born blind and start to hear after 18 days. Until the age of eight months, they are completely dependent on their mother; the mortality of cubs during the first year can reach up to 50 %. They accompany their mother until the next mating season (10 months), and separate afterwards, because she simply stops taking care of them.



## Activity

Lynx are solitary animals and are territorial except when females are with kittens of the year. The females are quite evenly scattered over the habitat, their territories are separated, because they compete for food, which is needed for raising their young. Male territories overlap with those of females and other males, since they compete against each other for the affection of females, especially during the mating season. Territories of males range up to 270 km<sup>2</sup> and territories of females up to 170 km<sup>2</sup>. Lynx mark their territories with urine and animals “respect” these marks. The number of lynx, population density, growth and size of territory mostly depend on the availability of the prey. An adult lynx can walk during its nightly wanderings through its territory up to 45 km, but this depends on the sex and age of the lynx, the density of the prey and success of hunting. The behavior pattern of lynx is directly connected with day and night. They rest during the day, and hunt and are active at night. This kind of pattern changes only during the mating season. After an active night they usually do not come to the same place, where they were the previous day, however they periodically do use about the same tracks when wandering.



## Habitat needs

The lynx in Europe mostly populates forested areas (deciduous, coniferous and mixed forests), in Central Asia open areas without forests, semideserts and areas above the tree line. The lynx is not a habitat specialist since it lives in many diverse forest types and areas. In Central Europe, it especially likes to live in high forests with a well-developed understory, where a significant portion of the forest is made up of fir and spruce. In these forest types, weather induced disturbance (windthrow, snow) can create fallen trees that make excellent features for lynx to hunt and ambush prey. The basic characteristics of a suitable habitat are:

- availability of prey,
- availability of hiding places for a daily rest,
- availability of hiding places for whelping and
- no major disturbances in the territory.

## Presence signs

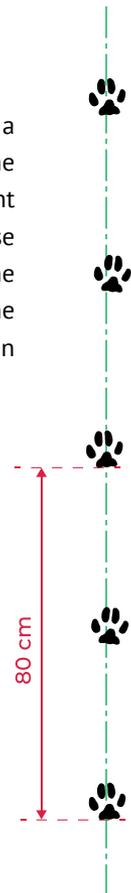
### Footprints

Lynx are digitigrades. Their footprint is round with four smaller digital pads and a larger palmar pad, which often has two cuts on the bottom side. When walking the lynx has its claws retracted that is why there are no claw prints on the footprint (exception: when walking on a steep slope or slippery surface, they sometimes use their claws to help walking). The length and width are similar and therefore the footprint seems round. The diameter and length of the footprint is 6–8 cm and the palmar pad is 3.5–4.5 cm wide. Forepaws are larger than hind paws. The lynx can spread its toes in deep snow, therefore the footprints look bigger.



*Lynx trail – footstep distance. (Drawings: Igor Pičulin)*

*Lynx footprint. The round shape and no claw prints are typical.*



Lynx typically walk and rarely run more than 100 m at a stretch. It puts the hind paws in the footprints of the forepaws. The step is around 80 cm long, but lynx can jump more than 4 m. In these cases, the footprints of all four legs are close together and there is a longer gap behind them. When moving, lynx choose steep, rocky and difficult to access terrain. However, they also regularly use forest roads and skid trails, where it marks rocks, stumps, small spruce trees and other objects (similar to a wolf). A lynx's footprint is in shape and size similar to the wolf and dog, sometimes even the jackal or fox. All these footprints differ from the lynx's, since they all have a claw print. Sometimes numerous footprints must be examined, because claws of dogs and similar species are not always visible in all footprints. The cat and wildcat also have no visible claws in the footprint, but they are smaller than the lynx (length and width of a cat footprint does not exceed 4 cm).



*Lynx like to walk on fallen tree trunks.  
(Photo: Matej Bartol).*

## Feces

Lynx are exclusively carnivorous and in Central Europe, they mostly feed on roe deer and rodents e. g. dormice (sometimes also red deer, chamoises, birds and reptiles). Subsequently, the feces often contain hair and sometimes pieces of bones, but not as much hair as a wolf's feces. The shape of a lynx's feces is similar to a wildcat's, which is smaller. Fox's feces are twisted along the axis and, except in winter, contain remains of plants and insects. A wolf's feces is usually somewhat larger (wider and longer), contains a lot of hair and has at least one twisted end. Wolves and foxes do not bury their feces. Sometimes grass can be found in a lynx's feces, which has a cylindrical, straight shape (are not twisted) and are pointy at one end. They can consist of one or more parts. Parts of the feces are often relatively short (the length is double the width), but not always. Size and color vary. The black, brown or grey feces has a diameter of 2–3 cm. **The lynx usually buries its feces**, therefore it is hard to find in nature. It is easier in snow, if tracks of digging are located. In the area of the prey 20 cm big piles of litter or snow can be found. If they contain feces, it is a good sign that it was a lynx or a cat. The feces has an unpleasant smell, but not as strong as the wolf's.



*Several non-twisted parts of the lynx feces.  
(Photo: Miha Krofel)*

## **Hair/Fur**

Just like the cat, the lynx likes to rub against vertical objects (e.g. a trunk, a wooden fence, a wall of shack, a broken branch), where pieces of hair can be found. A single hair (can be curly or straight) is thin and up to 5 cm long. The hairs are often white and thin at the base, yellowish, beige or bright orange in the middle and black at the tip. For a reliable differentiation from cat and wolf hair, it often has to be checked under the microscope or with DNA analysis.

## **Resting places and den**

It is hard to recognize lynx resting places since they do not make them. Often lynx choose an exposed location with a good overlook (e.g. at the edge of a cliff), but not necessarily. In winter the lynx often lies next to a trunk of a coniferous tree. The female rarely chooses any special places, when she gives birth. Often it is only a rock shelter or a shallow cave, generally on a rocky and difficult to access terrain. Sometimes the cubs are born in deep holes or between the roots of a (felled) tree.

## **Marking**

The lynx marks his territory with frequent urination. The feces are buried and do not serve for marking. Like other cats, the lynx sharpens its claws, which is also a marking method. Usually trees or felled trees and stumps are used; the scratches run along the trunk. The lynx often choose the same spots, but they are very hard to find in nature.

## **Vocalization**

Lynx vocalization is mostly heard during the mating season (February–March), when the male and female call each other with loud and slightly hoarse meows. These sounds can be heard up to 5 km away. Often these calls come in series, consisting of 3 to 10 calls, with pauses in between each series (e.g. 5 minutes).

## ***Signs of predation***

The lynx hunts by stalking or attacking from an ambush. Usually it gets within a few meters of its prey and catches it in a couple of jumps. If the attack is not successful in a couple dozen meters, the hunt is given up. Larger prey (ungulates) are **killed with a bite to the neck**, most often from the bottom side. The lynx rarely if ever bites the legs of lower part of the body, as is the case with canines (foxes, dogs, wolves). The sharp claws can cause deep cuts on the upper part of the body or the neck (visible after flaying). Canines can scratch too, but their blunt claws usually do not pierce the skin.

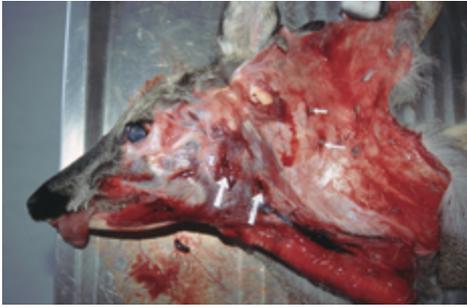


*Lynx scratches are sharp and deep.  
(Photo: Paolo Molinari)*

The lynx's prey has deep wounds on the throat and lower jaw, caused by the canine teeth. Suffocation is not always the cause of death, this happens in about half of the cases. Often the cause of death is a bite to the carotid artery and to the nervous system. The stab wounds are small, deep, clean and mostly without lacerations. Flaying is often needed to even notice the traces of the bite. In most cases there are very few visible stab wounds (3–4). The separation between the canine teeth is 28–37 mm, but mostly 30–34 mm. The separation between upper and lower teeth varies greatly. There are no bite wounds or bruises on the rest of the body.



*The distance between lynx's canine teeth is usually 30–34 mm. (Photo: Matej Bartol)*



*The lynx kills its prey with a bite to the neck (arrows pointing to bite wounds); no other bites to the rest of the body. The lynx kills its prey with a bite to the trachea or the blood vessels and nerves above the trachea. (Photo: Miha Krofel)*



*There are often few stab wounds, but they are small, deep, clean and usually without lacerations. Flaying is often needed to even notice bite traces. (Photo: Miha Krofel)*



*If the prey is flayed often only bruises in the neck area are visible. (Photo: Urs Breitenmoser)*

The lynx almost always **starts eating the thigh area first**. Gradually it moves to the muscles around the pelvis, back, shoulders and neck at the end. Some internal organs can also be eaten (heart, liver, lungs). The legs are usually left uneaten, though he nibbles at the ribs and shoulder blade. The lynx almost **never eats the digestive tract**, which is mostly found in the area of the carcass (if there have been no scavengers). Lynx do not remove the head, unlike foxes. The skin is not ripped when feeding, but is generally pulled towards the head and can (after a few visits) be found inside out around the neck and head.

**The typical lynx's prey is covered with the surrounding material** (leaves, grass, earth, branches, snow). The carcass is sometimes completely buried. When the carcass is only partially buried, the opened parts (e.g. the thighs and the bite wounds around the neck) are usually covered with the surrounding material. The prey is buried before the lynx leaves it; this is to protect it from scavengers. A bear can also bury its prey, but the pile is usually much bigger. Sometimes the lynx drags the carcass a few dozen meters away to a more hidden place. Generally he keeps returning to the prey for several days (with roe deer usually 3–4 days), until all the

muscle tissue is eaten. If humans come near the carcass, the lynx often leaves it behind and does not return. Therefore, he does not return to killed livestock. An individual lynx eats 2–4 kg of meat per night.



*The lynx starts by eating the thighs and gradually moves towards the head. A few day old carcass typically has the skin turned inside out, because the lynx does not eat the skin and pulls it towards the head.*  
(Photo: Miha Krofel)



*It is typical that the lynx buries (at least partially) its prey. Usually the open parts of the body (those he was eating) are better covered.* (Photo: Miha Krofel)



*The carcass is sometimes completely buried. Only one ear is visible on the photo.*  
(Photo: Miha Krofel)



*If the lynx is not disturbed, it keeps coming back (several days) to the prey, until it eats all the meat. After a few days (no scavengers) only bones, the head and skin remain.*  
(Photo: Miha Krofel)

## DAMAGE PREVENTION MEASURES

In general, different damage prevention measures can be used to protect human property. In Slovenia, high electric fences have been proven to be the most effective solution for preventing damages from large carnivores. Fences have to be at least 150 cm high to prevent wolves from jumping over the barrier and provide enough voltage (minimum 5 kV) to transfer a strong shock to the animal touching the wire. On the other hand, also livestock guarding dogs (LGDs) can effectively prevent damages from large carnivores. Since LGDs have been used in many different regions and countries for millennia, there are well developed breeds that are effective.

### High electric nettings

High electric netting is another useful solution for protection of grazing animals as they are versatile and mobile. The mobility of electric netting gives the user flexibility in their grazing management systems. Moreover, the mobility of this fencing type is very important since pastures during the grazing season should be rested and unfenced in certain cases. Electric netting also can be used as night enclosures for animals grazing in a larger pasture during the day or they can be used as the only fence for smaller herds. Depending on the size of the livestock herd being grazed and the judgement of the user, electric netting can be moved as needed.



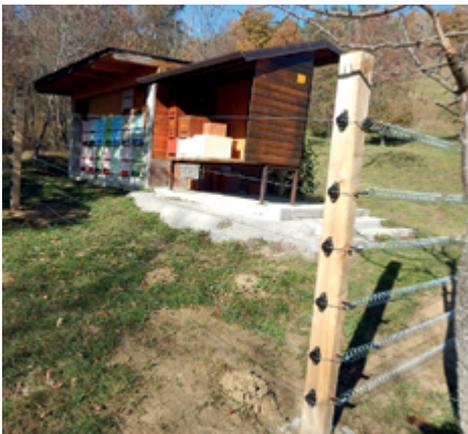
*High electric nettings are among the most effective damage prevention measures.  
(Photo: Tomaž Berce)*

### There some key elements to keep in mind when using high electric nettings for protection against large carnivores:

- keep a high voltage (at least 5 kV) in the wires all the time and control it regularly with the voltmeter
- provide an effective grounding system (at least three grounding rods of 1 meter)
- remove all the vegetation close to the fence
- regularly mow the grass (maximum 10 cm height)
- when protecting animals use at least 300 m of nettings
- the shape of the enclosure has to be round or oval without sharp angles or pockets
- the fence has to be fastened on the ground to follow the undulations of the ground
- regularly maintain a charged battery

## Multi-wire fences

This kind of fences are frequently used for fencing large pastures to keep the grazing animals on the pastures. Farmers mostly use two or three wires with the main purpose of keeping the grazing animals within a pasture and not to protect them from predators. The protection of grazing animals from large carnivores with multi-wire electric fences is estimated as inappropriate, due to frequent inconsistent use and more demanding maintenance. However, this protection measure may be appropriate in combination with others (e.g. night enclosure from high electric fences or livestock guarding dogs).



*Apiary protected with 6-wire fence.  
(Photo: Tomáš Berce)*

Multi-wire electric fences can be an effective protection measure, but only with proper use: the electric current must be present constantly, it is necessary to prevent possible trespassing under and between wires, and, when not in use, the installation must be removed. The more wires the enclosure has, the greater the efficiency.

We use fences with 6-wires and 150 cm in height for protecting stationary beehives from brown bears. Since the maintenance and the installation of a smaller enclosure is easy, these fences represent a good choice in terms of a long-term protection. Other key elements of the properly installed fence are described in the previous chapter.

## Livestock guarding dogs

Besides shepherds, livestock guarding dogs have played an important role in history of shepherding. The main task of the livestock guarding dogs is to protect the herd from predators as distinct from herd dogs who play a key role in herd management. The main characteristic of the livestock guarding dogs is a strongly expressed pack instinct. Since livestock guarding dogs grow up in the herd, it represents their pack, to which they belong completely. For that reason, these dogs become devoted to the herd and become instinctually protective. The area or “territory” where a livestock guarding dog protects livestock is consistently marked by the dogs by barking, urination and scats, which may help deter predators. Since injuries can be fatal for survival in the nature, large carnivores and other wild animals may tend to avoid conflict situations with livestock guarding dogs. To act as a pack, and thus successfully protect the herd from predators, it is advisable to have at least three guarding dogs in the herd. At the same time, it must be emphasized that the livestock guarding dogs should only move within enclosed pastures. First two years of a dog are crucial for the development of characteristics of a successful guardian against large carnivores, which is achieved by consistent training (regular corrections of unwanted behaviour in the first phase of integration in the herd). There are several suitable breeds of the livestock guarding dogs. Within the LIFE DINALP BEAR project we cooperate with breeders of Karst shepherd, tornjak, Sharplaninac and Caucasian shepherd breeds.



*Karst shepherd protecting a sheep herd.  
(Photo: Anita Tomšič)*

## LITERATURE

- Anonymous. 2015. Model Infection Control Plan for Veterinary Practices, Appendix 4: Model Infection Control Plan 2015. National Association of State Public Health Veterinarians (NAS-PHV), Veterinary Infection Control Committee (VICC).  
[www.nasphv.org/Documents/ModelInfectionControlPlan.docx](http://www.nasphv.org/Documents/ModelInfectionControlPlan.docx) (14 June 2019)
- Anonymous. 2016. Rabies: Key Facts, World Health Organization.  
<https://www.who.int/en/news-room/fact-sheets/detail/rabies> (14 June 2019)
- Berce T., Černe R. 2016. Reja domačih živali in sobivanje z zvermi - Varovanje drobnice pred velikimi zvermi. Zavod za gozdove Slovenije. Naročnik: Ministrstvo za kmetijstvo, gozdarstvo in prehrano, Ljubljana, 30 pp.
- Breitenmoser U., Breitenmoser-Würsten C., Lanz T., von Arx M., Antonevich A., Bao W., Avgan B. 2015. Lynx lynx (errata version published in 2017). The IUCN Red List of Threatened Species 2015: e.T12519A121707666. (17 May 2019)
- Brown C., Torres F., Rech R. 2012. A Field Manual for Collection of Specimens to Enhance Diagnosis of Animal Diseases. Boca Publications Group, Incorporated, 150 pp.
- Černe R., Krofel M., Jonozovič M., Sila A., Potočnik H., Marenče M., Molinari P. 2011. Prepoznavanje znakov prisotnosti in plenjenja večjih zveri. Zavod za gozdove Slovenije, Ljubljana, 72 pp.
- Garner J. S. 1996. Guideline for isolation precautions in hospitals. The Hospital Infection Control Practices Advisory Committee, Infect Control Hosp Epidemiology, vol. 17, pp. 53–80.
- Lenhart S., Seitz T., Trout D. 2004. Issues affecting respirator selection for workers exposed to infectious aerosols: emphasis on healthcare settings, Appl Biosafety, vol. 9, pp. 20–36.
- Molinari P., Breitenmoser U., Molinari-Jobin A., Giacometti M. 2000. Predatori in azione. Manuale di identificazione delle predazioni e di altri segni di presenza dei grandi mammiferi carnivori. Rotografica Limena, 125 pp.
- Nation P. N., Fanning E. A., Hopf H. B., Church T. L. 1999. Observations on animal and human health during the outbreak of Mycobacterium bovis in game farm wapiti in Alberta, Can Vet J, vol. 40, pp. 113–117.
- Trouwborst A., Krofel M., Linnell J. D. C. 2015. Legal implications of range expansions in a terrestrial carnivore: the case of the golden jackal (Canis aureus) in Europe. Biodiversity and Conservation, vol. 24, pp. 2593–2610.
- Turnbull P. 2008. Anthrax in humans and animals. (P. Turnbull, Ed.) World Health Organization. 219 pp.  
<https://www.who.int/csr/resources/publications/AnthraxGuidelines2008/en/> (14 June 2019)
- Semenza J. C., Menne B. 2009. Climate Change and Infectious Diseases in Europe. Lancet ID. 2009, vol. 9, pp. 365–375.
- Williams C. J., Scheftel J. M., Elchos B. L., Hopkins S. G., Levine J. F. 2015. Compendium of veterinary standard precautions for zoonotic disease prevention in veterinary personnel: National Association of State Public Health Veterinarians: Veterinary Infection Control Committee 2015. J Am Vet Med Assoc, vol. 237(12), pp. 1403–1422.
- Wunner W. H., Jackson A. C. 2010. Rabies: Scientific Basis of the Disease and Its Management. Academic Press, 556 pp.









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