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How to deal with bold wolves

– Recommendations of the DBBW –



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Translation of the original BfN-Skript 502 (2018)

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Cover picture: A yearling of the Munster wolf pack, summer 2015 (Bundesforst)

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1 Summary

For a long time, there were no wolves in Germany. Since 2000, the species has been steadily spreading out from Lusatia and populating more areas. People in areas recently settled by wolves are only gradually learning how to live alongside this animal and are often uncertain how to interpret wolf behaviour. How dangerous are wolves for humans? What constitutes normal behaviour and what is considered unusual or bold behaviour?

This report provides assessments of wolf behaviour as it relates to human safety and recommends managing wolves which display unwanted behaviour. In this report, conspicuous behaviour refers to wolf behaviour towards humans which is considered undesirable, and ranges from unusual to bold.

This report is intended to provide guidance and recommendations to the authorities responsible for wolf management, and focusses on wolf-human interactions. It defines terms frequently used in this context, summarises the current state of knowledge relating to the danger posed by wolves and describes the causes for the development of bold behaviour. Recommendations on how to react to reports of bold wolf sightings are also given. Moreover, the report assesses the most common types of wolf behaviour in relation to human safety.

These recommendations are primarily aimed at the competent federal state authorities, to enable them to make an initial assessment of wolf behaviour in terms of human safety and to prepare possible courses of action. However, it is not intended as a general template for action. Every situation in which a wolf is perceived as bold or is behaving conspicuously needs to be assessed on a case-by-case basis.

The aims of these recommendations are a) to ensure that people in Germany are not injured or killed by wild wolves; b) to foster and maintain public trust in wolf management authorities in wolf regions; c) to ensure that people's fear of wolves does not increase and d) to enable wolves to spread further in Germany without causing serious conflicts between wolves and humans.

2 Introduction

For a long time, there were no wolves in Germany. People in areas recently populated by wolves are only gradually learning how to live alongside this animal. Many people are uncertain how to interpret wolf behaviour. What constitutes normal behaviour and what is considered unusual? How dangerous are wolves for humans and must precautionary measures be taken in wolf regions to protect the people living there? Wolves rarely develop behaviour which affects the safety of humans. However, the few cases that are internationally known tend to draw a great deal of media attention, and are quickly assumed to be representative of wolf behaviour in general.

The common idea of the wolf as an animal needing untouched wilderness and wide expanses without human presence is at odds with reality. Today, wolves in Central Europe live in fragmented and densely populated cultural landscapes close to people. Wolves live in large territories which in Germany extend up to several hundred square kilometres. Every day, wolves cover large distances, and it is therefore inevitable that they will regularly come into contact with human settlements. They may occasionally pass through villages at night, look for food on the outskirts or walk in view of inhabited buildings during the day. Experience has shown that this type of behaviour does not, in itself, represent a threat to humans.

Wolf attacks on humans are extremely rare. However, because of their size and strength, wolves can frighten people and, in some situations, injure or even kill them. However, the fear many people have of wolves is out of proportion to the objective risk of an attack (Linnell and Alleau 2016, see also 5.1).

In the past, the common reaction to conflicts between wolves and human interests was to persecute and kill the animals, in many places to the point of extermination (Linnell and Alleau 2016). Today attitudes have changed, and there is broad public consensus that wolves and other large carnivores must be protected as an integral part of biodiversity (Boitani and Ciucci 2009). This is reflected in their legal status as a protected species. Options for killing a wolf (lethal removal) are strictly regulated, firstly because there is little public acceptance for this measure and secondly, because the legal framework only allows this means of managing specially protected species in justified exceptions (Schwartz et al. 2005). Under both European and national law, the wolf in Germany is under special protection. Section 45(7) of the Federal Nature Conservation Act (BNatSchG) stipulates that exceptions to the prohibition on killing specially protected species are only permitted if one of the criteria listed under section 45(7), first sentence of the BNatSchG is met, and if there is no reasonable alternative and the measure is not detrimental to the conservation status of the species. Therefore, each individual case of behaviour classified as bold needs legal clarification as to whether lethal removal is justified or whether there are alternative solutions. Non-lethal measures are generally more accepted by the public (e.g. Gillin et al. 1994, Rauer et al. 2003, Beckmann et al. 2004). Nevertheless, situations which require an individual animal to be killed will at times arise. In these cases, it is important to give the public a clear, comprehensible and science-based explanation of why the decision is necessary (Majić Skrbinšek and Krofel 2015).

The events surrounding the Munster wolf pack (see Annex 1, Cases 9, 10 and 11) have shown that there is a great need among the public and authorities alike for information on wolf behaviour generally and the management of bold wolves in particular. This was one of the main reasons why the Federal Agency for Nature Conservation (BfN) commissioned the DBBW, the Federal Documentation and Consultation Centre on Wolves (DBBW) to draw up a strategy for managing wolves exhibiting bold behaviour. The basis for this strategy was an unpublished report by Kaczensky et al. 2010, also commissioned by the BfN, "Assessing problem individuals in bear, wolf and lynx and recommending courses of action".

The work culminated in this report, which draws together knowledge gained up to November 2017 on bold wolf behaviour towards humans and describes the currently known causes for the development of problematic wolf behaviour. For the purposes of this report, conspicuous behaviour is understood to cover the entire range of wolf behaviour in relation to humans, from unusual or undesirable to bold. It contains the DBBW's instructions and recommendations to the responsible federal state authorities on how to proceed in particular conflict situations. The focus is on direct wolf-human interactions, as distinct from interactions between wolves and livestock. The killing of livestock by wolves is simply a means of obtaining food, not a form of aggression. Such behaviour has no relevance for the safety of humans and is therefore not addressed in this report. Conflicts between wolves and livestock require their own strategies in the form of nationwide preventive measures. Further information on this topic can be found in the recommendations on livestock farming and wolves from DBBW and BfN (BfN 2017).

Assessing whether a situation in which wolves display conspicuous behaviour towards humans can escalate and hence require intervention, or whether it is likely to resolve itself, calls for a high level of expertise and personal experience. There are no comprehensive scientific studies which have tested and compared the effectiveness of different forms of intervention aimed at preventing or resolving occurrences of bold wolves. If there is any doubt, the priority of the competent authority is human safety.

When compiling these recommendations, the DBBW drew on outside expertise, including that of colleagues in the Swedish Wildlife Damage Centre (Viltskade Centre VCS), which is probably Europe's most experienced body for dealing with undesirable behaviour in large carnivores towards humans. To a large extent, therefore, these recommendations (section 6) are in line with the latest Swedish report on this topic (Frank 2016), although tailored to the situation in Germany. Wolf management depends not only on the behaviour of the animals but also on local attitudes and conditions. The decision to shoot a wolf when its behaviour does not conform to human expectations is more likely to be taken in regions where most people are afraid of wolves (e.g. Finland, Kojola et al. 2016) than in places where people are less afraid of this animal (Italy or Spain).

This report is mainly aimed at the competent federal state authorities with the goal of enabling them to make an initial assessment of wolf behaviour in terms of human safety and to prepare possible courses of action. However, the report is not intended to be used as a general template for action. Every situation in which a wolf is perceived as bold or is behaving conspicuously needs to be assessed on a case-by-case basis.

The aims of these recommendations are a) to ensure that people in Germany are not injured or killed by wild wolves; b) to foster and maintain public trust in wolf management authorities in wolf regions; c) to ensure that people's fear of wolves does not increase and d) to enable wolves to spread further in Germany without causing serious conflicts between wolves and humans.

3 Terminology

In the public debate on wolves, terms relating to wolves showing conspicuous behaviour are repeatedly confused or used in the wrong context. The following section explains key terms used in this report.

Habituation describes the ability of an animal to become accustomed to, and no longer react to, repeated stimuli that are not linked to either positive or negative consequences (Immelmann 1982). Habituation in the sense used here is the adaptation of wolves and other wild animals to living in human-dominated landscapes and to the constant presence of people. Habituated wolves have become used to the presence of humans and learnt that they are not a danger. This can lead to a noticeably lower flight distance. Habituated behaviour is acquired through individual experience.

Habituation is vital to the survival of wild animals living in a human-dominated landscape. In national parks, wild animals are particularly strongly habituated to the presence of people, and their flight distance is often significantly lower than that of their conspecifics outside these areas. They do not, however, approach humans deliberately. This form of habituation, in which animals tolerate humans at a certain distance without showing an interest in them, is unproblematic.

Habituation is an adaptive process, and people can, intentionally or unintentionally, accustom particular wolves to their presence to such an extent that these animals allow humans to be present or to approach much closer than other wolves would.

Young animals in general often have a lower flight distance than older wolves. That is why young wolves are more easily habituated to humans than adults. If, for instance, wolf pups are repeatedly approached by humans, they can become used to the direct proximity of people. What may seem of little concern in young animals can be the basis for the development of bold behaviour in a fully-grown wolf.

Reports of problematic incidents with habituated wolves (e.g. McNay 2002, Smith and Stahler 2003) generally involve a strong habituation that far exceeds the level of habituation common for wild animals in human-dominated landscapes (see 5.2). However, often language does not differentiate between these two forms of habituation, speaking only of "habituated" wolves. This can give the impression that habituation is a problem in itself, which is not the case. This report therefore refers to "strong habituation" to differentiate it from the degree of habituation which is normal for wild animals in a human-dominated landscape. The term "strong habituation" is not, however, used in ethology.

Conditioning is a learning process in which a particular behaviour is reinforced or weakened by positive or negative stimuli. Here it refers to operant conditioning (as opposed to classical conditioning), in which an animal learns through reward or punishment and increases or reduces the frequency of a behaviour accordingly.

In the case of **positive conditioning** a spontaneous behaviour is reinforced with a positive stimulus (Immelmann 1982). This can be food, an interesting object or a pleasant experience (e.g. play). Habituation facilitates positive conditioning. One type of positive conditioning is **food conditioning**, in which the animals associate particular situations, places or behaviours with receiving food. Food conditioned wild animals have learnt to connect places of human presence (e.g. yards, settlements, camping sites, waste tips), or people themselves, with food. These wolves intentionally visit such places in the search for food, or they seek out direct contact to humans (e.g. when they have repeatedly been given food). Each success further strengthens the association between human presence and attractive food handouts.

Food conditioning that has been cemented by repeated success is very difficult to reverse. Positively conditioned animals can be very persistent if the anticipated attractant (food) fails to materialise. In such circumstances, large and powerful animals like wild boars and wolves can cause humans serious injury.

Aversive conditioning refers to the association between particular situations and negative stimuli such as pain or danger (fear/stress reaction). Aversive conditioning can be used on animals to counteract positive conditioning and/or strong habituation, for instance by linking human presence with negative stimuli. Aversive conditioning can be achieved with **deterrence**. Deterrence (also referred to as “hazing” in the literature) includes shooting at the animal with rubber bullets and setting off firecrackers and rocket flares. Driving a wolf away on a single occasion does not qualify as aversive conditioning, since generally this only causes the animal to change its location, not to associate the negative stimulus with a particular behaviour. For aversive conditioning to succeed, an individual must be repeatedly exposed to negative experiences in clearly recognisable situations. If the wolf is to avoid such situations in future, it must understand why it is having the negative experience. It is also important to ensure that the wolf is not in the same situation elsewhere without suffering the same negative result, as this would again reinforce the positive experience.

This report defines **close encounters** as encounters of human and wolf within 30 metres of each other, in which the wolf can recognise the human as such (i.e. not in a vehicle, on a raised hide or on horseback). Close encounters are not problematic in themselves. In most incidents, the wolf will retreat as soon as it has realised it is near a human. An adult wolf repeatedly tolerating humans at a distance of under 30 m, or even actively approaching them up to or below this distance, is an indication of strong habituation or positive conditioning. The distance of 30 m was taken as the guideline since most wolves have a much higher flight distance (e.g. Wam 2002, Karlsson et al. 2007). Moreover, deterrence measures can only be realistically implemented if the wolf can be approached to within 30 m (see 6.4).

Conspicuous behaviour in the sense of this report refers to a behaviour of wolves towards humans that seems to be outside the range of behaviour shown by most individuals of this species. Conspicuous behaviour covers the entire range from unusual or undesirable to bold behaviour. When conspicuous behaviour is reported the situation calls, at the least, for investigation. It then often turns out that, while the behaviour did not conform to the expectations of the observer and was therefore judged to be bold, it did not actually constitute problematic behaviour.

Wolves that remain for several days within 30 m of inhabited buildings are often perceived to be bold. However, it is important to distinguish whether the wolf is actually approaching a human, is tolerating the approach of a human to a close distance, or whether the wolf is approaching a building without directly seeing people. Such animals are described as "**wolves tolerant to houses**" (see Table 1). This behaviour is not desirable. In some cases, however, there is an explanation for such behaviour that makes this classification unjustified (see 6.2). **Bold (problematic)** behaviour in the sense of this report is behaviour which may become dangerous to humans if it escalates. Such behaviour at the least requires attention, but can also be deemed serious or critical (see 6.2, Table 1).

A **bold wolf** refers to an animal that voluntarily and repeatedly tolerates recognisable humans within 30 m, or that repeatedly approaches humans to within this distance.

Section 5.1, which examines the degree of danger posed by wolves, also refers to predatory attacks that occurred especially in former times in Europe (Linnell et al. 2002). **Predatory attacks** are characterised by their aim of killing and eating prey – in this case a human being. As a rule, they take the form of several attacks by an individual or pack, in a limited area and over a limited period of time.

Removing an animal from the wild and killing it is referred to as **lethal removal**. This can involve directly shooting the individual or capturing it and putting it down.

4 Wolves in human-dominated landscapes

By nature, wolves are wary of humans and avoid direct contact. Generally, a wolf will avoid humans before they become aware of its presence. Direct encounters between wolves and humans are rare, even in areas with wolf populations. Chance sightings from a car, for instance of a wolf crossing the road, are far more likely.

Most people living in wolf regions in Germany very seldom catch sight of a wolf. One reason for this is because wolves live in very large territories of up to several hundred square kilometres. Moreover, as a rule wolves avoid encountering humans due to temporal and spatial segregation. In Europe, wolves are overwhelmingly nocturnal (Ciucci et al. 1997, Blanco et al. 2005, Pedersen et al. 2005, Reinhardt and Kluth 2011) and stay away from areas where the likelihood of meeting humans is highest (Kaartinen et al. 2015). Studies in Finland and Germany found that wolves avoid settlements and roads (Kaartinen et al. 2005, Kojola et al. 2016, Reinhardt and Kluth 2011, 2015). However, the density of roads and human population is much higher in Germany than in Finland. Even in Lusatia, which by Germany's standards is relatively sparsely populated, there are few places where the nearest road is more than 1,000 m away. Even when wolves do everything they can to avoid people, it is impossible for them to succeed completely in a landscape that is so intensively used by humans (Reinhardt and Kluth 2015).

Like all wild animals living in cultivated landscapes, wolves have to cope with the fact that their habitat is full of human settlements. This makes it inevitable that at times they will pass close by or be obliged to pass through scattered settlements (see 4.1). As wolves are primarily active at night or twilight, this mostly occurs in the hours of darkness. Keeping sheep and goats in settlements or on farms without adequate fencing offers no secure protection, especially at night. Occasionally wolves may also be sighted in the vicinity of a settlement during the day, in the same way as fox, deer and wild boar.

4.1 Close encounters between wolves and humans

While wolves growing up in human-dominated landscapes avoid people, they do not avoid human infrastructure. For instance, they show almost no fear of cars or machinery. The same wolf that flees when it sees a person on foot 100 m away will tolerate a car driving past at a distance of 30 m. Wolves also often react less dramatically to a person sitting on a raised hide than to someone on foot. In order to classify and interpret close-range sightings, it is vital to determine whether the wolf has recognised the person as human (only this is considered a close encounter for the purposes of this report), and to note the wolf's behaviour.

In most encounters between humans and wolves, the animals withdraw once they have noticed the humans. This is often a quiet and orderly retreat rather than a panicked flight. There can even be instances when wolves display a very relaxed reaction to a close encounter.

When a dog is present in particular, instead of retreating a wolf may stop and observe, or even approach the human (see 4.1.1).

Attempts to approach radio collared wolves in Sweden involved people moving on foot as close as possible to the (resting) animals but without creeping or being particularly quiet. On no occasion did the wolves react aggressively. They immediately retreated as soon as they became aware of the person (with an average flight distance of 100 m). The flight distance was considerably less if there was a strong wind. In three cases (strong wind blowing away from the wolves) the resting or sleeping animals only became aware of the human at a distance of ≤ 20 m. Once the wolves noticed the human they jumped up and ran away (Karlsson et al. 2007). There are similar reports from Lusatia.

Between 2000 and spring 2016, 1,999 wolf sightings (including distances) were reported in Saxony. In 478 (24%) of these cases the distance given was less than 30 m. Notably, the vast majority of these sightings were made from a vehicle or a raised hide. In only 5% (n=97) the people were on foot. There were only nine reports (0.4%) of the wolf coming closer during the sighting, despite (probably) being aware of the human presence. It can be assumed that close-range wolf sightings are more likely to be reported than sightings at 100 m, since the former are particularly impressive for observers. This means that close-range sightings are probably rather over-represented in our data set.

Encounters with wolves at their kill are not generally a problem for humans either. However, care must be taken if the person is accompanied by a dog, as wolves can consider dogs to be competitors (see 4.1.1). As a rule, wolves do not defend their kill against humans (McNay 2002). In isolated cases, a wolf may only move away hesitantly, or return to the kill after a short time. On numerous occasions in Lusatia people drove a wolf away from a predated sheep by clapping hands or running and shouting. In another case, wolves fled from a freshly killed red deer doe at the side of the road when the postwoman approached on a bicycle.

In Canada a trapper was growled at when he came upon several wolves eating a fresh kill at dusk (McNay 2002). The fact that these wolves growled and defended their kill instead of fleeing is presented as unusual.

Generally, wolves do not even defend their pups against humans. In Russia and Belarus, taking pups out of the den is still a common means of reducing wolf populations. Sometimes, the wolves stay in the vicinity of the den when humans approach, howling and barking.

4.1.1 Dogs as attractants

Wolf behaviour can be influenced by dogs accompanying humans. In some cases, dogs can cause a close encounter between wolf and human or prompt a wolf to remain in the proximity of a settlement for a longer period. Dogs can be a strong attractant for wolves because the wolf considers them a social partner. Wolves can react differently to dogs depending on the situation. They may have a neutral reaction (the most common), a positive reaction (the dog is seen as a mate or play companion) or a negative reaction (the dog is perceived as competition). If a wolf sees a particular dog as a potential mate, it may completely disregard the presence of humans (see Annex 1, Case 3). In some circumstances, a wolf will react aggressively to other dogs which are close to its "mate". In Lusatia a female wolf without a partner remained for weeks in the vicinity of a village where her "chosen" dog lived (Reinhardt and Kluth 2007, see Annex 1, Case 1).

Most dog owners living in wolf regions will never have a direct encounter with a wolf, even if they walk their dogs in the area every day.

Occasionally, however, situations can develop in which wolves see dogs as competition and attempt to chase them off despite the presence of humans. McNay (2002) describes several cases in Alaska and Canada in which wolves followed people with dogs at a close distance, or even attacked the dogs in direct proximity to the owners. These attacks always targeted the dogs, not the humans. Similar cases have been reported in Sweden (Karlsson, personal communication), Russia (Bologov, personal communication) and Germany (Annex 1, Cases 10 and 11). At the beginning of an encounter, a dog owner cannot always determine the wolf's reason for approaching the dog. Further information on the topic of wolves and dogs can be found e.g. in the brochure "Mit Wölfen leben" (Living with Wolves) (SMUL 2016).

4.2 Wolves and hunting

It is a widely held opinion that sooner or later wolves in non-hunted populations cease to be wary of humans and consequently become a threat. This opinion has no scientific basis. There is no evidence that wolves in human-dominated landscapes are more dangerous than hunted wolves or wolves which live in areas uninhabited by humans. Bold individuals can occur in all wolf populations (Fritts et al. 2003, McNay 2002). This is often due to specific living conditions or to human behaviour, and has also been observed in other animal species. Although the wild boar, raccoon and fox are hunted nearly everywhere in Germany, strongly habituated and/or food conditioned individuals regularly occur. Hunted bear populations also include individuals that are habituated to humans or even food conditioned (e.g. in Slovenia; Jerina et al. 2011). Swenson (1999) concludes that the level of wariness in bears is evidently more influenced by the availability of human-derived food than by hunting.

The few known post-1950 cases in Europe in which non-rabid wild wolves killed humans occurred in a hunted wolf population (Spain). Wolf territories with a human settlement density similar to Germany and where there is also no (legal) wolf hunting can be found e.g. in Italy and Poland. In these areas too, there is no indication of wolves generally losing their wariness of humans. It must be noted, however, that wolves are hunted, at least illegally, virtually everywhere in Europe (Liberg et al. 2011) and in some European countries (e.g. Poland) wolves were only placed under protection relatively recently (e.g. Reinhardt et al. 2013).

Intensive hunting of wild ungulates, as practiced in many regions of Europe and North America, can mean that less cautious animals are more likely to be harvested (e.g. Ciuti et al. 2012, for elk) and breed less successfully. Mettler and Shivik (2007) surmise that trapping removes curious, less cautious coyotes from the population. As a consequence, in hunted populations, wary and neophobic animals have greater reproductive success. For that reason, it is perfectly possible that hunting leads to selection based on wariness and large flight distances. However, it cannot be conversely concluded that animals in non-hunted populations will automatically develop increasingly bold behaviour. Non-hunted animals do not, per se, take an interest in humans. Where there is no incentive to approach humans, animals will generally ignore them. Nevertheless, it is possible that non-hunted populations are more likely to experience situations in which human behaviour leads to the strong habituation and/or food conditioning of wild animals (see 5.2).

In North American national parks wolves grow up around large numbers of people and have no negative experiences with humans. Despite this, however, even after 50 years of not being hunted, wolves on Isle Royal remain cautious of humans, even though the island receives visitors in high volumes every year (Peterson and Vucetich 2002). In Yellowstone National Park in the US, wolves are the main tourist attraction and are not hunted. Since their reintroduction in 1995, people have visited the park in their hundreds of thousands to observe the wolves.

In some years, individual packs have made their dens or rendezvous site within view of roads, with tens of thousands of visitors watching them raise their pups.

Some packs have to cross the road every day in summer, close to human observers (Smith and Stahler 2003); these wolves, too, avoid direct contact to humans.

It is important to stress in this context that national parks take care that visitors follow rules and do not approach or feed the animals. Nevertheless, there are repeated incidents of people behaving wrongly. Some visitors confuse the good visibility and reduced flight distance of wild animals in national parks with tameness. Others appear unable to resist the temptation to feed the animals. Animals which then develop food conditioned behaviour often end up being shot. North American national parks have signage with powerful slogans like "a fed bear is a dead bear" in efforts to dissuade visitors from feeding the animals.

4.3 Injured and sick wolves

Wolves can be afflicted with illnesses and parasites, injured in traffic accidents or hurt by a prey animal defending itself. Corresponding symptoms become apparent. This alone, however, still does not justify human intervention. There is no evidence that injured or sick wolves (except rabid animals) present an increased danger to humans. Of course, an injured wolf should be treated with respect and caution because, like any other wild animal, it may defend itself if it feels cornered. Sightings of such animals should be reported to the wolf monitoring programme. Other measures are not justified, except when a notifiable epizootic disease such as rabies is suspected.

In the case of traffic accidents, injuries are frequently not visible and require a veterinarian to make an exact diagnosis. This can generally only be undertaken in a veterinary practice with appropriate facilities. In 2011, the Federal Environment Ministry, Saxony, Brandenburg and Schleswig-Holstein provided state authorities with a jointly compiled paper on the option of putting down wolves injured in traffic or other accidents. Some of the federal state management plans set out in detail the information and action chains to be followed in the event of an injured wolf. Saxony, where the wolf is covered by the hunting law, also has its own more extensive regulations. The management plans of the federal states can be found on the DBBW website (DBBW 2017).

Injured wolves have an astounding capacity to recover. Several cases have been reported of wolves with three legs successfully raising pups. "Einauge", the well-known one-eyed female wolf in Lusatia (2001 to 2013), raised at least 42 pups, despite having numerous physical impairments. She limped and had lost her right eye. A post-mortem examination showed that she had been shot twice in the course of her life.

When an injured or sick wolf is reported, it may be appropriate to conduct a follow-up search in order to determine the status of the injured animal.

There have been isolated cases of an injured wolf being captured to enable a detailed veterinary examination to be performed. The search should be conducted by people experienced in capturing wild wolves and who have the necessary permits. Wherever possible, a vet should be part of the search team. Including a dog trained in tracking wolves is also useful for the follow-up search. The point of the search is not to track a wolf over kilometres in order to capture it in any event, but to clarify, in a localised search, whether a dead or seriously injured animal is near the scene of the accident. If their injuries are not life-threatening, animals generally recover. Searching the scene of the accident for genetic material and using a trained dog to track the wolf for a maximum of one kilometre have both proved successful. This search with a dog can also secure genetic samples.

In several documented incidents the survival of injured animals has been genetically proven months later.

In one of these cases, a wolf that had been hit by a car lay immobile at the scene for 15 minutes. Subsequently it pushed itself forward by its hind legs, down an escarpment into the forest. At first, it was unable to stand. When the investigation team arrived, the animal had disappeared. From the tracks, the team concluded that after several hundred metres the animal was able to get to its feet again and though still disorientated, could move away. The search was stopped after just over one kilometre. Genetic analyses showed that at a later point the animal had become one of the breeders in a pack in a different federal state. Veterinarians concluded that the accident had probably caused trauma of the cervical vertebrae, preventing the wolf from extending its forelimbs. As the trauma passed, full functionality returned.

In another incident, the injured wolf was found 300 m from the scene of the accident and captured. The seven-month old animal was treated by a vet and kept in quarantine for five weeks at Görlitz nature reserve. It was subsequently radio collared and released. The young wolf was accepted back into its natal pack. A year later, it dispersed and founded its own pack.

Specially equipped enclosures are needed for the temporary holding of injured wild wolves. The enclosures should be as secluded as possible and the animals should have minimal contact to humans. This is not primarily to prevent the wolf becoming habituated, as experience gained in Germany and Poland (S. Nowak, personal communication) has shown that in such a situation the risk of habituation is negligible if the animal is older than six months and has had no prior contact to humans. However, keeping wild wolves in enclosures is extremely stressful for them. For animal welfare reasons, therefore, wolves that have grown up in the wild but cannot be released due to injury or sickness should not be kept in permanent captivity.

A suitable approach is to set up an enclosure where a wolf can be largely shielded from anthropogenic stimuli such as human noises over a longer period (several weeks or months). The different federal states could share the use of these enclosures.

5 Wolf-human conflicts

People connect wolves and other large carnivores to a range of conflict situations. These mainly stem from the fact that wolves prey on animals that are also hunted by humans, and because wolves can kill livestock and pets. Moreover, there are circumstances where wolves may pose a danger to humans, injuring or even killing them (Linnell and Alleano 2016).

This section looks at and evaluates wolf behaviour exclusively in relation to humans.

The killing of livestock and overcoming livestock protection measures is of course not desirable from a human viewpoint, nevertheless, such a behaviour is by no means unusual for a wolf. Wolves are large carnivores whose diet consists primarily of ungulates. Killing prey is not a form of aggression towards humans, it is the wolf's natural way of obtaining food. Overcoming protective measures such as fences does not mean that the wolf concerned should be considered more dangerous to humans than a wolf that does not kill livestock. Experience to date in Germany shows that in various situations wolves were driven away from predated livestock and forced to give up their kill, albeit in some cases reluctantly, through hand clapping and loud shouting. In none of these episodes did wolves exhibit a behaviour that could be deemed critical (see 4.1 and Annex 1, Case 13).

5.1 How dangerous are wolves in 21st century Europe?

There are numerous reports, dating from the 15th century up to the early 20th century, of wolf attacks on humans. While the details can of course no longer be verified, many of these reports are certainly reliable (Linnell et al. 2002, Linnell and Alleano 2016). Most of these wolf attacks fall into two categories: attacks by rabid wolves and predatory attacks (Linnell et al. 2002). Rabies was once widespread and before the introduction of the vaccine a bite from a rabid animal was a death sentence. Predatory attacks have historically always been viewed as very rare exceptions (Linnell and Alleano 2016).

More recently, there have been few verified wolf attacks in Europe and North America. The only known cases in Europe after 1950 occurred in Spain in the 1950s and 1970s. These involved three episodes in which four children were killed and four injured (Linnell et al. 2002). There are documented wolf attacks over recent decades from North America, in which the wolves demonstrated fearless or bold behaviour towards humans and which in some – though not all – cases were connected to food conditioning (McNay 2002, Linnell and Alleano 2016). In 2005, a man was killed by food-conditioned wolves (McNay 2007). Another incident occurred in 2010 in Alaska, when a woman out jogging was killed by wolves (Butler et al. 2011).

While these examples show that, like all large wild animals, wolves can pose a risk to humans, they do not mean that people living in wolf regions are in danger. Rabies has now been largely eliminated across Europe. Predatory wolf attacks, like those in Spain in the 1950s and 1970s or in recent decades in India (Linnell et al. 2002), are generally associated with very specific environmental conditions. These conditions can arise in areas of heavily fragmented habitat where prey animals are scarce and wolves feed on livestock and waste. In such circumstances, children can be very vulnerable, for example if they are tending livestock in the forest. In present-day Europe, the risk of wolves learning this sort of behaviour is very low (Linnell et al. 2002, Linnell and Alleano 2016).

5.2 Strongly habituated and food-conditioned wolves

In Europe, the likeliest cause of bold behaviour in wolves is a strong habituation to the proximity of humans, combined with positive stimuli such as feeding (food conditioning).

Nearly all of the handful of wolf attacks in Europe and North America that have been documented since the middle of the last century originated in this type of scenario. Most wolves involved in these incidents had previously displayed strongly habituated behaviour (Linnell et al. 2002, McNay 2002, Smith and Stahler 2003). Evidently, advanced habituation is a prerequisite for bold behaviour. When considering the potential danger posed by a wolf, the focus today is therefore on cases where wolves have become fearless, i.e. when they tolerate humans in their direct proximity without showing any signs of fear (Linnell and Alleano 2016), or perhaps even approach the people out of curiosity or in anticipation of receiving food. Human action is often the cause of such behaviour, meaning it can be flagged at an early stage and the subsequent risk minimised.

As described earlier, wild animals living in human-dominated landscapes have to tolerate people and their activities to a certain extent. In itself, this kind of habituation does not lead to bold behaviour. In encounters with people and vehicles, wolves that have had neither positive nor negative experience of humans generally respond with caution but not extreme shyness. They usually move away without undue haste. However, the close proximity in which people and wolves coexist in Europe holds the risk that humans will cause and exacerbate bold behaviour in wolves. Wolves are not bold animals from birth but learn this aspect of their behaviour, which is then consolidated and reinforced if they are "rewarded" for it. For instance, deliberately or carelessly leaving food in an accessible place can trigger or reinforce bold behaviour in wolves.

Food-conditioned individuals differ from other wolves in that the positive stimulus of feeding leads them to be interested in and actively seek out proximity to humans. If the anticipated food does not materialise these wolves may become so bold that they are a danger to humans (see 3).

Due to their curiosity and naivety, young wolves sometimes have a lower flight distance to humans than adults. Strong habituation can occur far more easily in these animals than in mature wolves. They are curious and attracted to novel stimuli. People deliberately visiting wolf rendezvous sites, e.g. to observe and photograph them, run the risk, whether intentionally or otherwise, of the pups becoming habituated to the close presence of humans. If this is reinforced with food, the animals quickly learn to actively seek humans. Wolves in Yellowstone National Park that displayed strongly habituated behaviour were almost all pups or yearlings (Smith and Stahler 2003). The incidents known to date in Germany (Cases 11 and 12) have also involved young animals. That being said, in North America there have also been incidents of older wolves exhibiting bold behaviour (McNay 2002).

It is actually surprising that wolves living in human-dominated landscapes do not develop bold behaviour far more frequently. This may be because wolves are by nature cautious animals, and, moreover, differ widely from individual to individual, with not all wolves being equally open to new stimuli. Like humans and many other highly developed animals, some wolves are more timid, others more adventurous. The latter react to new stimuli far more strongly and willingly. Behavioural researchers rank human and animal personality traits along what is known as the shyness-boldness continuum (Wilson et al. 1994). The different personality types identified in dogs are distributed across so many breeds that they are very likely to be present in wolves as well (Frank and Gialdini Frank 1982). The principle personality traits in dogs are consistent (Svartberg et al. 2004), i.e. curious or fearful dogs remain so throughout their lifetime. However, in their study on dogs, Starling et al. (2013) demonstrated that older dogs display bold behaviour less frequently than young animals. This could imply that the tendency towards bold behaviour becomes less marked with age.

Experiments with swift foxes (a North American fox species) found that individuals ranked as bold drew closer to new stimuli than their shyer peers (Bremner-Harrison et al. 2004). Animals with the characteristics curiosity and fearlessness are particularly sensitive to new stimuli and can consequently become habituated relatively quickly (Svartberg et al. 2004).

In terms of habituation in wolves, this means that even littermates which are exposed to the same stimuli can develop different degrees of habituation. In more cautious individuals a few unpleasant impressions are probably enough to restore their fear. Those, on the other hand, that are naturally rather curious and fearless and hence more open to positive stimuli may become habituated to humans more strongly and more quickly. However, they are also less impressionable – that is to say, they are more likely to maintain their behaviour and it is harder to put a stop to it. The study by Starling et al. (2013) indicates that bold behaviour might diminish with age.

Major personality differences between individual wolves and a possible decline in bold behaviour as animals age might explain why, in the Munster pack of Lower Saxony, some of the pups born in 2014 showed bold behaviour after leaving their parents (Annex 1, Cases 10 and 11), while others did not.

6 Management of wolves with conspicuous behaviour

This section focusses on wolves that behave conspicuously in relation to humans. The guiding principle for the development and implementation of wolf management is the safety of people, which must always be the first priority.

6.1 Options for action

Prevent

The best approach is to ensure that wolves never develop bold behaviour in the first place. Therefore, the simplest method is the preventive approach, aiming to ensure that human behaviour does not lead to strong habituation or food conditioning of wolves. The basic principle for dealing respectfully with wolves and other wild animals is "do not approach, do not feed".

Document

Monitoring is an element of wolf management. Monitoring consists of recording, assessing and interpreting signs of wolf presence in compliance with the reporting obligation under the Habitats Directive. However, in the human-dominated landscape, monitoring is also a useful tool for recognising bold wolf behaviour early on and, where necessary, taking measures to counteract it (see 6.2). This includes routinely recording and archiving reports of sightings using standard protocols. This facilitates later analysis. Even if many sightings cannot be verified and remain unconfirmed observations, their documentation does provide a kind of "background noise" as to how wolf-human encounters usually take place. Reported sightings that are out of the ordinary draw attention and can be directly compared to "normal" sightings. This is especially important in light of the fact that close-range sightings are more likely to be reported and are therefore over-represented in the data. Every suspected case of bold wolf behaviour should be investigated as quickly as possible to enable any traces (e.g. paw prints, hairs) to be documented.

React

Once a wolf displays bold behaviour the options for action are limited. In the early stages, removal of the respective attractant may be sufficient to put a stop to the undesirable wolf behaviour. If this fails, or the attractant cannot be identified, attempts can be made to achieve aversive conditioning by using negative stimuli like hazing. Such deterrence measures, however, can only be used in some narrowly defined incidents, and the prospects of success are uncertain (see 6.3). The last resort in the short list of options is lethal removal.

Communicate

Among the public, acceptance of lethal removal of wolves is low, as was apparent e.g. in the case of MT6 (Annex 1, Case 11). Non-lethal measures are generally more accepted (Gillin et al. 1994, Rauer et al. 2003, Beckmann et al. 2004). What is important is to communicate to the public, from the outset, the necessity for and background to measures such as deterrence (or why it is not possible) and lethal removal. If the management of a wolf with bold behaviour is supported by public relations work from the beginning, people can more easily understand the reasoning behind the steps chosen and are less taken aback by the measures implemented.

6.2 Responding to reports of bold behaviours

Situations in which people report bold wolf behaviour can be roughly divided into two categories: (1) Situations in which wolves really have acted in an unusually bold manner and (2) situations in which human expectations of what is “normal” wolf behaviour do not correspond to how wolves normally behave (Karlsson et al. 2007). It is crucial to be able to assess whether a wolf’s behaviour is truly bold or if it is reacting in a way any other wolf would do in a similar situation (Karlsson et al. 2007).

In order to enable fact-based analysis and assessment of whether a wolf is developing potentially problematic behaviour, it is important to routinely document sightings using standardised protocols and systematically archive them. All related photographic files should also be stored so that they can be called up quickly and attributed to the individual reports of sightings.

If an incident is reported that suggests conspicuous wolf behaviour, it must be investigated promptly. In some cases, this can be done by telephone. Whenever feasible and possible, prompt on-site evaluation should be carried out. The main purpose is to gain a better understanding of the incident so that it can be classified and, if possible, confirmed. In addition, this assures the observer that his or her report is being taken seriously.

When a wolf is reported within 30 m of a person or an inhabited building and the observer finds the encounter unusual, or if the monitoring institution assesses the situation as requiring attention, a case file should be opened and appropriate experts consulted. In such cases, the DBBW provides consultation to the federal state authorities and, if necessary, calls on outside experts from other countries. A national case registry of reports can be set up via the DBBW. This allows all reports of conspicuous wolf behaviour to be recorded, making it possible to analyse cases in which wolves developed bold behaviour.

This type of data collection contains all sightings relating to a case and, if applicable, actions taken. Most reports of bold wolf behaviour to date have proved to be unproblematic. However, there have been several extremely sensational reports of, for instance, wolf attacks on people, which subsequently turned out to be fabricated. This could only be shown through prompt and thorough investigation in the field.

Table 1 shows possible scenarios and their assessment in terms of danger posed to humans. The table is intended as a guide to those scenarios that can be problematic and those that are not dangerous to people. It is not possible to capture every conceivable situation in this kind of list, and every case is different. Case-by-case analysis will therefore always be necessary. For example, a wolf passing closely by vehicles is generally classified as unproblematic. If, however, there are indications that the animal has a clear interest in vehicles, this could be a sign of food conditioning, and the case would then need to be classified accordingly. In some contexts, even a wolf approaching people or spending a longer period of time in a settled area can be completely unproblematic. In Piedmont, Italy, during heavy snow conditions an older female wolf sought shelter in a village. Off the cleared paths, the snow was piled several metres high. Attempts to drive the wolf from the village were unsuccessful. As soon as the wolf sank into the deep snow drifts, she turned back. She tolerated people in close proximity in this situation. When warmer weather set in after a few days, the wolf disappeared into the mountains (F. Marucco, personal communication). As the nuances are often not clearly recognisable for laypeople, experts should always be consulted for assessment.

If an increased number of sightings are reported in an area, the public should be informed about the biology and behaviour of wolves in human-dominated landscapes, even when there is no immediate need for action.

Table 1 presents and assesses wolf behaviour. Certain human behaviours can also cause bold behaviour in wolves. If there is evidence that people have fed a wolf, the situation is first classified as requiring attention, even if the wolf exhibits inconspicuous behaviour. This type of situation absolutely requires greater vigilance.

Table 1: Assessment of wolf behaviour and an assessment of the risk it may pose for human safety with recommendations for action. Situations requiring attention need detailed analysis. The public should be informed in these cases (see 6.4).

Behaviour	Cause	Assessment	Recommended action
Wolf passes close to or through settled areas in the dark.	Wolves avoid people, but not human infra-structures.	Not dangerous.	No need for action.
Wolf moves within sighting distance of settlements / scattered houses during daylight.	Wolves avoid people, but not human infra-structures.	Not dangerous.	No need for action.
Wolf does not run away immediately when seeing vehicles or humans. Stops and observes.	Wolf has not had negative experiences. Young wolves, in particular, are often naively curious.	Not dangerous.	No need for action.
Wolf is seen over several days < 30 m from inhabited houses (multiple events over a longer time period).	This wolf behaviour can have various causes, e.g. food source, attraction to dogs.	Demands attention. Possible problem of strong habituation or positive conditioning.	Analyse situation. Search for attractants and remove when found. Consider aversive conditioning.
Wolf repeatedly tolerates people approach it closer than 30 m.	Wolf has become increasingly accustomed to the presence of humans.	Demands attention. Indicates strong habituation. Possible problem of positive conditioning.	Analyse situation. Radio collaring and aversive conditioning as soon as possible. If unsuccessful, removal.
Wolf repeatedly approaches people closer than 30 m.	Wolf behaviour can have different causes, e.g. the wolf has been "rewarded" by the presence of humans or a dog could be a trigger.	Demands attention / critical situation. Positive conditioning and strong habituation may lead to increasingly bold behaviour. Risk of injury.	Documentation and analysis of the situation. Situation-dependent measures, consider radio collaring and aversive conditioning as soon as possible. Remove the wolf if appropriate aversive conditioning is not successful or practical.
Wolf attacks or injures a human without being provoked.	e.g. rabies, extreme habituation.	Dangerous.	Removal.

6.3 Responding to confirmed behaviour that requires attention

If analysis of the situation shows that the observed behaviour requires attention, it is necessary to a) intensify monitoring, b) inform the public about the situation and steps being taken, and c) call for prompt reports of sightings to the responsible institutions.

If no active monitoring is in place in the area where the wolf is exhibiting the behaviour (e.g. outside of a known wolf territory), monitoring must be initiated immediately. If the wolf is in a monitored area, monitoring must be intensified in order to gather as much background information as possible about the wolves in the area and the animals (number, age, sex) involved in the incidents. In addition, the locations where the conspicuous sightings occurred should be visited and the events documented. In some cases, it makes sense to try to capture and radio collar wolves as part of the intensified monitoring. However, capturing a specific animal is generally unrealistic.

The people in the immediate area of the incident should be informed about the situation, potential causes and planned further steps. If the incident is widely known, it is recommended that wolf management authorities provide information at supra-regional level. Local people should be encouraged to report sightings directly to the wolf management institutions or the police and be asked to refrain from posting on social media first to allow for a fact-based assessment. This approach worked in the Netherlands, where initial sightings of a dispersing wolf (Annex 1, Case 10) were primarily posted on social media. Police then requested that sightings be reported to them first, and the public complied.

If the situation persists, i.e. there are continued verifiable reports of a wolf in direct proximity to houses, or tolerating people within 30 m and /or actively approaching them, there must be a thorough on-site search for potential attractants. Possible attractants might include a food source or a dog. If possible, the attractant should be removed.

The feasibility of deterrence measures against an animal should be reviewed if confirmed reports of a wolf tolerating or approaching humans within 30 m continue to come in. This is only practicable in a few clearly defined situations (cf. 6.4). Carrying out deterrence measures is easier if the animal in question has been radio collared. If the wolf displaying the bold behaviour is successfully captured and radio collared, a hard release with direct deterrence during the course of the release is recommended. This means waiting until the wolf completely wakes from sedation and making sure it is able to perceive the people around it. This alone is a very stressful situation for a wild wolf accustomed to choosing freely where it goes, as it is unable to flee. At release, the animal is then shot at with deterrent ammunition.

If the situation persists despite properly conducted deterrence attempts, lethal removal is the final step. Removal may also be recommended if deterrence is not possible and the situation is assessed as critical.

Lethal removal generally means shooting the wolf; in exceptional cases, it can mean live capture followed by euthanasia. Long-term captivity is not an option for reasons of animal welfare (see 4.3). This also applies to animals that show fearless behaviour and tolerate close encounters with humans or approach them. These animals approach people on their own terms – they can and do run away at any time if the situation frightens them. This kind of behaviour is not comparable to life in captivity under the control of people and in their direct proximity.

If a wolf authorised for removal is not clearly individually identifiable, there is no guarantee that the correct animal will be removed, although this is of course the goal. In addition, it is not always the case that only a single individual is involved.

Generally, permits for lethal removal should be limited to a specific area and time period. In some cases, the situation resolves itself, which is why an expiration date is appropriate. Limiting the permit to a certain area is intended to reduce the chance of shooting the wrong animal.

Exceptional permits for removal of a wolf can be issued under the provisions of Section 45(7) of the Federal Nature Conservation Act (BNatSchG). At the request of the environment ministers' conference, the BMU is working with the federal states on guidelines for execution of Section 45(7) BNatSchG when dealing with problem wolves.

When issuing permits for lethal removal, it should be considered that public reactions to the removals of Bear JJ1 and Wolf MT6 were very emotional and intense. Part of the reason may be that many people were not able to understand the decisions made. In future cases, greater focus should be placed on keeping the public informed. In spite of this, reactions can sometimes be so extreme that it is prudent to keep the removal team anonymous.

6.4 Protocol for dealing with bold wolves

This section contains general rules for handling reports of conspicuous wolf behaviour. Every action that can be necessary in this context is explained in detail. Figure 1 illustrates the general steps to be taken following reports of a bold wolf. Nevertheless, every case is unique and requires expert evaluation. The experts, in addition to assessing the behaviour, will provide the competent authorities with a recommended approach tailored to the specific case. The DBBW is available to the federal states for consultation and can be included in field activities if necessary.

Opening a case file

A case file contains all the information on reports of or confirmed incidents of conspicuous wolf behaviour. A file should always be opened when a sighting is reported of a wolf within 30 m of a person or inhabited houses and the observer finds the behaviour conspicuous, threatening or problematic, or when the monitoring institution assesses the situation as requiring attention. This applies only to first-hand reports of sightings. The goal is to be able to follow each potentially problematic situation in a case file, which is not always simple. Generally, reports received within 12 months relating to the same territory or individual should be included in the same case file.

Standardised maintenance of case files enables a) continuous case documentation and b) later data analysis. This makes it possible to learn from experience and improve future actions. Harmonising case files across national borders enables cross-border analyses and evaluations of the measures that work best in different situations.

Field investigation

At the latest following the second report in three months of a wolf tolerating or approaching humans to within 30 m, a field investigation should be carried out with the following goals:

1. Assess how many and which wolves are involved in the case;
2. Confirm reported sightings (e.g. whether reports match up) and to check distances (e.g. to people or buildings);
3. Identify potential attractants.

The requirements for confirming individual reports are similar to the guidelines provided in the national monitoring standards (Reinhardt et al. 2015). Reports can be confirmed as C1 (hard facts) or C2 (confirmed records).

Identifying attractants

If reports of conspicuous behaviour continue and a general area can be pinpointed, a thorough search for possible attractants should be conducted. Wolves and dogs are drawn to similar attractants, and therefore using dogs in the search is helpful, in particular if a food source is involved. Almost any dog is suited to this type of search. If a food source is not involved, a dog trained in tracking wolves can be used to help identify what is arousing the wolf's interest.

Encouraging reports of sightings

It is helpful to call on locals to report wolf sightings promptly and directly to the police or the monitoring institution. This makes it easier to obtain an overview of where reports are clustered and where potential attractants might be. It also facilitates gathering general information about additional occurrences as quickly as possible. The police must be made aware of the reporting chain. All incoming reports of sightings must be recorded according to the standardised protocol available to all wolf monitoring institutions.

Intensifying wolf monitoring

It is important to intensify monitoring in the affected area in order to collect more information about the wolf activity. Where feasible, an attempt should be made to capture and radio collar the wolf concerned. The people commissioned with the analysis of the case should visit the location where the wolf was seen and document what they find there. It is useful to take a dog to the location, as in some cases wolves are more likely to approach people if dogs are involved. If a wolf is actually sighted in the field, the animal's tolerance of an approach to within 30 m should be tested. The behaviour of the wolf should be documented.

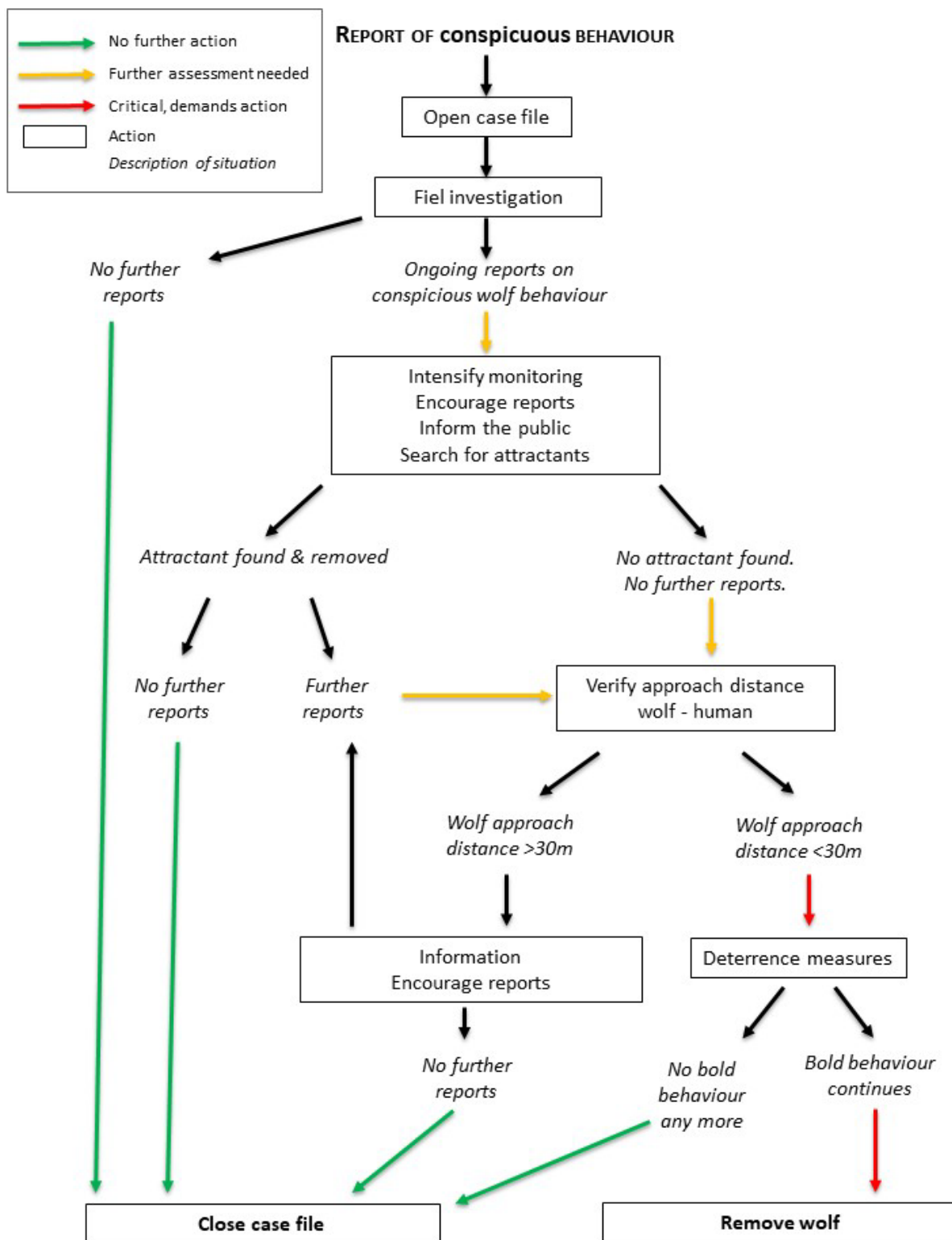


Figure 1: Schematic workflow when conspicuous wolf behaviour (in relation to humans) is reported (see text for details). This workflow illustrates the process but may not fit every individual case. For instance, removal may also be recommended if deterrence is not possible but the situation is assessed as critical. Every case must be analysed by experts.

Informing the public

In cases of wolves exhibiting conspicuous behaviour, informational events that directly address the people concerned have proved useful in Scandinavia. These kinds of events, at the location of the occurrence, are significantly more effective than large meetings with representatives from interest groups and politics.

Small meetings with the locals make it easier for people to talk with one another and to share information about sightings or possible attractants. In addition, it is easier to focus on the most current case. A larger-scale setting can expand the discussion to other topics such as regional and national wolf policies and management, which is not helpful in the specific local case.

The following points should be considered at the meeting:

1. In order to create a shared basis for further discussion, it is important to present what has been documented so far and to ask whether there are additional incidents that are unknown to the wolf management team.
2. Reports about experiences in other areas with similar problems should be shared. How were the problems handled, what worked and what was ineffective?
3. The protocol for dealing with problem wolves should be presented in overview. What measures are planned and what further steps will be taken if the situation continues unchanged?
4. Leave ample time for questions from the public.

Some people who attend the meeting will be apprehensive about the direction the situation could take. To increase trust in the competent authorities and calm fears, it is important that the presentation is well prepared and that any promises made at the meeting can be kept. These meetings should be conducted by a presenter who has the necessary knowledge, can answer the typical questions, enjoys public speaking and is good at building trust.

Deterrence

Wolves are intelligent animals that quickly detect the weaknesses of deterrence methods. It is therefore important to plan interventions thoroughly and ensure the availability of suitable personnel to carry them out. Action that is not well thought out can lead to an animal becoming accustomed to the measures taken, resulting in their failure (McCarthy and Seavoy 1994, Dolson 2015).

Deterrence is not a universal solution for all situations involving undesirable wolf behaviour. Successful deterrence resulting in negative conditioning requires specific circumstances. In practice, it is difficult to make a wild animal associate a negative experience with its own (undesirable) behaviour. Experience with deterring large carnivores in Europe has been compiled for bears (Majić, Skrbinšek and Krofel 2015). However, to date there are no published studies that examine the effectiveness of deterrence measures used against wolves. This is not surprising, as wolves rarely develop bold behaviour (Linnell et al. 2002, McNay 2002). In Europe as a whole, there are only a few cases in Sweden of attempted aversive conditioning of wolves. Sweden is perhaps the country with the most experience in deterrence of large carnivores. A small intervention team handles all cases of problematic behaviour in bears, wolves, lynx and wolverines. Nonetheless, the variety of methods make it hard for even the Swedish professionals to assess the effectiveness of the deterrence attempts. This ultimately makes it difficult to say which methods have which effect.

Using the strongest form of deterrence from the outset is a basic rule for achieving aversive conditioning, in order to avoid habituation to negative stimuli. It is also important to deter as soon as possible, before the animal's undesirable behaviour has become ingrained. The more often an animal is "rewarded" for a behaviour, the more difficult it becomes to change it. Anyone who has tried to break the habit of a specific behaviour in a dog using punishment knows that exact timing and precision are necessary to make the animal associate the undesirable behaviour with the unpleasant experience.

Generally, multiple repetitions are needed so that the dog actually associates the punishment with its own behaviour (and not, for example, with the presence of a particular person). When using these methods on wild animals like wolves, it is significantly more difficult to bring about a situation in which the wolf is not only punished but is also theoretically in a position to associate the punishment with its own behaviour. The animal must be able to understand that the punishment can only be avoided by discontinuing the undesirable behaviour. Ideally, deterrence leads to the wolf associating people and / or settled areas with unpleasant experiences and therefore avoiding close proximity to people. In theory, the sequence of this learning process is simple; in practice it is, to put it mildly, a challenge. Every time the animal displays the undesirable behaviour and experiences no negative consequences or actually has a positive experience, the deterrent effect is weakened and motivation to perform the undesirable behaviour reinforced.

Deterrence methods

Experience in Sweden has shown that shots fired in the air or use of firework devices that explode 10-15m in front of a wolf cause the animal to flee immediately. However, no long-term effect was observed (J. Frank, personal communication). This could be because the firework landed too far away from the wolf and had a habituation rather than a deterrence effect. It can be expected that wolves that grow up in Germany on or near military training grounds will quickly grow accustomed to pyrotechnics as they are already familiar with exploding ammunition. Another drawback of these methods is that they can be a significant fire hazard.

In contrast, a sharp pain caused by a projectile, provides a much stronger aversive experience than a bang or flash of light. Whether it is in fact the more effective method of deterrence has yet to be tested. A variety of ammunition optimised for various distances has been developed primarily for non-lethal use on humans. It is important that the shooter knows the distance the ammunition is designed for and can estimate it. If a wolf is shot at 30 m with a projectile designed for use at 70–90m, the animal can suffer serious injuries or even die. Rubber or plastic shot can be used only at a very short distance (max. 20 m). At greater distances, the scatter and relative lack of accuracy combined with a moving target mean that the shot risks hitting the animal's head or, in the worst case, its eye, causing serious injury.

The shooter should aim for the rear flank, as this area is relatively well muscled. Shooting at the animal's ribs should be avoided because they can break comparatively easily. A wolf is a fairly small animal, its rear flank no bigger than a small plate. This demands a high level of target accuracy. It should be noted that non-lethal ammunition handles very differently from lethal ammunition.

It is much more difficult to achieve the required level of accuracy with this type of ammunition. For this reason, use of deterrence ammunition is only recommended if the animal can be approached to within 30 m.

When can deterrence be used?

In order to achieve aversive conditioning through deterrence, a) it must be possible to hit the wolf with deterrence ammunition and b) the wolf must be able to associate the negative stimulus with its own behaviour.

Deterrence can be carried out more successfully when the wolf remains in a relatively small area and allows or makes approaches to within 30 m or when the wolf predictably and repeatedly returns to a particular location. In these cases, agents can wait on location for the animal. Then the wolf can associate the negative experience both with the place and the people.

However, if the animal moves over a large area (e.g. during dispersal) and exhibits the undesirable behaviour over multiple days at various locations, it is almost impossible for the deterrence team to always be in the right place at the right time. Generally, the wolf will already be gone by the time they arrive. In the event that the wolf is found on location, it will likely flee as soon as it notices that the humans arriving are targeting it. If the animal does not flee and can be shot with deterrence ammunition, it will likely associate the negative experience with the unusual situation of people suddenly arriving and moving towards it. The same animal can then continue to react in a relaxed way towards people and even approach them when they are behaving calmly, walking or working. In such cases, deterrence has little chance of success.

Practice makes perfect

People tasked with carrying out deterrence measures need experience in the use of various deterrence ammunition. They must regularly practice shooting with the various ammunition types at a variety of distances. They should be able to hit the rear flank of a moving wolf target with deterrence ammunition at 30 m in three out of three attempts. Experience with wolf behaviour around people and buildings is helpful. Those who carry out deterrence must also be able to properly document the process.

Deterrence cases are very rare, which makes it difficult to gain sufficient experience. In the short term, expertise from other countries should be used as a resource.

Wolf removal

It can admittedly be very difficult to know for certain whether it is always the same individual that is responsible for all observations of bold behaviour. However, in truly critical cases, it is relatively easy to remove the correct animal. Shooting criteria that specify firing on a wolf if it allows standing or moving persons within 30 m provide a high likelihood that the correct individual will be removed from the population. If an animal cannot be approached to within 30 m, the assessment of potential danger to humans posed by the animal should be reviewed.

6.5 Responsibilities in dealing with bold wolves

Table 2 illustrates which institutions handle and are responsible for the various tasks in dealing with bold wolves. Detailed responsibilities in wolf management are governed by the management plans of the federal states and can vary accordingly.

Table 2: Tasks and responsibilities in dealing with bold wolves. In individual cases, responsibilities can vary from state to state.

Institution	Responsibilities/ tasks
Institution responsible for management at federal state level	<ul style="list-style-type: none"> - organises, coordinates and executes management, including awarding contracts for monitoring, informing the public - guarantees functional monitoring structures - issues/organises necessary permits - requests consultation from the DBBW as needed - works with other federal states, the federal government and the DBBW as needed - organises and coordinates deterrence or lethal removal if necessary
Institution responsible for monitoring at federal state level	<ul style="list-style-type: none"> - organises, coordinates and executes monitoring - analyses data - flags potentially bold behaviour - informs responsible authorities or the DBBW as needed - organises, coordinates and executes measures including field investigation, intensification of monitoring, soliciting reports, informing the public, search for attractants - opens and maintains case files; if necessary, organises and coordinates deterrence or lethal removal
DBBW (commissioned by the Federal Agency for Nature Conservation under an R&D project running until 2025)	<ul style="list-style-type: none"> - advises federal state authorities on request - assesses behaviour and makes action recommendations on request - available as capacity allows to support field activities on request - notifies competent authorities in other federal states in coordination with the affected federal state - performs national analysis of case files and conducts international exchange - cooperates closely with international and domestic experts

7 Recommendations for Germany

Monitoring

It is important to set up wolf monitoring in a way that enables conspicuous wolf behaviour to be recognised promptly and the competent authorities to be informed (see 6.1). The competent authorities are responsible for creating structures that facilitate and guarantee professional monitoring. If the existing structures cannot or do not fulfil the requirements, they should be improved (Reinhardt et al. 2015).

It is sometimes difficult to verify reports of bold wolf behaviour. Not all people reach for their camera or mobile phone in stressful situations. This makes it even more crucial to investigate reported cases promptly. In federal states where this has not yet occurred, reporting systems should be set up that enable prompt relay of information. At the very least, the police should be informed about the appropriate channels for reported sightings.

Veterinarians in wolf regions should also be advised to secure any possible genetic material samples prior to treatment in cases where a wolf attack on a dog is suspected, in order to be able to verify the case.

Case file

In future, all cases of wolf behaviour requiring attention should be recorded in a national case registry. This makes it possible to identify cases actually involving bold behaviour and to track their frequency. Case files furthermore enable data analyses to determine the circumstances that can lead to development of problematic behaviour and what measures prove effective in dealing with it. The establishment of this kind of case registry should also be coordinated internationally, in order to foster exchange of experience in this area and facilitate international analyses.

Informing the public

In public communications about wolves, it should be made very clear that feeding wolves (even once) can ultimately cost the animals their lives. Repeated approaches by humans, especially directed towards young wolves, can lead to habituation to the immediate presence of people and later to the development of bold behaviour.

Beyond this, it is important to communicate to the public the kinds of wolf behaviour that are not problematic. Many people expect wolves to run away immediately upon sighting a person or even just a vehicle. Communication on this point is necessary to give the public an idea of normal, unproblematic behaviour of animals living in a human-dominated landscape.

If conspicuous wolf behaviour occurs over a longer period of time, the local community should receive transparent information about developments in the case. This is also a good approach in cases where the behaviour is not assessed as problematic, but has been perceived by residents to be so. In cases of problematic wolf behaviour requiring action, providing information helps people to better understand the measures being pursued and consequently to feel that the steps implemented are not taking them by surprise. Only honest, objective communication can help foster trust among the public for the competent authorities. If a case has become the object of supra-regional attention, informational efforts should also be directed to this level as well. Generally, it is better to approach the public actively with first-hand information rather than to react to what third parties have relayed to the media. At informational events on conspicuous wolf behaviour, it is extremely important to guarantee a uniform level of expertise and quality so that the public is not confused by diverging views and interpretations.

Special expertise in deterrence

As problematic wolf behaviour is rare and the use of deterrence even rarer, it is necessary to pool expertise and experience in deterrence. This should occur Germany-wide and in consultation with international experts. An expert team that can support the competent authorities on request with experience and theoretical knowledge should consist of both wolf experts and people who routinely handle weapons. It is also advisable to continue drawing on the expertise of the Swedish VSC (Viltskadecenter) for interventions over the next few years, as German management has had very little experience to date in wolf deterrence.

International coordination

At the moment, similar strategies for dealing with bold wolves have been and are being drawn up in several European countries. Our recommendations here have been developed jointly with the Swedish strategy (Frank 2016). It was this cooperation that led to the idea of a case registry to facilitate future data analyses. It would be highly desirable to coordinate national case files in such a way that Europe-wide analysis is possible in future. This DBBW report should be understood as a working document and updated in accordance with new findings.

Conclusion

To summarise, we recommend the following in order to react appropriately to wolves that display potentially bold behaviour in relation to humans:

- Wolf monitoring and management must be organised, in terms of structure and expertise, so that problematic behaviour can be recognised early on and counteracted.
- A national case registry should be maintained for national records and analysis of conspicuous wolf behaviour. A suitable module should be added to the national observations database of the DBBW. In order to facilitate future analyses, this module should be coordinated with other European countries.
- When wolf behaviour requiring attention is confirmed, the situation should be addressed with professional public outreach and information, primarily at local level. Depending on the case, public information may also be prudent in cases where the wolf behaviour is not assessed as problematic. Educating the public about the causes of bold behaviour is recommended as a preventive measure, as is targeted information on how to distinguish normal wild animal behaviour from behaviour requiring attention. Informational flyers for the individual federal states are practical for this.
- Direct feeding of wolves can lead to strong habituation/food conditioning, likely necessitating the lethal removal of the wolf, and is completely unacceptable.
- For the future efforts to address management of wolves exhibiting problematic behaviour towards humans, we recommend close exchange between the federal states and specialist training and equipment for agents who may carry out deterrence measures.
- The federal states are advised to implement reporting systems, prepare the required approval steps and specify contact persons for decision-making.

This strategy is a recommendation based on experience and scientific knowledge acquired to date. It should be updated and further developed in accordance with new findings.

8 Literature

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Annex 1 Example cases

The following presents some cases, each containing an assessment of the wolf's behaviour, recommendations for management and the proof of confirmation as set out in the national monitoring standards (Reinhardt et al. 2015).

The confirmation of wolf observations was classified according to criteria used in the trans-boundary monitoring project Status and Conservation of the Alpine Lynx Population (SCALP). The SCALP criteria were further developed to apply to wolf and bear presence and adapted to the conditions in Germany. The degree of confirmation is classified according to verifiability in categories 1 to 3.

C1: hard evidence = facts which unambiguously confirm the presence of the respective animal species (live capture, dead animal find, genetic proof, photograph, telemetric location).

C2: confirmed observation = observations (e.g. tracks, kills) confirmed by an experienced person as being caused by a wolf, lynx or bear. The experienced person can review and confirm the evidence either personally in the field or on the basis of robust documentation by a third party.

C3: unconfirmed observation = all observations which, due to lack of evidence, can neither be confirmed nor ruled out by an experienced person as being caused by a wolf, lynx or bear. These cover all sightings without photographic proof, including those of experienced persons; all signs that are too old, inadequately or incompletely documented, which provide too little information for a clear picture (e.g. in the case of tracks), or which for other reasons are not sufficient for confirmation. C3 observations can be divided into "likely" and "unlikely".

False: false observations = observations for which the species in question can be ruled out as a cause.

Evaluation not possible = signs which cannot be assessed due to lack of minimum necessary information, such as reported sightings of kills or tracks.

Cases of wolves displaying conspicuous or bold behaviour

Case 1 2004, Neustadt (Saxony)

Over several weeks in 2004, a radio collared female wolf spent the nights near a village in Lusatia, Saxony. The female was interested in a particular male dog. The dog had disappeared from a fenced garden for around 24 hours in mid-February, and was seen in the company of the female wolf when the owner managed to call the dog back. After this incident, the female wolf displayed a behaviour that suggested she had established a social relationship with the dog. At night, she remained in the vicinity of the dog owner's property, which was somewhat secluded. Her howling could often be heard. At that time (2004), there was only one wolf pack in Germany, the young female's natal pack. The previous year the female had mated with an unknown male dog and raised hybrid pups. In the absence of a potential wolf mate, she was now attempting to mate with a male dog once again. She exhibited aggressive behaviour towards a female German Shepherd from a neighbouring farm, the two females having noisy but non-bloody confrontations. As the female wolf was already radio collared, the situation could be monitored closely. The two dog owners were cooperative. After around two months, tensions diffused and the female wolf returned to her "normal" wolf life. (Reinhardt and Kluth 2007). The following year she mated with a male wolf immigrating from western Poland.

Assessment: Requires attention

Confirmation: C1 (telemetry)

Measures: Monitoring, informing local residents

Case 2 2008, Wittichenau (Saxony)

In September a wolf which displayed no shyness of humans was reported in a small town. The town was outside the confirmed wolf area. Wolf experts found a four-and-a-half-month-old pup in one of the town gardens. The pup appeared disoriented, but showed no fear of humans. The people that had observed the animal did not feel threatened, and had fed it sausage and bread. The animal was captured and examined, whereupon it was found to be (almost) blind. As it could no longer be released into the wild, the pup was put down. Genetic analyses confirmed that the pup was from a known pack. How the blind but well-nourished pup ended up so far from its pack remained unclear.

Assessment: Requires attention

Confirmation: C1

Measures: Removal

Case 3 2009, Neustadt wolf pack (Saxony)

In February 2009, the breeding female of the Neustadt wolf pack (the same animal as described in Case 1) showed a strong interest in a male dog. She waited every evening on the outskirts of the village for the dog to come by with its owner. On the first occasion, the female was accompanied by a larger wolf, but subsequently was only seen alone. The wolf waited in the dark and whined when the dog appeared. The woman who owned the dog was largely ignored during the encounter.

For about a week, she saw or heard the wolf every evening during the walk. However, when the owner and her dog were accompanied by another person, the wolf was neither seen nor heard. The dog owner was the only person to see the wolf during this time.

One day at around noon, while she was walking the dog in the adjacent forest, the female wolf appeared and followed the dog and its owner for about 45 minutes. She circled them, but never approached closer than 50m. As soon as the dog owner faced the wolf, the animal turned around and retreated. After this incident, the dog was taken to another location for ten days. The female wolf was subsequently no longer seen in the vicinity of the village. Later genetic analyses showed that the male of the wolf pack had disappeared, presumably shortly before the mating season. Clearly the female had not yet fully bonded to the new male she had been seen with on the first occasion. Instead, the female attempted to make contact with the dog, which she had "known" for a longer time, as it had been used in monitoring measures. Before the end of the breeding season, the female wolf mated with the new male and established the Seenland pack.

Assessment: Requires attention

Confirmation: C1

Measures: Removal of the attractant (the dog was temporarily taken to a different location)

Case 4 2010, Seenland wolf pack (Saxony)

At the beginning of 2010, a dog owner reported having the impression that a wolf was waiting for him and his dogs when he walked them in the heart of the Seenland wolf pack territory. For the most part, the wolf remained at a distance of over 100 m, but observed the man and sometimes followed him. A field investigation was carried out which confirmed that this was the same female wolf described in Cases 1 and 3. The dog owner was asked to refrain from walking his dogs in that area for a while, and this measure alleviated the situation.

Assessment: Requires attention

Confirmation: C1

Measures: Intensifying monitoring, removal of attractant (dogs were walked at a different location)

Case 5 2012, Munster wolf pack (Lower Saxony)

In August 2012, it was reported that three wolf pups had followed a soldier on a night march on the Lower Saxony military training ground of Munster Nord. According to the report, the pups could not be driven away and only retreated after the soldier had climbed a tower and kicked out at the animals as he came back down. The case attracted considerable media attention but was not investigated in any detail. The background to the incident remained unclear.

Assessment: Requires attention

Confirmation: C3

Measures: None

Case 6 2013, Munster wolf pack (Lower Saxony)

In 2013, three close encounters between a wolf and a dog were reported, all occurring in close proximity to the dog owner. In two of these cases, the dog and wolf had a physical fight. At least two of the cases involved the same wolf, a recognisable female yearling from the Munster wolf pack.

Assessment: Requires attention

Confirmation: C3

Measures: None

Case 7 2013, Nochten wolf pack (Saxony)

In November 2013, there were a number of sightings in Lusatia, Saxony, of an apparently disoriented wolf pup. The pup did not react to closely passing cars. It was observed and photographed eating out of the bin of a nearby restaurant and catching a hen during the day amongst the houses. The photos showed that the pup was very small and thin. Over the summer, the pups of the local pack had already presented serious symptoms of mange. Due to its disoriented behaviour and extremely delayed development, the recommendation was to capture the pup and, if considered necessary following a veterinary examination, put it down.

However, attempts to capture the animal failed, as it was constantly sighted at different locations, each time disappearing before the trapping team arrived. After a while the sightings ceased and the presence of the animal was not confirmed again.

Assessment: Requires attention

Confirmation: C1

Measures: Intensifying monitoring, informing the public, capture attempts

Case 8 2014, Schorfheide (Brandenburg)

At the end of October 2014, a fight occurred between a male wolf and a female dog, causing the latter serious injury. The fight took place near a secluded forester's lodge in a clearing of a large forest. The immediate environs of the lodge were surrounded by a fence. The dog had gone under the fence and beyond the property when the fight occurred. The spirited intervention of the dog owner succeeded in separating the animals, and the dog was treated by a vet. The area did not belong to any confirmed wolf territory.

Even before the incident, the wolf had apparently been seen several times near the property. Afterwards, camera traps recorded the wolf near the lodge on several occasions over a four-week period. Sometimes the wolf scent marked. It remained unclear as to why the wolf was so interested in the property, nor were the exact circumstances of the physical fight between the animals properly explained. There was no other evidence of interactions between a wolf and a dog in the area. The wolf management authority reinforced the wooden fence around the lodge with an electric fence to prevent the dog leaving the property in future. The wolf eventually left and to date has not been located again, even through genetic monitoring.

Assessment: Requires attention

Confirmation: C1

Measure: Monitoring, securing property with an electric fence

Case 9 2015, Munster wolf pack (Lower Saxony)

In early 2015, there were numerous media reports of wolf sightings in the territory of the Munster pack. The wolves were frequently seen during the day, for instance crossing roads, taking almost no notice of passing cars. There are numerous photos and video recordings of these sightings. When all reported sightings were analysed, it was found that close-range sightings (≤ 30 m) of wolves from the Munster pack were far more common than of wolves from packs in Saxony. It should be noted that most of these sightings were from a car. Photos and videos indicate that the wolves displayed very relaxed behaviour in the vicinity of the cars, which were less than 30 m away from them.

There were also close encounters between wolves and people on foot. This type of close encounter was reported on average almost twice as frequently in Munster (5 territory years) than from all wolf territories in Saxony combined (69 territory years). On these occasions, the wolves of the Munster pack repeatedly continued to approach the walkers, even after recognising them as human. The most alarming reports of wolves following humans over a longer distance were not verified with video or photographic evidence. Based on the available (and publicised) recordings, it was nevertheless evident that some of the Munster pups were showing an interest in cars and/or people. Moreover, there is evidence of several occasions when people approached within 10m of pups to film or photograph the animals.

In response to the reports, the Lower Saxony nature conservation authorities decided to intensify and professionalise the wolf monitoring in Munster. They also ordered wolves of the pack to be captured and radio collared, and commissioned a situation analysis.

In the summer of 2015, bold behaviour in the territory of the Munster wolf pack declined significantly, ceasing completely after two yearlings were captured and radio collared. The situation analysis found the breeding pair of the Munster pack to be more tolerant of human activity than other wolves in Germany. The wolves in the Munster pack were also more diurnal than is usual for the species. However, there was no evidence that the parents were interested in humans or cars. Their 2014 offspring, by contrast, showed clear signs of curiosity about humans and cars (one of the yearlings ran after the trapping unit's vehicle). This is an indication of positive conditioning.

There were many rumours of the pups being fed and of people playing with them, but these could not be verified. Nevertheless, the fact that the young wolves sometimes tolerated humans at a distance of below 10m and that some of the pups were evidently interested in people and cars are clear indications of strong habituation and positive conditioning.

In light of current knowledge on the development of strong habituation and positive conditioning, it must inevitably be concluded that the behaviour of the pups of the 2014 litter of the Munster wolf pack was the result of people behaving wrongly.

Assessment: Requires attention to critical

Confirmation: C1

Measures: Intensifying and professionalising monitoring, conducting situation analysis, capturing and radio collaring pack members in order a) to keep better track of the situation and b) to facilitate any necessary deterrence measures.

Case 10 2015, Wolf GW368m, Munster wolf pack (Lower Saxony and the Netherlands)

From February to April 2015, a dispersing pup travelled through western Lower Saxony and for a few days around the Netherlands before returning to Lower Saxony. The animal evidently journeyed along roads. It was seen on an almost daily basis and was photographed and filmed while on the outskirts of or sometimes even within settlements. Using these records and some genetic samples, it was possible to reconstruct nearly the entire route travelled by this wolf.

In response to this striking behaviour, the nature conservation authorities decided to capture the animal in order to examine it more closely and learn more about its identity (it was not clear at first whether or not the wolf had escaped from captivity). However, attempts to capture the animal failed because it moved on too quickly. Later genetic analyses confirmed that it was one of the litter born in 2014 to the Munster wolf pack.

The young wolf was evidently accustomed to the proximity of humans. While it did not make any direct attempts to come into contact with people, it tolerated their presence at close range. The animal behaved as if it was entirely normal for a wolf to walk along roads or through villages during the day. During this dispersal, the wolf gradually showed increasing signs of insecurity when it came across humans close up. However, this made no difference to its behaviour. The wolf was travelling through a densely populated, human-dominated landscape and was exceptionally diurnal, and was therefore repeatedly exposed to situations in which it felt uncomfortable, as is apparent from video footage. However, the wolf did not seem to have had any negative experiences with humans. The people it encountered were generally too surprised and more concerned with photographing or filming the animal than driving it away. In early April the wolf returned to its parents' territory, dispersed again a few days later and shortly after was killed in a traffic accident on the highway.

Assessment: Requires attention

Confirmation: C1

Measures: Attempts at capture (in Germany and the Netherlands).

Case 11 2016, wolf MT6, offspring of Munster wolf pack (Lower Saxony)

In the second half of 2015 no close encounters between wolves and humans were reported in the territory of the Munster wolf pack. There were some close-range sightings from cars, all involving MT6, one of the two radio collared yearlings. In autumn, MT6 began to display exploratory dispersing behaviour. He covered an area of over 2,000km², but always returned to his natal territory. In December MT6 was sighted in a village and filmed. A few weeks later he followed a woman walking her dog in the vicinity of the village. He approached as close as 5m. When the woman let her dog off the lead, the animals had a physical fight. The dog was injured and had to be treated by a vet.

The following weeks MT6 was repeatedly seen in or on the outskirts of human settlements. He mostly ignored people and dogs, but tolerated their presence at a distance of far less than 30 m. In February, MT6 again followed a dog and its owner at a distance of less than 5m, this time in a village. The nature conservation authorities then decided to invite an expert from Sweden to undertake deterrence measures in order to achieve negative conditioning.

From 5 to 7 March, deterrence attempts were carried out. Since only the VHF transmitter in the collar was still working (the satellite unit had stopped functioning in November) and MT6 was roaming a huge area, the wolf was very difficult to find. On 6 March he was located from the air. He was accompanied by a second wolf, a pup, which was very frightened of the humans and immediately ran away as soon as it recognised them at a distance of 200m. MT6 followed the pup on this occasion. Thanks to the transmitting collar, it was still possible to approach MT6 several times while he was resting, and to cut off his route when he ran.

For legal reasons, shooting at the wolf with rubber bullets was not an option, even though this would have been possible on several occasions. Instead, MT6 was loudly and repeatedly pursued by humans with dogs. However, at no time during these trials did MT6 display undesirable behaviour when he was put under pressure. The wolf kept to the forest over these two days and did not deliberately approach the humans.

Following this action, around a week passed without any reports of MT6, after which he was sighted again. At the end of March, he approached a car, showing an interest in the vehicle. In April the number of sightings, including close encounters, increased significantly. There were at least 14 reports at this time, many with photos or video footage. At around noon on 1 April, MT6 skirted a town, and on 4 April he followed an elderly woman and her dog into a village, approaching to within 5m. On 24 April, a radio collared wolf was reported to have bitten a dog which was slow moving behind its family (3 people) on a short leash during a walk. While this report could not be confirmed as C1 under the monitoring standards, just one day later MT6 was filmed following a person with several dogs, making repeated attempts to get close to the dogs. As the wolf's erratic behaviour made it impossible to undertake targeted deterrence, while at the same time its bold behaviour was becoming more and more frequent, the Lower Saxony Environment Ministry gave approval for MT6 to be killed. The DBBW issued an opinion supporting this decision. MT6 was shot on 27 April.

Assessment: requires attention to critical

Confirmation: C1

Measures: intensifying monitoring, attempts at aversive conditioning, removal.

Case 12 2016/17, wolf "Pumpak", Rietschen (Saxony)

From mid-November to mid-January there were multiple sightings of a wolf in the residential area around Rietschen in the Görlitz district of Saxony. The wolf's behaviour implied that it was seeking food in the residential area. To begin with, the animal was seen in particular during the day, only later switching its activities more to the night hours. The wolf retreated on direct encounters with humans.

From the first reports of sightings, the situation was intensively monitored in the field. Every reported sighting was investigated promptly and the vicinity of affected villages searched for attractants. The search revealed food sources in a number of places, suggesting that the wolf was quite successful in its hunt for food. In consultation with residents, camera traps were installed on and around properties. Some residents set up their own camera traps and forwarded the results to the wolf monitoring.

The contact office "Wolves in Saxony" (Wölfe in Sachsen), a state financed office responsible for public relations work on wolves, stepped up their information work in the area to keep the population informed about the animal. Locals were asked not to dispose of any food waste on compost heaps or near houses, in order to avoid giving the wolf any further incentive to look for food close to human settlements.

The LUPUS Institute compiled a case file for this wolf, summarising all incidents and evaluating each sighting. From 14 November 2016 to 25 January 2017 there were a total of 27 reported sightings, of which five were C1 sightings that definitely or probably related to this wolf. There were also 30 camera trap incidents on the area, of which 28 were C1 and attributable to this animal. Some of the camera trap photos show the wolf taking something edible from the compost heap. Over time the sightings became rarer and the wolf grew increasingly nocturnal. No escalation of its behaviour was observed.

The identity of the wolf was established using genetic analysis. He proved to be a yearling male from the Ruzow pack in Poland. The animal had already been radio collared twice in Poland, and was referred to by the Polish scientists as “Pumpak” (Tubby). According to the Polish experts, this wolf had been fed by humans as a pup. It can be assumed from this that on numerous occasions in the past the wolf had received food from humans or found food in the vicinity of humans. Based on these positive experiences, he had subsequently deliberately sought out human settlements to look for something to eat. The animal avoided direct encounters with people.

At the end of November, Görlitz district asked LUPUS for an expert opinion on this wolf. In a meeting, representatives of Görlitz district agreed with the LUPUS assessment that the wolf's behaviour, while undesirable, had no implications for public safety. Further action was planned in the form of increased monitoring flanked by public relations work, as well as efforts to capture and radio collar the animal prior to hard releasing it back into the wild. However, the approval required for this was not granted. Instead, the district commissioner decided to remove the wolf.

On 19 January 2017, the Saxony Ministry of the Environment and Agriculture agreed with the decision of the Görlitz Office of the District Commissioner to grant an exceptional permit for the lethal removal of this wolf.

A shooting permit for the wolf was issued on the same day. The last camera trap photos of this wolf were taken on 20 January 2017. Five days later, there was another reported sighting which might have been this wolf. The lethal removal permit expired after four weeks and was not renewed. There was no further evidence of this wolf.

<i>Assessment:</i>	<i>Requires attention</i>
<i>Confirmation:</i>	<i>C1</i>
<i>Measures:</i>	<i>Increased monitoring and public relations work. Authorisation of lethal removal</i>

Examples of wolf behaviour which attracted large public interest, but which was unproblematic

The following cases are examples of how wolf behaviour can be perceived as bold in the minds of the public, but does not merit this assessment from an expert point of view.

Case 13 2014, February, wolf in Cottbus (Brandenburg)

In February 2014, a wolf pup was seen in a part of Cottbus. The animal had probably been startled by a carnival parade and wandered for a while around the neighbourhood. A number of people saw and photographed the pup at close range. It was a district where the forest borders directly on the town. The pup, thought to be from the nearby Teichland pack, had probably entered the neighbourhood at night and then been frightened by the noise and crowds. The nature conservation authorities ordered monitoring in the area to be increased. However, the pup had obviously wandered into the situation just by mistake and was not recorded there again.

Assessment: *Normal wolf behaviour. Not dangerous.*

Confirmation: *C1*

Measures: *Intensifying monitoring*

Case 14 2015, February, wolf near a flock of sheep (Schleswig-Holstein)

In February 2015, a wolf pup in Schleswig-Holstein caused a flock of sheep to panic and break out of their pasture. It then repeatedly chased the sheep, despite people getting in its way in efforts to deter it. The incident was documented in a video, which showed the wolf to be quite harassed by the person who ran towards it yelling and waving a broom. In spite of this, the wolf made several attempts to approach the sheep, which had scattered around the landscape in small groups. Only after a good hour did the wolf give up and run off. Following this incident, the nature conservation authorities approved deterrence and even lethal removal if the animal displayed similar behaviour again. However, there was no repeat of the incident. Further presence of the wolf, an offspring of the Munster pack, was not genetically confirmed, nor were there any subsequent verified reports of conspicuous behaviour which could be ascribed to this wolf. Earlier reports from the neighbouring state of Mecklenburg-Western Pomerania of a wolf exhibiting little shyness remained unverified.

While the behaviour described above is not common, it is not so extraordinary as it might first appear. The wolf was focussed on the sheep and showed no interest whatsoever in the humans. It made no attempt to approach the humans, but to reach its targeted prey in spite of the presence of people. Wolves are often in situations where they are driven away from potential prey or a kill, for instance by wild boars, which not unfrequently will attack wolves of their own accord. Another example are scavengers such as bears trying to take over a kill. In such circumstances it is in a wolf's nature to try to win the contest.

Assessment: *Normal wolf behaviour. Not dangerous.*

Confirmation: *C1*

Measures: *Nature conservation authorities approved deterrent measures and, if necessary, lethal removal of the animal should it again display a similar behaviour.*

Case 15 **2015, March, Vechta (Lower Saxony)**

In March 2015, there was a single unconfirmed sighting of a wolf in the district of Vechta near Goldenstedt which drew a huge media response. At around 9 p.m. an animal that looked like a wolf was seen in a field. There was a forest kindergarten a few hundred metres away. Using these two basic and completely unrelated facts, the media contrived a gripping story.

Although nothing had actually happened, the public was worried. This animal (if it even was a wolf) was going, at night, from A to B, and by chance passed within several hundred metres of a forest kindergarten, where children played during the day.

Assessment: *Normal wolf behaviour. Not dangerous.*

Confirmation: *C3*

Measures: *A number of informational events were held in the area, and a fence erected around the forest kindergarten.*

Case 16 **2015, March, Uelzen, Munster wolf pack (Lower Saxony)**

In March 2015, the driver of a tractor filmed five wolves from the Munster pack as they passed at around 20 to 30 m away from his tractor. The two parents were running ahead and at some distance their three pups followed. One of the pups stopped after passing the tractor and looked at it. When the driver opened another window, the parent animals, which by then were around 80m away, stopped as well and looked back before moving on.

This video was published in local media under the headline "Preparing for the Hunt" (Aufstellung zur Jagd). In the ensuing weeks the video circulated around various federal states as ostensible proof of bold wolf behaviour in all the respective regions, where, in each case, it was purported to have been filmed.

In fact, experts consider such behaviour to be unproblematic. Wolves and other wild animals are often more comfortable around vehicles than around recognisable humans.

Assessment: *Normal wolf behaviour. Not dangerous.*

Confirmation: *C1*

Measures: *None*

Annex 2 Wolf encounters – what to do

The following text can be used verbatim for public information purposes. The 2006 BfN flyer "Wenn Sie einem Wolf begegnen" (If you encounter a wolf) was updated in 2015 and is also available in German. Reprints can be requested from the BfN.

Wolf encounters – what to do

If you are on foot or bicycle in wolf regions, it is rare to encounter a wolf but it is a possibility. Encounters within 100 m generally only occur if wolves have not noticed a person's approach, for example due to wind conditions. When wolves notice people, they generally do not flee in panic, but instead orient themselves for a moment before retreating. Among all of the documented wolf sightings in Lusatia, there have been only very few in which wolves approached people despite already being aware of their presence. Usually this happened in cases involving inexperienced, curious young wolves or when the wolf's interest in dogs or sheep near the person overrode the impulse to flee.

Generally, in any encounter, it is best to behave calmly and maintain distance. If the wolf does not withdraw and the situation makes you feel uneasy, speak loudly or clap your hands to make yourself noticeable. Do not run, as this could trigger chasing behaviour. Should the wolf approach you, which is unusual, stay where you are, stand tall and attempt to intimidate the wolf. In this kind of situation, it is better to take a step towards the animal than to step back.

Like wild boars, wolves are large, powerful wild animals. Show them respect. Do not attempt to approach or entice a wolf. Allow the wolf space to retreat. Do not feed wolves under any circumstances and do not leave leftover food in the open. The instinctive caution wolves exhibit towards people can be lost if the animals experience positive stimuli associated with humans. This can foster problematic behaviour in wolves and may lead ultimately to injuries to people.

For this reason, it is important to report encounters with wolves to the wolf management authority in your federal state. Bold behaviour can then be flagged early on and counteracted if necessary.