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Wild Animal Attacks on Humans in Croatia

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ABSTRACT

Contacts between humans and wild animals are common and frequent, but very rarely end in attacks by wild animals on humans. The aim of this paper is to identify the circumstances of wildlife attacks on humans in Croatia, while the idea behind the paper is that a better understanding of interactions between humans and wildlife should subsequently lead to fewer attacks. As there is no database on attacks by wild animals on humans in Croatia, the data for this analysis was collected from scientific publications, media, and relevant reports. The variables analysed refer to the type of attacks and the victims of the attacks. The results showed that there were 33 attacks by wild animals on humans in Croatia in the period from 2005 to 2023; the most frequent were attacks by wild boars, brown bears, and grey wolves. The characteristics of the attacks differ depending on the animal that perpetrated the attacks, but there are some common characteristics: the attacks mainly took place in rural areas; the victims were mostly male and over 40 years old; in almost all attacks they suffered minor injuries; and during the attacks the victims were in most cases hunting, walking dogs or herding livestock. The data obtained from this analysis can be used to develop preventive measures and define appropriate behaviour in areas with wildlife.

Keywords: wild boar; brown bear; grey wolf; injuries; safety

INTRODUCTION

In the recent decades, the number of attacks by large carnivores (e.g., wolves, bears) on humans has increased, both in industrialised and developing countries (Penteriani et al. 2016, Bombieri et al. 2023). This increase has been caused by several factors: intentional feeding of wildlife (Penteriani et al. 2016), unintentional feeding by leaving food in litter in places accessible to wildlife (Nowak et al. 2021), and the increase of people participating in outdoor activities (Bombieri et al. 2019). Most attacks by large carnivores occur between late spring and early autumn, which coincides with the time when people are most engaged in outdoor activities (Penteriani et al. 2016). In addition to environmental factors, attacks are also influenced by socio-economic factors: large global studies have shown that victims of wildlife attacks in developed or urban societies are usually engaged in recreational activities such as hiking or visiting national parks. In developing countries, i.e., in rural societies, victims mainly perform their daily tasks during attacks, such as working in the fields, herding livestock or picking forest fruits (Löe and Röskaft 2004, Bombieri et al. 2023).

Although, in general, the number of wild animals and the number of attacks by wild animals on humans is constantly increasing, the probability of such an attack is very low (Penteriani et al. 2016, Bombieri et al. 2019). However, if such an attack does occur, the consequences are unpleasant, can be long-lasting and affect both the victim and the surrounding community (Löe and Röskaft 2004). Overestimating the risk of attacks by wildlife can lead to anxiety and an unjustified fear of encountering wildlife (Moscardo et al. 2006, Penteriani et al. 2016), which can subsequently lead to biophobia, an irrational fear of spending time in nature due to the possibility of being attacked by wildlife (Goulding and Roper 2002). Furthermore, excessive fear of attack by wildlife can have a negative impact on conservation efforts by creating negative public attitudes towards these endeavours (Löe and Röskaft 2004).

Since only a few people, such as hunters, come into frequent or direct contact with wildlife or have much

experience with it, the attitudes and opinions of the general population towards wildlife are mainly shaped by the media (Bombieri et al. 2019). Attacks by wild animals on humans are of great interest to the media (Löe and Röskaft 2004), although in Europe, for example, the likelihood of such an event actually occurring is low (Arbieu et al. 2021). Unfortunately, the media often approach this topic in an unobjective way, which includes speculations and exaggeration (Ambarli 2019). Instead of educating the public on how to behave when encountering wild animals, they are often unnecessarily frightened by attacks that are actually very rare (Bombieri et al. 2019), because "media coverage of such attacks generally includes sensational texts and dreadful pictures appealing more to the public's emotions than their logic" (Penteriani et al. 2016). As an example of biased reporting about wild animal's attacks on humans, Arbieu et al. (2021) note the death of a British female tourist in Greece in 2017, who deceased after being attacked by an animal, at first unclear whether it was a dog or a wolf. This tragic event attracted a lot of media attention (Iliopoulos et al. 2022), and most Greek media blamed the wolf for the death of the tourist, believing that an attack by a wolf on a human would attract more public attention than an attack by a dog (Arbieu et al. 2021).

To avoid reactions that are "based on myth, ignorance, exaggeration, and sensationalism" (Floyd 1999), Arbieu et al. (2021) argue that when reporting about wildlife attacks to public, a greater role should be given to scientists and experts who approach the topic objectively and utilise interdisciplinary knowledge to objectively present both positive and negative facts about these events to the public. Löe and Röskaft (2004) state that the circumstances of attacks by wild animals on humans have only recently begun to be researched and that the role of scientists and experts is crucial, considering that aggression by wild animals towards humans is a complex problem due to various environmental and social factors (Nowak et al. 2021). These factors include the behaviour of the animals prior to the attack, the demographic characteristics of the victims, the seasonality of the attacks and the activities that the victim was engaged in prior to the attack. A comprehensive understanding of the circumstances or patterns of attacks that have already occurred can help prevent future attacks (Behdarvand and Kaboli 2015).

The literature review shows that attacks by wild animals on humans have rarely been studied in the context of tourism or recreational activities (Moscardo et al. 2006); notable exceptions are Durrheim and Leggat (1999), Thompson et al. (2003), Toovey et al. (2004), Moscardo et al. (2006), Penteriani et al. (2017) and Ikeda et al. (2019). In Croatia, most of the studies on attacks by wild animals on humans were conducted by medical professionals (see Lojkić et al. 2009, Šprem et al. 2013, 2014, Vodopija et al. 2016, 2021, Sarajlić et al. 2022, Tunjić Pejak et al. 2022), so, as expected, they mainly analysed the medical aspects of the attacks. More comprehensive, interdisciplinary studies analysing different aspects of the attacks are much rarer and have been conducted as part of larger studies involving experts from several countries who examined one species (see Bombieri et al. 2019) or a guild (see Penteriani et al. 2016, Bombieri et al. 2023).

This paper aims to determine the circumstances of wild animal attacks on humans in Croatia: which animals most frequently attack humans, the spatial and temporal circumstances of the attacks, the activities of the victims during the attacks and the consequences of the attacks. In addition, several wild animal species are analysed in this paper. In this way, a broader and more detailed picture of wildlife attacks will be obtained.

MATERIALS AND METHODS

Löe and Röskaft (2004) argue that sources of data on wolf attacks on humans are "few, often fragmentary and difficult to find". In general, this statement could also be applied to data on other wild animals' attacks on humans. In Croatia, there is no database on attacks by wild animals on humans. There is also no standardised system for collecting data on such incidents in other countries (Moscardo et al. 2006). There are several systems in the USA, Canada, Sweden and India, but they are not linked or comparable as they do not collect identical or standardised information (Löe and Röskaft 2004).

Therefore, the data for this paper was collected on the internet, using common search engines such as Google and the literature database Google Scholar. Word combinations in Croatian and English were entered into the search engines, e.g., "attack", "human" and specific wildlife species. This method of data collection has been used in literature that studied attacks by wild animals on humans, such as Penteriani et al. (2016, 2017), Ambarli (2019) and Bombieri et al. (2019, 2023).

The variables analysed relate to the attacks and the victims of the attacks. The following information was collected about the attacks: (1) wildlife species involved; (2) location; (3) general location category; (4) date of attack; (5) time of attack; and (6) the number of animals involved in the attack. The following data were collected on the victims of the attack: (1) gender; (2) age; (3) group composition at the time of the attack (alone or in a group); (4) the activity of the victim at the time of the attack; (5) the circumstances of the attack; (6) the type of injuries; and (7) the nature of injuries (possible outcomes were fatal and nonfatal). The information collected was defined using variables from published papers such as by Tough and Butt (1993), Durrheim and Leggat (1999), Herrero and Higgins (2003), Mayer (2013) and Bombieri et al. (2019, 2023).

In the data processing, three groups were formed depending on the location of the attack (Group 1 = urban area, Group 2 = rural area, and Group 3 = suburban area). For the variable relating to the time of the attack, two groups were formed (Group 1 = morning, and Group 2 = afternoon). Two groups were also formed according to the season in which the attack took place (Group 1 = spring-summer period, and Group 2 = autumn-winter period). In terms of the number of endangered individuals, two groups were formed (Group 1 = individual, and Group 2 = group of individuals). For the activity of the affected individuals, three groups were formed (Group 1 = recreation/hiking, Group 2 = hunting, and Group 3 = daily work activities).

Data on 33 attacks was collected, for the period from 2005 to 2023. In cases where one animal attacked more than one person on the same day, these attacks were recorded as one attack. The primary processed data was entered and systematised in the Microsoft Excel® software package, and further data analysis was carried out using statistical software Statistica® (TIBCO Software Inc., version 14, Palo Alto, CA, USA) and SPSS® (IBM-SPSS Inc., version 28, Armonk, NY, USA). The nonparametric Chi-Square Test of Independence was used to determine whether there is an association between categorical variables by comparing the type of different species with the above-mentioned categorical variables such as location of the attack, time of the attack, etc.

RESULTS

The following section presents the attacks of wild animals on humans in Croatia. It analyses the conditions of the attacks and their consequences. The number of attacks by certain wild animal species per year is shown in Figure 1. The geographical distribution of wildlife attacks is shown in Figure 2.

As the p-value is greater than the significance level we chose (p=0.05), no correlation was found between the wildlife analysed and the location of the attack (χ^2=11.375, p=0.077).

Wild Boar (*Sus scrofa* L.)

Between 2007 and 2023, there were 14 attacks on humans by wild boar, which is the highest number of attacks by any wild animal included in this study. Details of these attacks can be found in Table A1 in the Appendix. The wild boar attacks took place throughout the whole territory of the Republic of Croatia. Nine attacks occurred in the continental part and five in the coastal part; 64.29% of the attacks took place in rural areas, 28.57% in suburban areas and 7.14% in urban areas. There were one to two attacks per year in the observed period, and in some years, such as 2008, 2013 and 2020, as well as in the period from the end of 2014 to the end of 2019, there were no attacks.

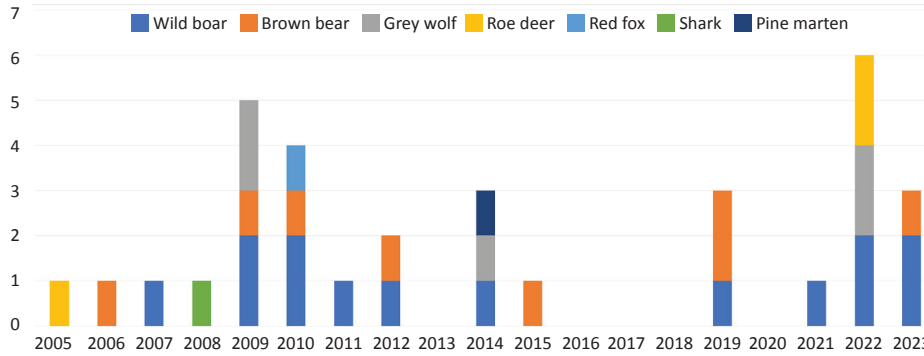

Figure 1. Wild animal attacks on humans (2005-2023).

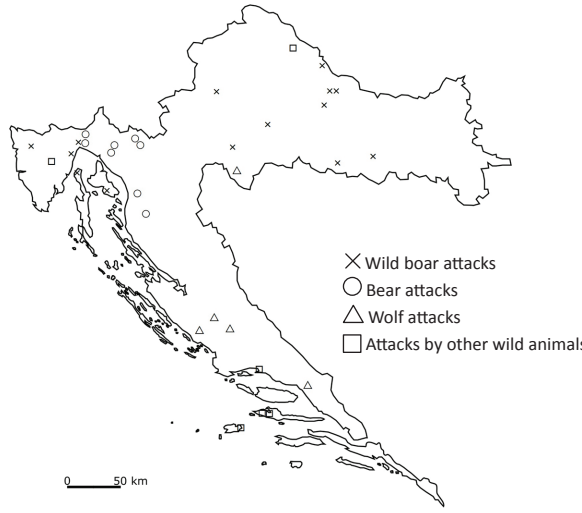

Figure 2. Geographical distribution of wild animal attacks.

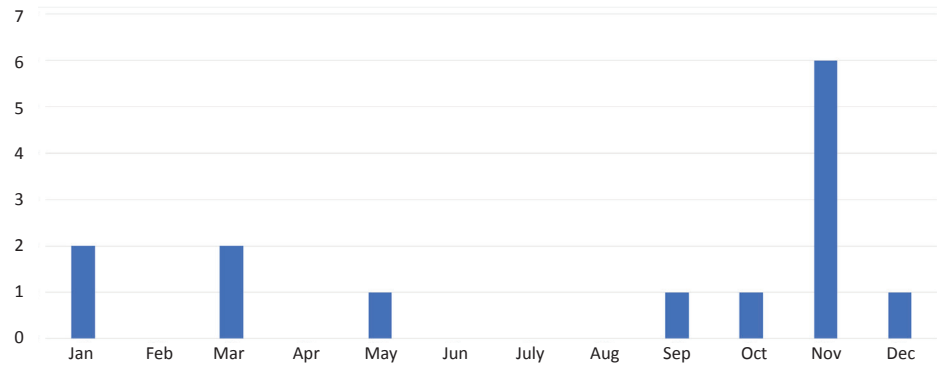

Figure 3. Wild boar attacks per month.

If we look at the distribution of attacks by month, we see that all attacks took place between September and early May, with most attacks (6 out of 14) occurring in November. Most of the attacks took place in the morning and before noon, with three attacks taking place in the afternoon. For all species in this analysis, no association was found between wildlife and time of the attack (χ^2=1.850, p=0.604), but a significant association was found in relation to time of the year (χ^2=13.645, p=0.003). It should be noted that brown bears and wild boars have a higher frequency of attacks in autumn and winter.

In all attacks, people were attacked by only one animal. Even in the attack where a female with juveniles was present, only one animal, the female, committed the attack. All attack victims were male; the age of the victims varied from 24 to 60 years, and the mean age was 47 years (M=47.45, SD=11.13). Most victims were not alone at the time of the attack but were in a group; this is to be expected as 57 % wild boar attacks occurred during hunting. Attacks where the victim was alone during the attack occurred in other situations, such as when cycling, herding livestock or gamekeeping. Regarding the circumstances of the attacks, it was found that in most cases (43% of attacks) the victims were attacked by a wounded animal, mainly while hunting or gamekeeping. The second most common attack circumstance is an attack due to a sudden encounter with an animal, and in one case the attack was initiated by a female with juveniles (Mrkić Modrić and Kućel Ilić 2022). The victims were mostly bitten or stabbed, and the injuries were mostly located in the lower part of the body, i.e., on the legs and sometimes on the hands. None of these injuries were fatal and the victims recovered after receiving medical treatment.

Brown Bear (*Ursus arctos* L.)

The next wild animal in terms of frequency of attacks on humans is the brown bear. According to available data, there were eight bear attacks on humans between 2006 and 2023.

All the attacks took place in two counties located in mountain (Dinaric Alps) region: Primorje-Gorski Kotar County, where most of the attacks took place, and Lika-Senj County; 87.5% of the attacks took place in rural areas and 12.5% in suburban areas. The attacks occurred once a year, except in 2019, when there were two attacks. Unexpectedly, the attacks took place between May and early January. Two attacks occurred in winter, one in December and one in January. The December attack occurred when the bear sanctuary staff entered the area where the bears live. The bear was irritated by the unusually high temperatures and attacked first the sanctuary volunteer and then the guard who tried to defend her (Nova TV 2006). When looking at the time of day of the attacks, no pattern can be found as the attacks occurred throughout the day. In five of the eight attacks, the reason for the attack was a sudden encounter with a female with juveniles. Similar to wild boars, the female committed the attack, and the juveniles were not involved.

All the victims were male, with the exception of the above-mentioned volunteer from the bear sanctuary. She is also the youngest victim of a bear attack, and the oldest was 82 years old at the time of the attack, while the mean age of the victims is 50 years (M=50.44, SD=21.06). Most victims were in a group at the time of the attack, and the activities they were most frequently engaged in during the attack were hunting (in 4 out of 8 cases) and dog walking. A marginally significant difference was found between the analysed wildlife attacks and the types of activities of the attacked individuals (χ^2=16.575, p=0.051). Furthermore, hunting activities were mainly associated with attacks by brown bears and wild boars, while everyday activities are more associated with attacks by wolves and other wild animals.

The victims suffered puncture and bite wounds to various parts of the body. In none of these attacks were the wounds fatal to the victims.

Grey Wolf (*Canis lupus* L.)

Besides wild boar and brown bear, the grey wolf is the third wild animal that most frequently attacked humans. In the period from 2009 to 2022, there were five wolf attacks on humans.

Of the five attacks, four occurred in the southern part of Croatia and one in continental Croatia, in Sisak-Moslavina County. The attacks took place at different times of the year, from February to September, and also at different times of the day, so it is not possible to find a temporal pattern of

the attacks. In four attacks, humans were attacked by one animal, and in one attack, several animals were involved, although it is not possible to determine their exact number based on the available data and the victims' statements (Kuzmić 2009). A significant correlation was found between wild animals and the number of endangered individuals (χ^2=21.563, p=0.001). This specific result is influenced by the fact that attacks by wild boars and brown bears mainly affected groups of people, while attacks by wolves mainly affected individuals. Three attacks occurred while herding livestock, one while working in the yard and one while walking the dog. The circumstances of the attack were as follows: twice wolves attacked humans while attacking livestock; in one case the attack was perpetrated by a female with juveniles and in one by a rabid animal. In three attacks the wounds were minor and consisted mostly of bites and scratches on arms and legs. In the attack by a rabid wolf, the victim suffered severe injuries and it was necessary to amputate the left hand, nose, upper lip, and part of the upper jaw. The victim was also severely bitten on the right arm and leg (Lojkic et al. 2009).

Other Wild Animals

Except by wild boars, brown bears and grey wolves, people in Croatia have also been attacked by roe deer (*Capreolus capreolus*), red fox (*Vulpes vulpes*), pine marten (*Martes foina*), and shark. Details of these attacks can be found in Table A4 in the Appendix.

As shown in Table A4, two women were attacked by roe deer on Hvar in August 2022. The animal involved in the attacks was not hunted, so it is assumed that both attacks were perpetrated by the same animal. One victim suffered a minor stab wound and scratches to the legs and arms (Crnčević 2022b), the other a severe rib injury (Crnčević 2022a). The third deer victim was injured while hunting. The hunter was hit on the leg by a roe deer, resulting in a twisted knee and a tear of the anterior cruciate ligament (Šprem et al. 2013). The next animal that attacked humans was the red fox. The victim was attacked because he wanted to defend his dog from a fox and was bitten on the left leg (Regional Express 2010). One of the most serious animal attacks on humans was an attack by a shark on a diver. The causes of this attack are not known, but it is known that the victim was an experienced diver who was employed as a diving instructor by the Slovenian army. In this attack, the victim suffered serious injuries: a bite to the left leg, a torn calf muscle, a severely injured artery and nerves that move the foot, and disability after this attack (Express 2018). The least dangerous attacks were by pine martens. In Split in 2014, the same pine marten attacked and bit three people. Two victims were bitten when they tried to catch the animal by hand, and the third victim was attacked while riding a bicycle (Eterović 2014).

The most frequent attacks by wild animals on humans were snakebites. Between 1998 and 2019, 632 people were hospitalised due to snakebites. The highest number of hospitalisations was in 2001, when 58 people were hospitalised due to snakebites; in 2000, 57 people were hospitalised and in 2018, 40 people were hospitalised (Tunjić Pejak et al. 2022). There were three death cases due to snakebites in 2006, 2007 and 2013. Two of the victims were 69 and 80 years old, and the third victim was a child who was bitten by a viper during a picnic (Sarajlić et al. 2022).

DISCUSSION

The characteristics of the attacks differed between the attacks of different animals, but some common features were found: the attacks mainly took place in rural areas, the victims were mostly male and over 40 years old, in almost all attacks, the victims suffered minor injuries, and during the attacks, they were mainly hunting, walking dogs, or herding livestock. As mentioned in the introduction, attacks by wild animals in industrialised countries mainly occur during leisure time, whereas in developing countries they occur during work (Bombieri et al. 2023). In our analysis, 27% of attacks occurred during work and the rest during leisure activities.

Wild Boar (*Sus scrofa* L.)

Wild boars have been attacking humans since ancient times (Mayer 2013), probably because wild boars are one of the most common and widespread large mammals. It is estimated that there are more than 10,000 wild boars in Croatia today (estimate across all age and sex categories) (Gavran et al. 2019). In our analysis, wild boar attacks were the most numerous of all wildlife attacks, i.e., 14 out of 33 attacks were perpetrated by wild boars. Hunting can encourage wild boar attacks, as Šprem et al. (2013) showed in their analysis of wild animal attacks on hunters: of the seven attacks in their analysis, five were perpetrated by wild boars. In contrast to grey wolves and brown bears, which are perceived by the public and the media as dangerous animals that should be avoided, wild boars are sometimes portrayed as cute and relatively harmless. In Poland, for example, a herd of wild boars ran across a beach while tourists were resting and sunbathing (VauMijau 2023). Several wild boar attacks that ended fatally show that wild boars are not harmless animals (see Manipady et al. 2006, Shetty et al. 2008, Tumram et al. 2015).

Despite these lethal attacks, it should be noted that wild boars are shy animals (Mayer 2013) that avoid contact with humans as they run away from them (Gunduz et al. 2007), so conflicts between humans and wild boars are indeed rare (Tumram et al. 2015). However, in situations where they are provoked, wild boars may violently attack a person or animal that they perceive as a threat (Manipady et al. 2006). The number of contacts between wild boars and humans has recently increased, as wild boars enter human properties or settlements in search of food (Nagasawa et al. 2017), which they find in waste (Mayer 2013) or on agricultural land (Ikeda et al. 2019). In our analysis, wild boar attacks occurred in different areas: mostly in the countryside, but also in suburban areas, and one attack took place in an urban environment. Mayer (2013) came to similar conclusions: in a comprehensive analysis of 412 attacks that took place worldwide, he found that 73% of attacks occurred in rural areas, 22% in suburban areas and 5% in urban areas.

Although usually shy, wild boars can become aggressive during the mating season. Our analysis showed that attacks occurred from late September to early May, with most attacks occurring in November. Nagasawa et al. (2017) found similar results in Japan, where attacks occurred between October and April. Other studies also suggest that wild boar attacks tend to occur in winter: Tumram et al. (2015) describe one attack in December, Gunduz et al. (2007) describe three attacks in January, and Kose et al. (2011) describe one attack in February. It is possible that the increased occurrence of wild boar attacks in autumn and winter is also influenced by hunting activities, since most battues take place in late autumn and winter (Vujnović 2016). Several authors (Manipady et al. 2006, Gunduz et al. 2007, Mayer 2013, Tumram et al. 2015) indicate that wild boars are nocturnal or predominantly nocturnal animals; however, in our analysis, the attacks occurred between 8 AM and 5 PM. Wild boars were probably disturbed by humans, which caused their activity during the day.

The demographic characteristics of the victims are consistent with the findings of a comprehensive study conducted by Mayer (2013): the victims were predominantly male in their forties and fifties who were traveling on foot at the time of the attack. Mayer (2013) also notes that most victims were alone at the time of the attack, which differs from our analysis. This difference likely results from the fact that eight of the fourteen attacks in our analysis occurred during a hunt in which the victims were accompanied. In the attacks, the victims suffered puncture and laceration wounds mainly in the lower part of the body, which is consistent with other studies showing that the wounds in wild boar attacks occur mainly in the area from the waist down (Mayer 2013), such as the lower part of the abdomen, legs (Manipady et al. 2006, Gunduz et al. 2007) and thighs (Kose et al. 2011, Tumram et al. 2015). None of the victims in our analysis suffered fatal injuries, which is consistent with other studies showing that wild boar attacks are rarely fatal (Tumram et al. 2015).

Brown Bear (*Ursus arctos* L.)

Bear attacks on humans are “rare phenomena of significant interest to the public and wildlife managers” (Herrero and Higgins 2003). It is difficult to make assumptions about bear behaviour because the behaviour of individuals is highly variable and varies considerably from one bear to another (Penteriani et al. 2017). In North America, bears are responsible for about a quarter of all wild animal attacks on humans (Penteriani et al. 2016), and in Europe, between 2000 and 2015, most bear attacks on humans occurred in Romania, Slovakia, Sweden, and Finland (Bombieri et al. 2019). In general, the number of bear attacks on humans has been increasing over time (Cardall and Rosen 2003), as the number of people participating in outdoor recreational activities has also increased, thus raising the possibility of contact between humans and bears (Penteriani et al. 2016). Despite this increasing number of contacts, injuries and deaths due to bear encounters are “extremely uncommon” (Floyd 1999), especially considering that millions of people visit national parks or participate in other activities in areas where they might encounter bears (Floyd 1999).

Bear attacks on humans can be divided into defensive and offensive attacks. Defensive attacks occur when the bear feels threatened, e.g., during a sudden encounter with humans. Offensive attacks occur when the bear wants something, e.g., food or space, or in the most extreme cases when it sees humans as prey (Löe and Röskaft 2004). Almost all the attacks in our analysis were defensive, as in six out of eight attacks, the humans were attacked by females with juveniles who believed that by attacking the humans they would be defending the juveniles (Tough and Butt 1993). The only attack that can be described as offensive was the bear attack on sanctuary keepers who entered the area where the bears live, even though the sanctuary rules prohibit entry to bears older than 1.5 years. In the case of this attack, an additional problematic circumstance was that the bears were still awake in mid-December; they were restless because they were not hibernating due to weather disturbances (Popović 2006). Probably due to the unusually warm winters for this geographical region, the attacks in our study took place during most of the year, i.e., from May to early January. In other studies, such as by Tough and Butt (1993), Herrero and Higgins (2003) and Bombieri et al. (2019), most attacks occurred in summer and autumn.

Regarding the socio-demographic characteristics of victims, several studies (Cardall and Rosen 2003, Herrero and Higgins 2003, Bombieri et al. 2019) have found that most victims are male, in their forties and were hunting or hiking at the time of the attack. Our study found similar results: all but one of the victims were male, in their 50s on average and hunting or walking their dogs at the time of the attack. Six out of eight attacks involved a sudden encounter with a female with juveniles, which is consistent with research by Floyd (1999), who found that in 70-80% of brown bear attacks, the attack was initiated by a female with juveniles. In three attacks, dogs were present and led by the victims. It can be assumed that females with juveniles were not only irritated by the presence of humans, but also by dogs in their vicinity. Bombieri et al. (2019) argue that the presence of dogs can provoke a bear attack and that it is necessary to keep the dog on a leash during outdoor activities to reduce the possibility of such attacks.

During the attack, the victims are injured in various parts of the body. When victims fall to the ground, they may suffer head and abdominal injuries (Tough and Butt 1993, Cardall and Rosen 2003). In our study, the victims mainly suffered injuries to the extremities and abdomen, and none of the victims suffered fatal injuries.

Grey Wolf (*Canis lupus* L.)

The third species that attacked humans was the grey wolf. Wolf attacks were less frequent than wild boar or bear attacks. Between 2009 and 2022 there were five wolf attacks on humans. Ambarli (2019) states that "wolves have a long history of conflict with humans". Although the wolf is generally considered the most dangerous predator in Europe (Nowak et al. 2021), the number of wolf attacks on humans worldwide has steadily decreased since 1985, in contrast to other large carnivores such as bears or coyotes, whose number of attacks has increased (Penteriani et al. 2016). Despite this actual decline in the number of attacks, conflicts

between humans and wolves are portrayed negatively in the media (Ambarli 2019).

Linnell et al. (2002) divided wolf attacks on humans into three categories: (1) attacks by rabid wolves, (2) predatory attacks, and (3) defensive attacks. In a large global study covering the period from 2002 to 2020, Linnell et al. (2021) found that most attacks were perpetrated by rabid wolves, followed by predatory and defensive attacks. Of the five attacks that occurred in Croatia, only one was an attack by a rabid wolf. Rabid wolves are rare in Croatia; Lojkić et al. (2009) state that four rabid wolves were recorded in 10 years. Two cases from our study could be characterised as predatory attacks. These two attacks occurred while herding livestock, i.e., in a situation where wolves attacked the livestock, but also the herders who were trying to defend the livestock. These two attacks occurred in rural areas where sheep and goats are traditionally kept. Ambarli (2019) states that in Turkey, most predatory attacks on humans occur in areas where sheep and goats are kept and graze freely in the open. These two attacks were perpetrated by several wolves, most of which attacked livestock, while one attacked a human. This is consistent with Behdarvand and Kaboli (2015), who found that two to five wolves were involved in predatory attacks in Iran. The other two attacks were defensive. One also occurred while herding livestock, but it was not an attack on livestock but an attack by a female with juveniles. The last attack occurred while walking the dog. Similar to bear attacks (see Bombieri et al. 2019), the presence of a dog can also provoke attacks by wolves on both dogs and humans. Behdarvand and Kaboli (2015) state that their research conducted in Iran found that 19% of wolf attacks on humans were related to pets, and the study conducted by Ambarli (2019) in Turkey found that 17.2% of wolf attacks on humans were related to domestic animals.

In our study, the victims of wolf attacks mostly suffered bites to the arms and legs, with the exception of the victim who was brutally attacked by a rabid wolf. Linnell et al. (2002) found that in the past, but also in the present, shepherds are usually wounded in the arms and legs when trying to protect their livestock or dogs from wolves.

Other Wild Animals

Attacks on humans by other large carnivores were rare. For example, nine people have died from shark attacks in the last 150 years, and the last shark attack occurred in 2008 (Express 2018). The most numerous attacks by wild animals were snakebites; in the period from 1998 to 2019, 632 people were hospitalised due to snakebites (Tunjić Pejak et al. 2022), and three people died (Sarajlić et al. 2022). It is interesting to note that in Croatia, attacks by large carnivores were not fatal to humans, unlike attacks by domestic animals such as bulls (Karakaš 2023) and rams (Škavić et al. 2015). Penteriani et al. (2016) argue that bees, mosquitoes, snakes, spiders and domestic dogs are responsible for more human deaths than large carnivores such as bears or wolves.

Limitations

Certain limitations should be considered when interpreting the results of this study. Firstly, only a small number of attacks were included in the study, as no other attacks by wild animals were recorded that could be included in the analysis. Due to the small number of attacks analysed, it is difficult to draw general conclusions. The results obtained are local and can hardly be extrapolated to other countries. Secondly, as the data on attacks come from the electronic media and academic literature, it is possible that some attacks were not reported in the media and academic literature and that the actual number of attacks is higher than the number we determined. Nevertheless, this analysis provides a good insight into the attacks that occurred and enables a better understanding of this topic, which has hardly been studied in Croatia.

CONCLUSIONS

Although the exact number of wild animal attacks on humans is not known (Löe and Röskaft 2004), it is undeniable that thousands of different encounters and interactions between wild animals and humans do not end in an attack, injury, or death of the human (Penteriani et al. 2016). Šprem et al. (2014) state that Croatia is relatively safe in terms of wild animal attacks on humans, which was also confirmed by our study. In the period from 2005 to 2023 there were 33 attacks, which corresponds to an average of two attacks per year. None of these attacks were fatal; some attacks even resulted in no injuries. Most of those attacked suffered minor injuries, while a small number of attacks were more serious, as the victims were more severely injured, and the consequences of the attack were limb amputations (Lojkic et al. 2009) or physical disability (Express 2018). Of all attacks by wild animals, only snake bites were fatal.

The fact that only a few attacks can be described as predatory attacks proves that Croatia is a country safe from attacks by wild animals. In most cases, the attacks were a defensive reaction of the animals provoked by humans. To further reduce these attacks on humans, which are in fact quite rare, it is necessary to take preventive measures and define appropriate behaviour when entering an area where wild animals live (Bombieri et al. 2023). Löe and Röskaft (2004) argue that there are two general solutions to reduce wild animal attacks on humans. The first is to reduce the possibility of encounters between humans and wildlife. This can be achieved by designating an area where the animals live undisturbed by humans and human activities. The second solution is that when people encounter wild animals, they should behave in a way that does not provoke an attack. Therefore, people visiting areas where wildlife is present should be educated on how to behave when encountering wildlife (Šprem et al. 2014), especially those who live in urban areas and therefore do not frequently come into contact with wildlife. It has been shown that people contribute to attacks through their behaviour. Some of the activities that can lead to an attack include chasing a wounded animal while hunting, walking a dog that is not a leash, and approaching a female with juveniles (Penteriani et al. 2016). A key role in this education should be given to scientists and experts who use their knowledge of wildlife to inform the public objectively and without bias (Herrero and Higgins 2003).

Appendix A

Table A1. Wild boar attacks on humans.

Case	Location	Location category	Date of attack	Time of attack	Number of animals in attack	Victim gender	Victim age	Group composition	Activity of the victim	Attack circumstances	Injury type	Nature of injuries
1	Punat	Urban	3.5.2023	Morning	One	Male	Unknown	In a group	A wild boar entered the store	The victim was attacked while trying to tie up a wild boar	None	Nonfatal
2	Ivanje, Cres	Suburban	7.3.2023	8:00 AM	One	Male	60	Alone	Herding livestock	Wounded animal	None	Nonfatal
3	Ferdinandovac	Rural	22.1.2022	3:00 PM	One	Male	24	In a group	Hunting	Aggressive reaction after a sudden encounter	Torn lower leg, and open wound	Nonfatal
4	Dobreć, Lovran	Suburban	19.1.2022	5:00 PM	Four, one was involved in attack	Male	43	Alone	Dog walking	Female with juveniles	Blows to the head and thigh	Nonfatal
5	Zagreb	Suburban	9.11.2021	Morning	One	Male	Unknown	Alone	Biking	Aggressive reaction after a sudden encounter	Superficial head injuries after falling from a bicycle	Nonfatal
6	Vižinada	Suburban	6.12.2019	2:00 PM	One	Male	62	Alone	Activity near the house/in the backyard	Aggressive reaction after a sudden encounter	On the lower part of the legs, the flesh was torn in five places	Nonfatal
7	Nova Gradiška	Rural	7.10.2014	Unknown	One	Male	Unknown	In a group	Hunting	Wounded animal	Severe injuries to the leg (calf) and cuts on the arm	Nonfatal
8	Glina	Rural	25.11.2012	10:30 AM	One	Male	27	In a group	Hunting	Wounded animal	A bite wound – 4 cm long laceration of the skin and underlying soft tissue (without muscular tissue injury) of the left knee	Nonfatal
9	Pleternica	Rural	1.3.2011	11:15 AM	One	Male	46	Alone	Gamekeeping	Wounded animal	Large superficial bite wound with skin tearing left side of back	Nonfatal
10	Jurdani	Rural	15.11.2010	8:30 AM	One	Male	62	In a group	Hunting	Unknown	Bite wound left lower leg with muscle tearing	Nonfatal
11	Grubišno polje	Rural	14.11.2010	9:30 AM	One	Male	51	In a group	Hunting	Unknown	Bite wound right thigh and left lower leg with muscle tearing	Nonfatal
12	Virovitica	Rural	1.11.2009	10:00 AM	One	Male	63	In a group	Hunting	Wounded animal	Bite wound left thigh with muscle tearing	Nonfatal
13	Donja Jelenska, Popovača	Rural	27.09.2009.	Unknown	One	Male	44	In a group	Hunting	Wounded animal	Side bite under the ribs	Nonfatal
14	Virovitica	Rural	3.11.2007	10:00 AM	One	Male	40	In a group	Hunting	Unknown	Bite wound left thigh, right thigh scratches	Nonfatal

Source: Grgurinović and Putar (2009), Šprem et al. (2013, 2014), Topić (2014), Kocijančić (2019), Gavranović (2021), Konfic (2022), Mrkić Modrić and Kućel Ilić (2022), Bitići (2023), Salković (2023).

Table A2. Brown bear attacks on humans.

Case	Location	Location category	Date of attack	Time of attack	Number of animals in attack	Victim gender	Victim age	Group composition	Activity of the victim	Attack circumstances	Injury type	Nature of injuries
1	Lokve	Suburban	8.5.2023	5 PM	One	Male	26	Alone	Dog walking	Possibly female with juveniles	Several bites on the upper leg	Nonfatal
2	Vratnik, Senj	Rural	9.8.2019	Afternoon	One	Male	68	Alone	Dog walking	Unknown	The left thumb was bitten off, the left lower leg was severely injured	Nonfatal
3	Vrbovsko	Rural	12.1.2019	Unknown	Two, one was involved in attack	Male	60	In a group	Hunting	Female with juveniles	Paw kick and bite	Nonfatal
4	Moravice	Rural	25.10.2015	Morning	Three, one was involved in attack	Male	42	In a group	Hunting	Female with juveniles	Severe injuries to the left lower leg, left upper arm and head	Nonfatal
5	Klana	Rural	28.8.2012	10 AM	Two, one was involved in attack	Male	28	Alone	Dog walking	Female with juveniles	Multiple bite wounds on chest, abdomen and extremities	Nonfatal
6	Kastav	Rural	13.11.2010	7 AM	Two, one was involved in attack	Male	82	In a group	Hunting	Female with juveniles	A bite on the front of the left thigh, a small wound on the right elbow and small lacerations on the chest, head and fingers.	Nonfatal
7	Fužine	Rural	28.9.2009	7:15 PM	Three, one was involved in attack	Male	69	In a group	Hunting	Female with juveniles	Bite wound left upper arm, scratches of left hand and both legs	Nonfatal
8	Kuterevo	Rural	16.12.2006	Noon	One	Female	19	In a group	Attack on guards at the bear shelter	The guards entered the area where the bears live	Minor injuries	Nonfatal
						Male	60				Bitten hands and right thigh	Nonfatal

Source: Nova TV (2006), Net.hr (2010), Čuljat (2012), Šprem et al. (2013), Kleva (2015), Balen (2019), Radio Mrežnica (2019), RTL Danas (2023).

Table A3. Grey wolf attacks on humans.

Case	Location	Location category	Date of attack	Time of attack	Number of animals in attack	Victim gender	Victim age	Group composition	Activity of the victim	Attack circumstances	Injury type	Nature of injuries
1	Zagvozd	Rural	14.7.2022	10 AM	One	Male	64	Alone	Herding livestock	Female with juveniles	None	Nonfatal
2	Kistanje	Rural	13.6.2022	9 AM	Four animals, one was included in attack	Male	Unknown	Alone	Herding livestock	The victim was attacked during a livestock raid.	Hand injury	Nonfatal
3	Drniš	Suburban	26.9.2014	Evening	One	Female	33	Alone	Dog walking	Unknown	A bite on the left hand.	Nonfatal
4	Donji Žirovac	Rural	22.3.2009	2 PM	One	Male	67	Alone	Activity near the house/in the backyard	Encounter with a rabid animal	Amputation of the left hand, nose, upper lip and part of the upper jaw. Severe bites in the right arm and leg.	Nonfatal
5	Cista Velika	Rural	21.2.2009	11 PM	Few animals, the exact number is unknown	Male	25	Alone	Herding livestock	The victim was attacked during a livestock raid.	Scratches on the lower leg	Nonfatal

Source: Kuzmić (2009), Lojkić et al. (2009), Pavić and Tkalčević (2014), Nejašmić (2022), Pilić (2022).

Table A4. Attacks on humans by other wild animals.

Case	Species involved	Location	Location category	Date of attack	Time of attack	Number of animals in attack	Victim gender	Victim age	Group composition	Activity of the victim	Attack circumstances	Injury type	Nature of injuries
1	Roe deer	Hvar	Suburban	15.8.2022	Unknown	One	Female	Unknown	Alone	Walking	Unknown	Slight puncture wound, further scratches on legs and arms.	Nonfatal
2	Roe deer	Hvar	Suburban	12.8.2022	6:00 AM	One	Female	65	Alone	Walking	Unknown	Severe bodily injury to the rib	Nonfatal
3	Roe deer	Koprivnica	Rural	13.11.2005	11:30 AM	One	Male	26	In a group	Hunting	Rammed by a running roe deer buck	Ramming into the right leg with knee distortion and ACL rupture	Nonfatal
4	Fox	Gračišće	Rural	25.3.2010	11:20 PM	One	Male	81	Alone	Activity near the house/in the backyard	The victim tried to protect his dog from the attack of a fox	A bite to the left lower leg	Nonfatal
5	Shark	Vis	Rural	6.10.2008	Unknown	One	Male	43	In a group	Diving	Unknown	A bite to the left leg, a torn calf muscle, a badly injured artery and nerves moving the foot	Nonfatal
6	Pine marten	Split	Urban	27.5.2014	Morning	One	Male	38	Unknown	Walking	The victim wanted to catch the animal with his hand	A bite on the hand	Nonfatal
	Pine marten	Split	Urban	27.5.2014	Morning	One	Male	54	Unknown	Walking	The victim wanted to catch the animal with his hand	A bite on the leg	Nonfatal
	Pine marten	Split	Urban	27.5.2014	Morning	One	Male	20	Unknown	Biking	Unknown	A bite on the leg	Nonfatal

Source: Regional Express (2010), Šprem et al. (2013), Eterović (2014), Express (2018), Crnčević (2022a, 2022b).

Author Contributions

HM conceived and designed the research, also performed data collecting. KB and ML processed the data and performed the statistical analysis. HM supervised the research, HM, KB and ML wrote the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

REFERENCES

Ambarli H, 2019. Analysis of wolf–human conflicts: implications for damage mitigation measures. *Eur J Wildlife Res* 65(6): 81. https://doi.org/10.1007/s10344-019-1320-4.

Arbieu U, Chapron G, Astaras C, Bunnefeld N, Harkins S, Iliopoulos Y, Mehring M, Reinhardt I, Mueller T, 2021. News selection and framing: The media as a stakeholder in human-carnivore coexistence. *Environ Res Lett* 16(6): 064075. https://doi.org/10.1088/1748-9326/ac05ef.

Balen M, 2019. Bear attack on Velebit, the third in the last 15 years: Here's what to do if you come face to face with an enraged beast. *Dnevnik.hr*. Available online: https://dnevnik.hr/vijesti/hrvatska/medvjed-napao-bozu-nekica-na-velebitu-jedva-izvukao-zivu-glavu---571247.l?fbclid=IwAR22pYjBl1GH0B7GI170VqCbULYXsuumEVVSkb5GIFKnjHgNGpGu1ve7N2U (17 December 2022). [in Croatian].

Behdarvand N, Kaboli M, 2015. Characteristics of Gray Wolf Attacks on Humans in an Altered Landscape in the West of Iran. *Hum Dimens Wildl* 20(2): 112-122. https://doi.org/10.1080/10871209.2015.963747.

Bitići K, 2023. Incredible footage from Krk! Where do the wild boars go? To the store: 'I can already see it on the spit'. *24 sata*. Available online: https://www.24sata.hr/news/nevjerojatna-snimka-s-krka-kuda-idu-divlje-svinje-u-ducan-ma-ja-to-vec-vidim-na-raznju-907826 (5 March 2023). [in Croatian].

Bombieri G, Naves J, Penteriani V, Selva N, Fernández-Gil A, López-Bao JV, Ambarli H, Bautista C, Bespalova T, Bobrov V, Bolshakov V, Bondarchuk S, Camarra JJ, Chiriac S, Ciucci P, Dutsov A, Dykyy I, Fedriani JM, García-Rodríguez A, Garrote PJ, Gashev S, Groff C, Gutleb B, Haring M, Härkönen S, Huber D, Kaboli M, Kalinkin Y, Karamanlidis AA, Karpin V, Kastrikin V, Khlyap L, Khoetsky P, Kojola I, Kozlow Y, Korolev A, Korytin N, Kozsheechkin V, Krofel M, Kurhinen J, Kuznetsova I, Larin E, Levykh A, Mamontov V, Männil P, Melovski D, Mertzanis Y, Meydus A, Mohammadi A, Norberg H, Palazón S, Pătrașcu LM, Pavlova K, Pedrini P, Quenette PY, Revilla E, Rigg R, Rozhkov Y, Russo LF, Rykov A, Saburova L, Sahlén V, Saveljev AP, Seryodkin IV, Shelekhov A, Shishikin A, Shkvyria M, Sidorovich V, Sopin V, Støen O, Stofik J, Swenson JE, Tirski D, Vasin A, Wabakken P, Yarushina L, Zwijacz-Kozica T, Delgado MM, 2019. Brown bear attacks on humans: a worldwide perspective. *Sci Rep* 9(1): 8573. https://doi.org/10.1038/s41598-019-44341-w.

Bombieri G, Penteriani V, Almasieh K, Ambarli H, Ashrafzadeh MR, Das CS, Dharaiya N, Hoogesteijn R, Hoogesteijn A, Ikanda D, Jędrzejewski W, Kaboli M, Kirilyuk A, Jangid AK, Sharma RK, Kushnir H, Lamichhane BR, Mohammadi A, Monroy-Vilchis O, Mukeka JM, Nikolaev I, Ohrens O, Packer C, Pedrini P, Ratnayeke S, Seryodkin I, Sharp T, Palei HS, Smith T, Subedi A, Tortato F, Yamazaki K, del Mar Delgado M, 2023. A worldwide perspective on large carnivore attacks on humans. *PLoS Biol* 21(1): e3001946. https://doi.org/10.1371/journal.pbio.3001946.

Cardall TY, Rosen P, 2003. Grizzly bear attack. *J Emerg Med* 24(3): 331-333. https://doi.org/10.1016/S0736-4679(03)00004-0.

Crnčević M, 2022a. A deer attacked a walker on the popular lungomare and seriously injured her! Discomfort spreads across the island... *Jutarnji list*. Available online: https://www.jutarnji.hr/vijesti/hrvatska/setacicu-na-popularnom-lungomareu-napao-jelen-i-tesko-je-ozlijedio-otokom-se-siri-nelagoda-15234504 (12 August 2022). [in Croatian].

Crnčević M, 2022b. A new shock on island Hvar, in just four days a roe deer attacked and injured two women on a popular promenade. Citizens testify: "She grabbed him by the horns and defended herself, but as soon as she let him go...". *Slobodna Dalmacija*. Available online: https://slobodnadalmacija.hr/dalmacija/otoci/novi-sok-na-hvaru-srnjak-u-samo-cetiri-dana-napao-i-ozlijedio-jos-jednu-zenu-na-popularnoj-setnici-gradani-svjedoce-uhvatila-ga-je-za-rogove-i-branila-se-ali-cim-ga-je-pustila-1216511 (16 August 2022). [in Croatian].

Čuljat E, 2012. Father of the attacked young man: It was terrible, all the clothes were bloody. *Večernji list*. Available online: https://www.vecernji.hr/vijesti/otac-napadnutog-mladica-bilo-je-strasno-sva-odjeca-bila-je-krvava-447131 (30 August 2022). [in Croatian].

Durrheim DN, Leggat PA, 1999. Risk to tourists posed by wild mammals in South Africa. *J Travel Med* 6(3): 172-179. https://doi.org/10.1111/j.1708-8305.1999.tb00856.x.

Eterović Z, 2014. Marten attacks! It bit three people from Split. *24 sata*. Available online: https://www.24sata.hr/news/kuna-napada-ugrizla-trojicu-splicana-od-znjana-do-zente-368659 (28 May 2022). [in Croatian].

Express, 2018. Sharks in the Adriatic: 11 swimmers died in 150 years. *Express*. Available online: https://express.24sata.hr/life/morski-psi-na-jadranu-u-150-g-umrlo-11-kupaca-11151 (29 June 2022). [in Croatian].

Floyd T, 1999. Bear-inflicted human injury and fatality. *Wilderness Environ Med* 10(2): 75-87. https://doi.org/10.1580/1080-6032(1999)010[0075:BIHIAF]2.3.CO;2.

Gavran M, Gregić M, Tolušić Z, Gantner V, 2019. The Fluctuation in Wild Boar Population in the Hunting Area in Eastern Croatia. *Agroznanje* 20(3): 151-161. https://doi.org/10.7251/agren1903149g.

Gavranović J, 2021. Wild boars attack the people of Zagreb, hunters can't do anything to them. *HRT*. Available online: https://vijesti.hrt.hr/hrvatska/divlje-svinje-napadaju-zagrepcane-lovci-im-ne-mogu-nista-3421777 (10 November 2022). [in Croatian].

Goulding MJ, Roper TJ, 2002. Press responses to the presence of free-living Wild Boar (*Sus scrofa*) in southern England. *Mammal Rev* 32(4): 272–282. https://doi.org/10.1046/j.1365-2907.2002.00109.x.

Grgurinović Ž, Putar Z, 2009. The enraged boar tore apart eight dogs, and picked up the hunter with its tusks. *Večernji list*. Available online: https://www.vecernji.hr/vijesti/razjareni-vepar-rastrgao-osam-pasa-a-lovca-digao-kljovama-25805 (28 September 2022). [in Croatian].

Gunduz A, Turedi S, Nuhoglu I, Kalkan A, Turkmen S, 2007. Wild boar attacks. *Wilderness Environ Med* 18(2): 117-119. https://doi.org/10.1580/06-WEME-CR-033R1.1.

Herrero S, Higgins A, 2003. Human injuries inflicted by bears in Alberta: 1960-98. *Ursus* 14: 44-54.

Ikeda T, Kuninaga N, Suzuki T, Ikushima S, Suzuki M, 2019. Tourist-wild boar (Sus scrofa) interactions in urban wildlife management. *Glob Ecol Conserv* 18: e00617. https://doi.org/10.1016/j.gecco.2019.e00617.

Iliopoulos Y, Astaras C, Chatzimichail E, 2022. Dogs, not wolves, most likely to have caused the death of a British tourist in northern Greece. *Nat Conserv* 50: 115–143. https://doi.org/10.3897/natureconservation.50.81915.

Karakaš J, 2023. Bizaar Tragedy. He traveled the whole world, and was killed by a bull on the mountain he loved the most. *Jutarnji list*. Available online: https://www.jutarnji.hr/vijesti/hrvatska/bizarna-tragedija-prosao-cijeli-svijet-a-ubio-ga-bik-na-planini-koju-je-najvise-volio-590644 (30 June 2023). [in Croatian].

Kleva S, 2015. A bear attacked a hunter in Gorski kotar Region and seriously injured him. *Novi list*. Available online: https://www.novilist.hr/novosti/crna-kronika/medvjed-napao-lovca-u-gorskom-kotaru-i-tesko-ga-ozlijedio/ (25 October 2022). [in Croatian].

Kocijančić T, 2019. A wild boar in Vižinada willage it broke into the yard in broad daylight and bit a man! Tragedy was prevented by his son. *Istria terra magica*. Available online: https://www.istriaterramagica.eu/novosti/crna-kronika/bizarna-nesreca-divlja-svinja-u-vizinadi-usred-bijela-dana-upala-u-dvoriste-i-napala-muskarca-tragediju-sprijecio-njegov-sin/ (20 December 2022). [in Croatian].

Konfić M, 2022. A young hunter (24) died when a wild boar attacked him near the Drava river. *Glas Podravine*. Available online: https://glaspodravine.hr/mladi-lovac-24-stradao-kada-ga-je-kraj-drave-napala-divlja-svinja/?fbclid=IwAR32AoJWjGxyZXeQkulvkNT1ahpGi__N3fXhyDiIUfb_NV3I-0dLvYuF5Wg (29 January 2022). [in Croatian].

Kose O, Guler F, Baz AB, Akaln S, Turan A, 2011. Management of a wild boar wound: A case report. *Wilderness Environ Med* 22(3): 242-245. https://doi.org/10.1016/j.wem.2011.06.005.

Kuzmić A, 2009. The brave shepherd chased away the wolves and get punished by law. *Jutarnji list*. Available online: https://www.jutarnji.hr/vijesti/hrvatska/hrabri-pastir-otjerao-vukove-pa-zaradio-izgon-i-prijavu-2881199 (22 December 2022). [in Croatian].

Linnell JDC, Andersen R, Andersone Ž, Balčiauskas L, Blanco J, Boitani L, Brainerd S, Breitenmoser U, Kojola I, Liberg O, Loe J, Okarma H, Pedersen HC, Promberger C, Sand H, Solberg EJ, Valdmann H, Wabakken P, 2002. The fear of wolves: A review of wolf attacks on humans. Norwegian Institute for Nature Research, Trondheim, Norway, 65 p.

Linnell JDC, Kovtun E, Rouart I, 2021. Wolf attacks on humans: an update for 2002–2020. Norwegian Institute for Nature Research, Trondheim, Norway, 46 p.

Lojkic I, Galic M, Cac Z, Jelic I, Bedekovic T, Lojkic M, Cvetnic Z, 2009. Bites of a rabid wolf in 67-old man in north-eastern part of Croatia. *Rabies Bull Eur* 33(3): 5-7.

Löe J, Röskaft E, 2004. Large carnivores and human safety: A review. *Ambio* 33(6): 283-288. https://doi.org/10.1579/0044-7447-33.6.283.

Manipady S, Menezes RG, Bastia BK, 2006. Death by attack from a wild boar. *J Clin Forensic Med* 13(2): 89-91. https://doi.org/10.1016/j.jcfm.2005.08.007.

Mayer J, 2013. Wild pig attacks on humans. In: Armstrong J, Gallagher G. (eds) Proceedings of the 15th Wildlife Damage Management Conference, March 25-28, 2013, University of Nebraska, Lincoln, Nebraska, pp. 17-35.

Moscardo G, Taverner M, Woods B, 2006. When wildlife encounters go wrong: Tourist safety issues associated with threatening wildlife. In: Mansfeld Y, Pizam A. (eds) Tourism, Security and Safety. Elsevier Butterworth-Heinemann, Oxford, England, pp 209-227.

Mrkić Modrić S, Kućel Ilić A, 2022. A boar attacked man and seriously injured him near Lovran: "It was like being hit by a train, I barely survived... This is where children usually walk". *Novi list*. Available online: https://www.novilist.hr/rijeka-regija/opatija/veprica-ga-napala-iznad-lovrana/ (21 January 2022). [in Croatian].

Nagasawa H, Omori K, Maeda H, Takeuchi I, Kato S, Iso T, Jitsuiki K, Yoshizawa T, Ishikawa K, Ohsaka H, Yanagawa Y, 2017. Bite Wounds Caused by a Wild Boar: A Case Report. *Wilderness Environ Med* 28(4): 313-317. https://doi.org/10.1016/j.wem.2017.06.004.

Nejašmić M, 2022. A shepherd attacked by a wolf? I've seen all kinds of beasts, but never like that. *Agroklub*. Available online: https://www.agroklub.com/stocarstvo/pastira-napao-vuk-ili-vukopas-svakakvih-bestija-sam-vidio-ali-tako-sto-nikada/78835/ (19 June 2022). [in Croatian].

Net.hr, 2010. He was attacked a female bear, he almost lost his life. *Net.hr*. Available online: https://net.hr/danas/crna-kronika/napala-ga-medvjedica-umalo-izgubio-zivot-2aefea4a-b1c1-11eb-be6f-0242ac14002d (14 November 2022). [in Croatian].

Nova TV, 2006. Footage of a bear attacking rangers. *Dnevnik.hr*. Available online: https://dnevnik.hr/vijesti/crna-kronika/marko-balen-prepricava-dogadzaj.html (17 December 2022). [in Croatian].

Nowak S, Szewczyk M, Tomczak P, Całus I, Figura M, Mysłajek RW, 2021. Social and environmental factors influencing contemporary cases of wolf aggression towards people in Poland. *Eur J Wildlife Res* 67(4): 69. https://doi.org/10.1007/s10344-020-01455-1.

Pavić H, Tkalčević H, 2014. Panic in Drniš city: "A wolf jumped me from the bush and wanted to tear me apart". *24 sata*. Available online: https://www.24sata.hr/news/panika-u-drnisu-zaskocio-me-vuk-iz-grma-i-htio-me-rastrgati-386041 (26 September 2022). [in Croatian].

Penteriani V, Delgado MDM, Pinchera F, Naves J, Fernández-Gil A, Kojola I, Härkönen S, Norberg H, Frank J, Fedriani JM, Sahlén V, Støen OG, Swenson JE, Wabakken P, Pellegrini M, Herrero S, López-Bao JV, 2016. Human behaviour can trigger large carnivore attacks in developed countries. *Sci Rep* 6(1): 20552. https://doi.org/10.1038/srep20552.

Penteriani V, López-Bao JV, Bettega C, Dalerum F, Delgado M del M, Jerina K, Kojola I, Krofel M, Ordiz A, 2017. Consequences of brown bear viewing tourism: A review. *Biol Conserv* 206: 169-180. https://doi.org/10.1016/j.biocon.2016.12.035.

Pilić Z, 2022. In a minute, the man lost a third of his herd, which feeds his wife Juanita and five daughters. *Slobodna Dalmacija*. Available online: https://slobodnadalmacija.hr/dalmacija/zagora/sasi-iz-kistanja-nije-do-pjesme-piju-li-nam-vuci-sa-izvora-vodu-i-to-ne-zbog-thompsona-covjek-je-u-minuti-ostao-bez-trecine-svog-stada-koje-hrani-supruguhuanitu-i-petero-kceri-borio-se-s-kosirom-zaklali-su-i- (3 July 2022). [in Croatian].

Popović Ž, 2006. It's the tambourine's fault. *Jutarnji list*. Available online: https://www.jutarnji.hr/naslovnica/kriva-je-tamburica-3260600 (17 December 2022). [in Croatian].

Radio Mrežnica, 2019. A hunter from Rakovica was attacked by an angry bear because he got between her and the little one. He made it out alive, but the bear did not. *Radio Mrežnica*. Available online: https://radio-mreznica.hr/lovca-iz-rakovice-napala-ljuta-medvjedica-jer-se-isprijecio-izmedu-nje-i-malog-on-izvukao-zivu-glavu-ali-medvjedica-nije/?fbclid=IwAR0nuPWVp7WhyzC8SPILWtcHr_v4CijI6Zg1zy0qB5CKlzLufKPxDVODPWo (16 January 2022). [in Croatian].

Regional Express, 2010. A fox attacked a man in Gračišće. *Regional Express*. Available online: https://www.regionalexpress.hr/site/more/lisica-napala-ovjeka-u-graiu (26 March 2022). [in Croatian].

RTL Danas, 2023. Karla was bitten by a bear in Gorski Kotar: "Run at me and you see that you are her goal and that she will not stop". *Danas.hr*. Available online: https://danas.hr/rtl-danas/karla-je-u-gorskom-kotaru-izgrizla-medvjedica-trci-na-mene-i-vidis-da-si-joj-ti-cilj-i-da-nece-stati-63812016-094b-11ee-b5fe-fa4f1abfd486 (12 June 2023). [in Croatian].

Salković W, 2023. A shepherd on Cres was attacked by an enraged wild boar, he killed it with a stone: "Only those who have experienced know such fear...". *Novi list*. Available online: https://www.novilist.hr/rijeka-regija/otoci/ovcara-na-cresu-napala-razjarena-divlja-svinja-on-ju-usmrtio-kamenom-takav-strah-zna-samo-onaj-tko-ga-je-iskusio/?meta_refresh=true (8 March 2023). [in Croatian].

Sarajlić G, Antoljak N, Miler Knežević A, Erceg M, 2022. Incidence of death from snakebite in Croatia from 2005 to 2019. *Časopis za javno* 18(57): 44–46. [in Croatian].

Shetty M, Menezes RG, Kanchan T, Shetty BSK, Chauhan A, 2008) Fatal craniocerebral injury from wild boar attack. *Wilderness Environ Med* 19(3): 222-223. https://doi.org/10.1580/08-WEME-LE-192.1.

Sindičić M, Zec D, Huber Đ, 2011. Analysis of brown bear damages in Croatia in the period from 2004 until 2009. *Šumar List* 135: 63-68. [in Croatian].

Škavić P, Šprem N, Kostelić A, 2015. Fatal Injury Caused by a Ram (*Ovis Aries*) Attack. *J Forensic Sci* 60(5): 1380–1382. https://doi.org/10.1111/1556-4029.12813.

Šprem N, Škavić P, Dežđek D, Keros T, 2014. The wild boar attack--a case report of a wild boar inflicted injury and treatment. *Collegium Antropol* 38(4): 1211-1212.

Šprem N, Škavić P, Krupec I, Budor I, 2013. Patterns of game animal attacks on hunters in Croatia over a 13-year period. *Wilderness Environ Med* 24(3): 267-272. https://doi.org/10.1016/j.wem.2013.03.018.

Thompson J, Shirreffs L, McPhail I, 2003. Dingoes on Fraser Island - Tourism Dream or Management Nightmare. *Hum Dimens Wildl* 8(1): 37-47. https://doi.org/10.1080/10871200390180136.

Toovey S, Annandale Z, Jamieson A, Schoeman J, 2004. Zebra Bite to a South African Tourist. *J Travel Med* 11(2): 122–124. https://doi.org/10.2310/7060.2004.17083.

Topić J, 2014. The boar attacked and seriously injured the hunter. *Večernji list*. Available online: https://www.vecernji.hr/vijesti/vepar-napao-i-tesko-ozlijedio-lovca-966242 (10 October 2022). [in Croatian].

Tough SC, Butt JC, 1993. A review of fatal bear maulings in Alberta, Canada. *Am J Forensic Med Pathol* 14(1): 22-27. https://doi.org/10.1097/00000433-199303000-00005.

Tumram NK, Dhawne SG, Ambade VN, Dixit PG, 2015. Fatal tusk injuries from a wild boar attack. *Med Leg J* 83(1): 54–56. https://doi.org/10.1177/0025817214528431.

Tunjić Pejak D, Adam VN, Srzić I, 2022. Venomous Snakebites in Croatia, Clinical Presentation, Diagnosis and Treatment. *Acta Clin Croat* 61(1): 59-66. https://doi.org/10.20471/acc.2022.61.s1.10.

VauMijau, 2023. The swimmers were enjoying the water, and then a herd of wild boar rushed onto the beach... *Jutarnji list*. Available online: https://www.jutarnji.hr/vaumijau/aktualno/kupaci-su-uzivali-u-vodi-a-onda-je-na-plazu-dojurilo-krdo-divljih-svinja-nastao-je-stampedo-15343149 (6 June 2023). [in Croatian].

Vodopija R, Primorac D, Boneta J, Sokol K, Vojvodić D, 2021. From the archives of the Zagreb antirabies clinic: hospitalized persons due to animal bites from 1995 to 2006. *Acta Med Croatica* 75(3): 217-223.

Vodopija R, Racz A, Pahor D, 2016. The incidence of jackal bites and injuries in the Zagreb anti rabies clinic during the 1995-2014 period. *Acta Clin Croat* 55(1): 151-155. https://doi.org/10.20471/acc.2016.55.01.20.

Vujnović Z, 2016. Trophy quality of wild boar tusks in eastern part of Croatia during last eight hunting years, MSc Thesis, University in Zagreb, Faculty of Forestry, Zagreb, Croatia, 46 p. [in Croatian].