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Human injuries and fatalities caused by brown bears in Russia, 1932–2017

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We compiled, summarized and reviewed 338 cases of people killed or injured by brown bears from 1932 to 2017 in Russia, home of about half of the world's brown bears. During the Soviet period, 1932–1990, hunters and outdoor workers were injured/killed by bears more frequently than people engaged in other activities, 28% and 19% among all incidents, respectively. However, after 1991, people who gathered wild resources, hiked or were within human settlements were most affected (22, 16 and 15%, respectively). Single bears were involved in most of the incidents before and after 1991 (76% and 74% of the cases, respectively). In 1991–2017, the post-Soviet period, when data availability was better, bear-caused injuries and fatalities (264 records) occurred more often on the Russian Pacific Coast (111 incidents) and in Siberia (109 incidents) than in European Russia (44 incidents), where human encroachment in bear habitat is higher. During the same period, the percentages of fatalities were not significantly different among the areas; 39% in European Russia, 49% in Siberia and 50% on the Pacific Coast. Casualties occurred mainly during daytime and especially in summer and autumn. In 182 incidents with known probable causes, bears most frequently attacked when provoked or disturbed (38%) and surprised (21%), but 18% of the incidents seemed to reflect bear predatory behavior. Hence, we encourage researchers and wildlife managers to develop educational programs on large carnivore biology and behavior and to better manage human activities in bear country in order to minimize human–bear conflicts in Russia and elsewhere.

Keywords: brown bear attacks, human–carnivore conflict, human–wildlife coexistence, Russia, *Ursus arctos*

Large carnivores help maintain biodiversity and ecosystem functions (Ripple et al. 2014). Nevertheless, the beneficial impacts of large carnivores on ecosystems do not operate in isolation from people and human activities (Graham et al. 2005). Large carnivores sometimes attack livestock (Zimmermann et al. 2005) and even humans (Thirgood et al. 2005). Habitat loss and degradation (Miquelle et al. 2010) and human population growth with resultant encroachment into previously inaccessible locations (Herrero et al. 2011) have contributed to more frequent human–carnivore encounters around the globe.

Human–carnivore conflicts have been indeed a part of the history and evolution of both humans and carnivores (Camarós et al. 2016). Human attitudes towards large carnivores are complex and the intensity of human–large carnivore conflicts is dependent on a variety of environmental, social and personal factors (Swenson et al. 1995, Røskaft et al. 2003). Although usually rare, large carnivore attacks on people are the most dramatic form of human–carnivore conflict (Knight 2000). Large carnivore attacks often elicit biophobic responses among people (Røskaft et al. 2003), which in many instances has caused serious declines in carnivore populations (Woodroffe et al. 2005).

The great interest in brown bear *Ursus arctos* attacks demonstrated by the media, has amplified the negative perception of brown bears (Craighead and Craighead 1971) and consequently jeopardizes species management and conservation (Kojola et al. 2018). For this reason, numerous studies have analyzed human–brown bear incidents in North America (Shelton 1994, Herrero and Higgins 2003, Penteriani et al. 2016, Smith and Herrero 2018) and Europe (Nyholm 1989, Swenson et al. 1999, De Giorgio et al. 2007, Støen et al. 2018), describing factors involved in incidents and their prevention.

Numbers of human–bear incidents have increased recently in Europe and North America, because of increasing bear abundance and growing numbers of people engaging in outdoor activities, hunting and inappropriate human behavior in

bear country (Penteriani et al. 2016, Smith and Herrero 2018, Støen et al. 2018). However, some bears in North America have demonstrated predatory behavior (Graf et al. 1992, Shelton 1994). In Scandinavia, the number of people injured or killed annually by bears increased with the growing bear population size during the last four decades, but this was true only for hunters, i.e. the increase in the bear population size did not correlate with incidents affecting unarmed people (Støen et al. 2018).

Human–brown bear coexistence remains quite enigmatic in the Russian Federation, hereafter Russia, where about half of the world's brown bears live (McLellan et al. 2017). Only 4% of the total number of scientific publications on brown bears in ISI, the Web of Knowledge, came from Russia (n = 4553, based on a search on 27 September 2018, using the search term 'brown bear'). Therefore, better knowledge on brown bears in Russia is crucial to inform bear conservation and management of human activities at the worldwide scale.

Both the brown bear population size and the number of casualties have been growing in Russia (Baskin and Barysheva 2016). Bear behavior and rates of bear-caused casualties have been reported to vary geographically, with a higher occurrence of incidents in Siberia and on the Pacific Coast than in European Russia (Vaisfeld et al. 1993), although the latter includes regions characterized both by large human populations and some bear densities as high as on the Pacific Coast (Komissarov and Gubar 2013). Previous studies found that people were injured more often when cubs were present or bears were wounded and/or followed by hunters than by single and uninjured bears (Baskin 1996). Soviet and Russian studies (Pazhetnov 1990, Suvorov 1991, Revenko 1994) concluded that minimizing human disturbance in bear country, as well as prevention of bear food-conditioning and habituation, were necessary measures to avoid economic damage and improve human safety.

The main objective of our study was to investigate the circumstances associated with brown bear attacks and whether the pattern of the attacks varied across areas of Russia, which has potential implications for the conservation-oriented management of brown bears on the worldwide scale, given the high percentage of the world's brown bears that inhabit Russia. Furthermore, this knowledge can also help inform conservation and management of other large carnivore populations.

Material and methods

Study area

Russia occupies 17.1 million km^2, with a human population of 146 804 400 (FSSS 2017). We classified the 83 administrative regions into three main areas; European Russia, Siberia and the Pacific Coast, which differ in their densities of brown bears, humans and paved roads, levels of human disturbance, abundance and variety of bear food items during hyperphagia, and percentages of forest and protected areas (see Table 1 for further details). The study area covered 14 biomes, including tundra, taiga, deciduous and mountainous forests, alpine tundra and meadows. Between 1932 and 2017, bear casualties have been recorded in 44 of the 83 administrative regions.

Study species

The brown bear population in Russia was estimated at 132 000 individuals in 1992 (Chestin 1997). According to the Ministry of Environment and Natural Resources of the Russian Federation, it increased to 245 100 individuals by 2017 (Gorlova 2017). In contrast, another state agency reported a recent abrupt decrease in brown bear numbers, from 225 100 in 2015 to 143 000 in 2017 (The Prosecutor General's Office of the Russian Federation 2018). Bragina et al. (2015) suggested that the reportedly increasing bear population in

Table 1. Differences among main areas within Russia (European Russia, Siberia and the Pacific Coast) in average human population, brown bear population (Russian estimates), percentages of protected area, forest cover and paved road density between 1991 and 2017, as well as main bear food items during hyperphagia. Summarized data from Zavatskyi and Shevtsov 1991, Vaisfeld et al. 1993, Federal Agency of Geodetics and Cartography 2007, FSSS 2017, 2018a, Gorlova 2017.

Variable	European Russia		Siberia		Pacific Coast	
Human population	104 623 542	±866 900	32 995 342	±808 664	5 577 621	±523 657
Brown bear population	51 569	±7780	64 150	±13 857	43 574	±10 658
Forest cover	65%	±11	47%	±1.2	51%	±0.41
Protected area	8.4%	±6.3%	9.7%	±7.1	9.3%	±3.1
Paved road density	189 km/1000 km^2	±63	46/1000 km^2	±15	20/1000 km^2	±5
Main bear food items during hyperphagia	*Vaccinium myrtillus*, *V. vittis-idaea*, *V. oxycoccus*, *Quercus*, *Corylus* spp.; *Fagus* spp. (Caucasus); *Pinus sibirica* (around the Ural Mountains)		*V. myrtillus*, *V. vittis-vidaea*, *V. oxycoccos*, *P. sibirica*, *P. pumila*		*V. oycoccus*, *V. vittis-idaea*, *V. uliginosum*, *Corylus* spp., *P. sibirica*, *P. pumila*, *P. koraiensis*, *Salmonidae* spp.	

recent decades was a result of changes in bear monitoring methods, which included annual surveys, surveys on established plots and oat fields, and written surveys completed by hunters (Komissarov and Gubar 2013). Nevertheless, officially reported population numbers should be treated with caution; the International Union for Conservation of Nature (IUCN) recently estimated that about 100 000 brown bears inhabit Russia (McLellan et al. 2017), i.e. the IUCN estimation is barely half of the Russian estimates.

The number of legally hunter-killed bears also increased in recent years (FSSS 2018b). Hunting quotas allow an annual harvest of 3–15% of the population at the regional scale, depending on regional bear numbers and conservation status (hunted or red-listed populations) (Gubar 2007). However, only about one-third of the annual national brown bear quotas have been filled since 2004 (Komissarov and Gubar 2013). Numbers of issued hunting licenses have remained low even in Siberia, in spite of its high bear population (Zyryanov et al. 2011). Besides the seemingly low impact of legal hunting, poachers may have killed from 5000 to 12 000 bears per year in 2003–2007 (Gubar 2007) and more bears annually than hunters with bear licenses between 2008 and 2013 (Komissarov and Gubar 2013).

Data collection

We used the term 'casualty' for a bear-caused human injury or fatality and 'incident' to describe a case when a human-bear encounter led to one or more casualties. Hence, the total number of casualties (injuries and fatalities) was higher than the total number of incidents, as incidents sometimes resulted in multiple injuries or fatalities. We have not evaluated the severity of the injuries, due to the lack of consistent data on medical examinations in the reports. We used methods consistent with those of Smith and Herrero (2018) and accepted all our collected reports as true, if they included a minimum amount of information. Nonetheless, we did not include non-injurious incidents in our database and analyses because this type of incidents appeared to be highly underrepresented during the entire study period in regions where encountering a brown bear is a rather common occasion. Data about bear-caused casualties included a long-term (1950–2015) dataset collected by us (S. Barysheva and L. Baskin), scientific publications on brown bears and human–bear conflicts, and Russian media reports accessed ad hoc via online computer searches in Yandex (Russian equivalent of Google) which included a search term 'bear' combined with the following words – 'нападения медведей' ('bear attacks'); 'медведь напал' ('bear attacked'); 'медведь-шатун' ('vagabond bear'); 'медведь набросился' ('bear pounced'); 'медведь растерзал' ('bear mauled'); and 'медведь убил' ('bear killed'). In total, we checked six books (only one book contained chapter summaries in English, the rest in Russian), 22 scientific publications (three in English, the rest in Russian), and 527 media reports (three in English, the rest in Russian). Online reports mainly consisted of reports from regional newspapers and information agencies such as Argumenty i Fakty, Komsomolskaya Pravda, Kamchatka24, <www.NEWSru.com>, <www.lenta.ru>, <www.TASS.ru> and <www.ohotniki.ru>. We also gathered additional details about incidents by checking several online sources reporting the same incident. Media reports (n = 26) that lacked essential information, e.g. location, date or primary human activity, were discarded. We only considered incidents involving brown bears.

Totally, we included 338 incidents involving brown bears that caused human injuries or deaths from 1932 (date of the first collected incident with sufficient details) until 2017, with a particular focus after 1991, when 264 cases were reported. We have divided the entire time span into two periods, Soviet and post-Soviet/Russia, that is before 1991, and after 1991, because all aspects of human life differed, e.g. human mobility was lower before 1991 and those who did go to the forests were mainly locals (i.e. people better acquainted with life in bear-populated areas). Whereas in recent decades and with the increased road density, more people from urban areas have obtained better access to bear country.

In addition, casualties (and particularly ones that ended up with only injuries) were more likely underreported in the Soviet times. We could not access the media sources from that period and most of the accessed information on the incidents before 1991 came from books and scientific publications. Since 1991 media coverage has improved all over the country and bear incidents were more likely to be evenly reported both in areas with lower (European Russia) and higher (Siberia and the Pacific Coast) bear population estimates. We are well aware of potential inconsistencies of incident reporting over time and among areas and wish to note that interviewing survived victims and witnesses, gaining access to regional police records of bear-caused fatalities and people missing in the forest would certainly have improved the accuracy of this study. Therefore, restricted information about the details of bear incidents may have introduced a bias into our conclusions. Nevertheless, we gathered information from all available sources to compile a sample as large as possible to reduce the potential biases. We used the χ^2 test for given frequencies to compare if collected bear incidents were equally distributed among geographical areas during the entire study period and the z-test to compare the frequency of fatalities among casualties in European Russia, Siberia and on the Pacific Coast to determine if these proportions were different for the period between 1991 and 2017 (Crawley 2012).

To identify the causes and circumstances associated with bear attacks, we included bear- and human-related variables potentially involved in the incidents, geographical location and biome of the incident site, year, date and time of the day (nighttime or daytime). Approximate geographical locations of the incidents allowed us to determine the 14 types of biomes where incidents occurred, i.e. southern tundra, pretundra woodlands, northern taiga, middle taiga, southern taiga, subtaiga, mountainous taiga, deciduous forest, mountainous deciduous and dark coniferous forest, treeless mountains and alpine tundra, alpine meadow, alpine grassland, meadow steppe and steppe (Federal Agency of Geodetics and Cartography 2007). We also incorporated the regional data on the mast failure years, i.e. years when the productivities of main bear food sources during hyperphagia (berries, pine seeds and salmonids) (Pazhetnov 1990, Gordienko and Gordienko 2006) were documented to be lower than average.

We distinguished the following probable causes of bear casualties; food defense, cub defense, hunted, invading bear's space or provoking the bear (e.g. when people approached

a bear at a close distance while it was in a den or during photographing), surprise (sudden encounter), and predatory behavior, which included predation or attempted predation, i.e. when bears searched, stalked, attacked, killed/dragged a person and often fed upon the victim (Hopkins et al. 2010). We also considered special circumstances associated with casualties that could help understand the causes of bear aggressiveness, such as, whether a bear was reported as sick/old/nuisance, whether it had been wounded by people attacked by the bear, or wounded, but not by the people attacked by the bear. We considered information about the sex and age of bears to be reliable only in cases involving female bears with cubs or when a bear had been killed and its sex and/or age were reported.

We assigned the age of the victims as children/teenagers (<17 years), adults (18–64) or seniors (>65). We categorized the number of people involved in an incident as single, two or more than two persons. The primary human activities encompassed hunting bears, hunting other species, fishing, livestock herding, hiking, professional outdoor activities (e.g. logging, geological exploration or working at oil and gas fields), and gathering wild resources (e.g. berry or mushroom picking). We also considered incidents that occurred in settlements and inside a house/hunting cabin/car separately. Information about the presence of a dog, a firearm or about the habituation/food-conditioning of a bear was included in a dataset, although reporting of such important details was poor. Data visualization was conducted using RStudio ver. 1.1.453 (<www.r-project.org>), ggplot2 ver. 3.0.0 (Wickham 2016) and the open-source web tool (Datawrapper 2018).

Results

Our data spanned 85 years (1932–2017) and included 338 incidents, involving at least 386 persons. During 1932–1990, hunters were more often attacked by bears than any other group ($\chi^2_7 = 33.64$, $p < 0.05$) (Fig. 1). Other incidents involved professional outdoor workers, hikers, people in human settlements, gathering wild resources or fishing. After 1991, a lower proportion of bear-caused casualties involved hunters and people in professional outdoor activities, whereas casualties involving people gathering wild resources and hiking, which included walks near human settlements, occurred more frequently ($\chi^2_8 = 118.61$, $p < 0.05$) (Fig. 1). Since 1991, bears injured/killed people in settlements or in the vicinity of settlements in 40 cases, of which 35% were in Siberia and 53% on the Pacific Coast. In cases when people were attacked inside their houses, hunting cabins or cars (n = 4; three incidents were in Siberia), bears were not reported to be habituated, food-conditioned or directly provoked by the humans, but demonstrated predatory behavior towards people.

Single bears were involved in most incidents both before and after 1991 (76% and 74% respectively). Between 1932 and 2017, more unarmed people were injured (n = 45) and killed (n = 70) than those who carried firearms (21 injuries and 34 fatalities). Nonetheless, information about the presence of a firearm/other defense means (e.g. hunting knife) was not available for 37% of injuries and 49% of fatalities. Dogs were present during 15% of injurious and 9% of fatal incidents, but the presence of a dog was also poorly reported (only in 51% of injuries and 60% of fatalities).

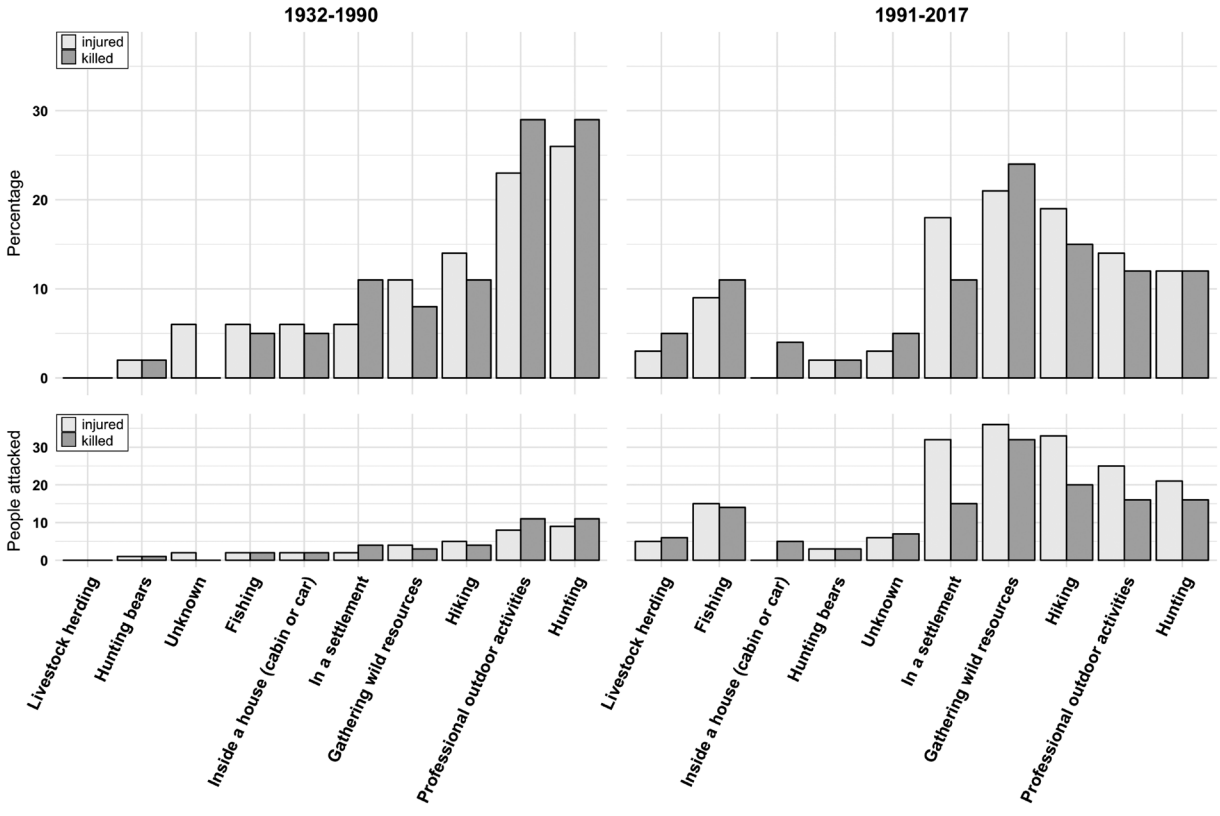

Figure 1. Primary activities of people injured and killed by brown bears in Russia, 1932–2017, based on the number and percentage of total casualties.

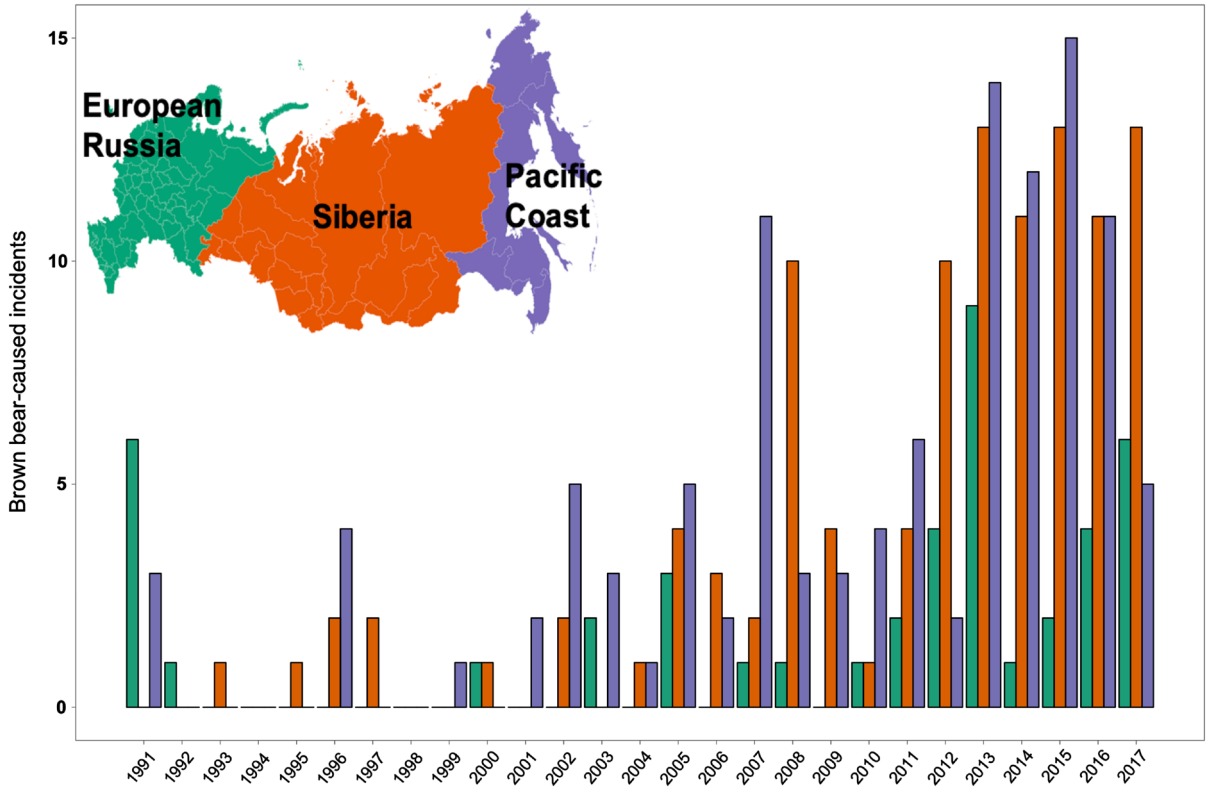

Figure 2. Frequency of brown bear incidents within areas of Russia, 1991–2017.

Before 1991, more injurious incidents were reported in European Russia (28 cases) than in Siberia (26) and on the Pacific Coast (21), which could have been a result of low reporting in distant and sparsely populated areas or absence of digitized information about such cases. Between 1932 and 1990, percentage of fatalities in reported casualties was notably higher in Siberia (73%) and on the Pacific Coast (57%) than in European Russia (35%), which might be the outcome of greater attention of media and bear scientists to outrageous rather than more fortunate incidents. Between 1991 and 2017, bear incidents were reported continuously in all areas, but the numbers were higher on the Pacific Coast (n = 111) and Siberia (109) than European Russia (44) ($\chi^2_2 = 33.02$, $p < 0.05$, Fig. 2, 3). The proportions of fatalities, however, were not significantly different either between European Russia (39% of all incidents) and Siberia (49%) ($Z = -1.63$, $p = 0.15$) or between European Russia and the Pacific Coast (50%) ($Z = -1.53$, $p = 0.18$).

Between 1991 and 2017, incidents took place mainly in the mountainous, middle and southern taiga biomes that are typical for Siberia and the Pacific Coast; 118, 37 and 33 cases, respectively. Bear incidents occurred mainly in summer (44%) and autumn (41%) (Fig. 4) and during daytime (79%). Incidents during nighttime (n = 37) were unevenly distributed among the areas; 11% of incidents in European Russia, 35% on the Pacific Coast and 54% in Siberia ($\chi^2_2 = 10.43$, $p = 0.01$). Bears that were reported as food conditioned caused injuries/fatalities during nighttime only in Siberia (n = 8) and on the Pacific Coast (n = 5).

During 1991–2017, bears most frequently attacked people that were unaware of the bear's presence (n = 92) or following a sudden encounter (n = 34). In 26 incidents after detection by people, the bears chased and then attacked the people. In 69 cases, details about the bear's behavior at the time of attack remained unknown, except that the bears had not being hunted nor initiated the attacks. Bears attacked most often after people had come close and provoked (n = 73) or surprised them (n = 41), but some bears also demonstrated predatory behavior (n = 34). Comparatively few bears attacked people when defending their food (n = 19) or cubs (n = 17). For 72 incidents, the primary cause of bear attacks was not reported. The bears involved were reported to be old/nuisance/sick animals (n = 43), wounded by the people whom the bears attacked (n = 15), or had been wounded, but not by the people they later attacked (n = 4).

In 53 incidents, bears consumed or attempted to consume people whom bears intentionally pursued (n = 18, from police reports or surviving witnesses), after being provoked by humans (n = 8), and when bears defended either their food (n = 7) or cubs (n = 3). In 17 cases, the probable cause of attack was unknown. For incidents with a known outcome for bears (n = 190), 110 survived and 84 were eliminated by hunting managers or the police (n = 45), or by people whom the bears had attacked or who accompanied people attacked by the bears.

The majority of people injured or killed were adults (n = 130 and n = 97, respectively). Senior-aged persons (19 injured, 19 killed) and children/teenagers (eight injured, three killed) were also involved. Totally, 246 men and 50 women were among the casualties. In 18 incidents, gender was not documented. All injured/killed hunters and livestock herders were men. The majority of persons involved in other activities were also men, 80% of injured and 84% of killed. Of 310 people injured or killed by bears, 146 were

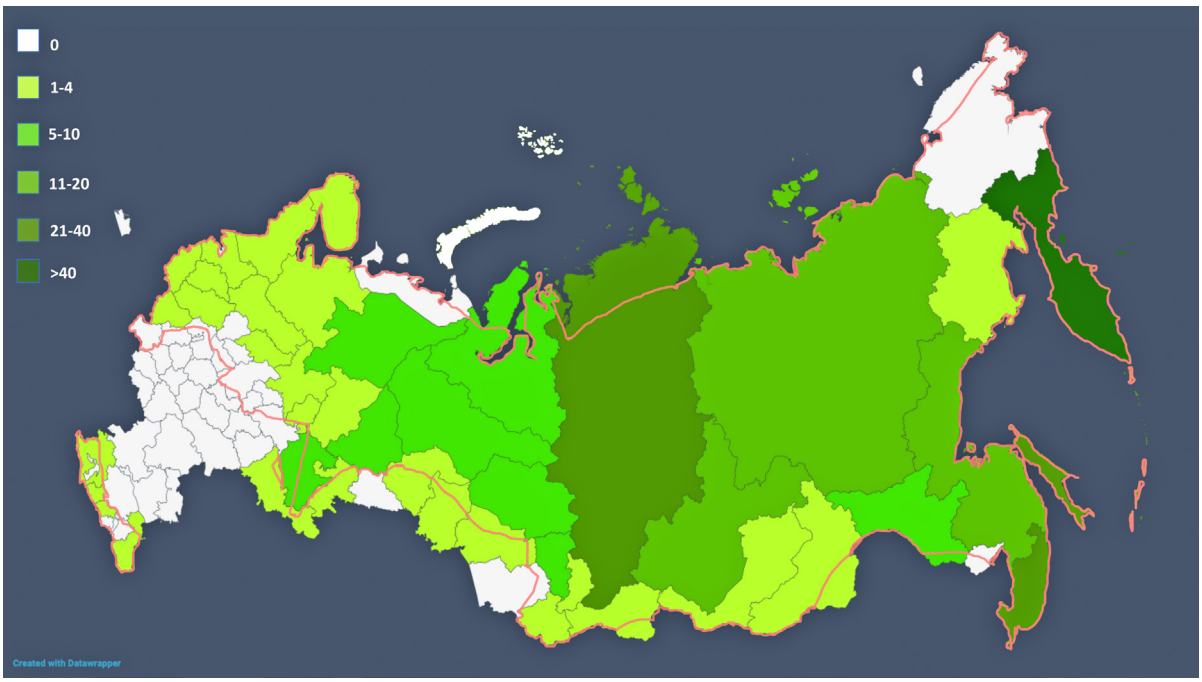

Figure 3. Spatial distribution (administrative regions) of human incidents caused by brown bears in Russia, 1991–2017. White color shows the regions without brown bear incidents. Different shades of green colors code for the frequency of incidents within the administrative regions during the study period, with darker shades indicating higher frequencies. Pale red line indicates the approximate border of the brown bear distribution within the country.

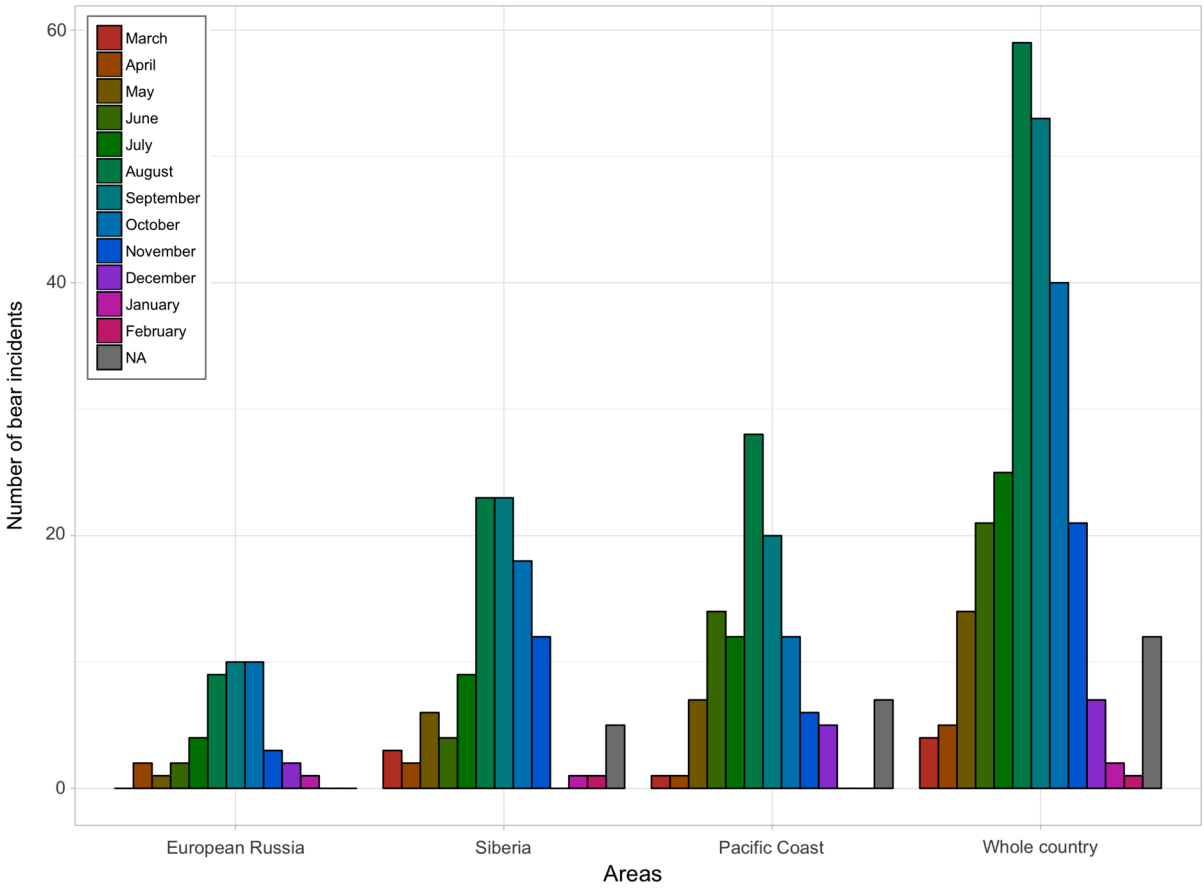

Figure 4. Monthly distribution of brown bear incidents in Russia, 1991–2017.

alone, 82 in groups of two and 58 in groups larger than two persons. In 24 incidents, the group size was not reported.

Bears classified as 'vagabond' in the reports (sometimes referred to as 'hanging bears' or *shatuns* in Russian) were involved in 19 incidents, resulting in seven injuries and 12 deaths. Vagabond bears, as described in Russian literature, are bears that fail to fatten during the predenning period, due to internal (sickness, injury) or external (poor availability of main food items) constraints, and thus behave abnormally. However, in our dataset, only four of the 12 fatalities reportedly caused by vagabond bears occurred during the mast failure years with poor berry or/and pine seed production or low salmon availability.

Discussion

Our study collected and analyzed 85 years of records of brown bear incidents that resulted in human injury or death across Russia, a vast country with about half of the world brown bear population, and with comparatively few published papers at the international level. Importantly, our results indicated a temporal change both in the frequency of bear attacks and in activities of people who were most often injured or killed by bears. Despite the growing number of licensed hunters in Russia (EMISS 2018, FSSS 2018b), after 1991, hunters were no longer the main group facing the highest risk of a bear casualty, as they were earlier. Gathering wild resources and hiking became the most common human activities related to brown bear-inflicted casualties, as has been found in Alaska (Smith and Herrero 2018). Such shifts might be explained by the changes in the density of paved roads in Siberia and on the Pacific Coast, which almost doubled since 1991 (FSSS 2018a), providing people with better access to remote areas than before. Recently increased numbers of people pursuing outdoor activities other than hunting during summer (n = 115) and autumn (n = 85) (Fig. 4) in Siberia and on the Pacific Coast may have resulted in a growing number of bear incidents. Hence, our results support the prediction in Herrero and Fleck (1990) that increased levels of human disturbance in bear country have negative consequences both for human safety and bear welfare.

Incidents in general were more numerous in Siberia and on the Pacific Coast than in European Russia. The proportion of fatalities among the incidents, however, did not differ significantly among the three geographical areas. Historically, brown bears in European Russia have experienced a heavy hunting pressure, similar to bears inhabiting western Europe (Swenson et al. 1995, Zedrosser et al. 2011). Bears may avoid people whenever possible in the western part of Russia (Pazhetnov 1990, Vaisfeld et al. 1993), whereas bears in Siberia and on the Pacific Coast, which are less likely to contact humans, may have a bolder behavior that could explain why bears tended to attack people more often (Zavatskiy 1993, Baskin 1996). Nonetheless, predicting bear's behavior remains complicated, owing to a variety of environmental, human- and bear-related factors involved in a human–bear incident (Herrero 2002).

Lone bears were involved in more fatalities than female bears with cubs, in agreement with previous studies from North America (Herrero and Higgins 2003) and Scandinavia (Støen et al. 2018). As in Scandinavia, casualties involving hunters peaked in October and November (61%), at the end of the hyperphagia period and beginning of denning, which may vary between late September and mid-December, depending on area. In that period, bears may respond more aggressively to disturbance, because of reduced activity levels associated with prehibernation behavior (Sahlén et al. 2015a).

Only 19 incidents (7% of the total) were attributed to conflict-prone vagabond bears, 'shatuns', a vaguely defined concept, repeatedly used in the Russian literature (Suvorov and Smirnov 2006, Puchkovskyi 2017). Therefore, we suggest using the term more cautiously in future scientific studies. However, when human food is available, bears may start to associate food with humans, lose fear, and are more likely to have conflicts with people, as documented in North America (Herrero and Higgins 2003). In Russia, bears considered to be food-conditioned were responsible for just eight incidents in Siberia and five on the Pacific Coast. Still there were another 40 cases where bears consumed or attempted to consume their victims. Despite the predatory intention of the brown bears involved in those cases, our results showed that few of them were habituated or food-conditioned, perhaps due to a larger number of problem/sick/old bears in this sizeable population (Zyryanov et al. 1993) or underreported brown bear habituation and/or food-conditioning when injurious incidents occurred. It is important to note that food-conditioning does not necessarily result in nuisance behavior (Steyaert et al. 2014). Bear occurrence near settlements can reflect the distribution of different sex and age classes of bears in the landscape, without being food conditioned (Elfström et al. 2014). Hence, further research is needed to clarify the potential causes of bears approaching human settlements in Russia.

Our study has limitations related to the huge scale of the study area and the use of coarse-scale environmental, bear- and human-related variables. Moreover, to summarize information from a variety of sources, we had to assume data reliability. We cannot discard the possibility that some incidents were fraudulent, as has been shown elsewhere (Caniglia et al. 2016). Ideally, the site of a large carnivore attack should be described and analyzed with similar criteria as for human crime scenes, to ensure very detailed information (Garrote et al. 2017). This is important to inform the public, given the consequences that such incidents have for human wellbeing and on human attitudes towards carnivores. For instance, in Scandinavia, bears are shot by default if they are involved in an incident with people, regardless of the cause of the incident (Støen et al. 2018), and in our study, at least 31% of the bears involved in incidents were killed. Moreover, 25–140 bears were eliminated each year as nuisances on Kamchatka (Pacific Coast) alone since 2011 (Argumenty i Fakty 2014, Kamchatka24 2015, 2018a, b, Argumenty i Fakty 2017), yet no study has investigated the potential link between bears using areas near people, food-conditioning and garbage storage, which may ultimately force bears to approach settlements. Moreover, underreported presence of a dog and firearms prevented us from drawing solid conclusions about the potential impacts dogs or defense means may have had on the outcomes of bear incidents.

Conclusions

Increased levels of human disturbance in the forest and human risk-enhancing behaviors (Shelton 1994, Penteriani et al. 2016) have contributed to human–carnivore conflicts in North America and Europe, and mitigation of these factors has improved human safety and bear welfare (Creachbaum et al. 1998, Linnell et al. 2001). In Russia, researchers have also noted the presence of these same factors (Pazhetnov 1990, Suvorov and Smirnov 2006), provided recommendations on how to avoid bear attacks (Krechmar 1986, Buyanov and Buyanov 2015). In order to prevent human–bear conflicts, Russian biologists have emphasized the problem of bear food-conditioning and habituation (Bobyr 1987, Suvorov 1991) and advocated the increase of hunting quotas in Siberia and on the Pacific Coast, (Zyryanov et al. 2011, Komissarov and Gubar 2013). However, bear hunting is certainly a high-risk activity that increases human injuries by wounded bears, as documented in Scandinavia (Støen et al. 2018). This casts serious doubts on the suggestion that increasing bear hunting quotas alone would alleviate bear–human casualties. Moreover, hunting is known for increasing bear vigilance and altering habitat use and distribution during hyperphagia (Ordiz et al. 2012, Hertel et al. 2016), which can negatively affect bear survival over winter.

Despite a growing frequency of casualties, few recent papers in Russia focused on human–bear coexistence. Hence, we suggest that studying the factors contributing to bear incidents and the widespread use of preventative methods (Smith et al. 2008, Ordiz et al. 2013, Sahlén et al. 2015b) may be useful in reducing the risk of incidents.

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Conflicts of interest – The authors declare that there is no conflict of interest regarding the publication of this article.

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