Human–Wildlife Interactions 17(1):3–20, Spring 2023 • digitalcommons.usu.edu/hwi

Human fatalities resulting from wild pig attacks worldwide: 2000–2019

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Abstract: Although reported to be rare, human fatalities resulting from wild pig (*Sus scrofa*) attacks do occur. Toward a better understanding of patterns in fatal wild pig attacks, we synthesized worldwide reports of wild pig attacks on humans between 2000 and 2019. We documented 163 separate reports of fatal wild pig attacks that resulted in 172 human deaths. On average, 8.6 human deaths occurred annually due to wild pig attacks during those 2 decades. The majority of fatal attacks resulted in a single human death; however, there were 6 cases in which an individual fatal attack resulted in 2–4 human deaths. These fatal wild pig attacks occurred in 29 countries, mostly within the wild pig's native global range. Fatal attacks primarily occurred under non-hunting circumstances and involved seemingly unprovoked wild pigs. Under hunting circumstances, fatal attacks primarily involved provoked or wounded wild pigs. Fatal attacks typically involved a solitary wild pig, with 12% involving multiple pigs. Solitary pigs involved in fatal attacks were typically large boars that in most attacks exhibited defensive behaviors, although we discovered 7 attacks during which the pig's behaviors appeared to be predatory. Three fatal attacks were initially investigated as homicides. Overall, victims of fatal wild pig attacks were between 3 and 85 years old and were traveling on foot when the attack occurred. The majority of victims of fatal attacks were adult (20–59 years old), male, traveling on foot, and working in isolation. Among all fatal attacks, 50% identified the cause of death, which included exsanguination/hemorrhagic shock, severe injury, heart attack, craniocerebral injury, severe injury/disembowelment/intestinal prolapse, and toxemia/septicemia. Fatal wild pig attacks occurred primarily in rural areas, with fatal attacks 390% more likely to occur in rural areas with large populations and at least 45% forested and agricultural cover. The greater the rural human population size within a country is, the greater the number of fatal wild pig attacks.

Key words: attack, Eurasian wild boar, feral hog, human fatality, *Sus scrofa,* wild pig

Attacks by wild pigs (*Sus scrofa*) on humans have been documented since early times. Although reported to be rare, such incidents can result in serious outcomes for the human victims, including death (Chauhan et al. 2009, Chauhan 2011, Mayer 2013, Silwal et al. 2016). Fatal wild pig attacks on humans were described in ancient Greek writings (Graves 1990) and documented as early as 753 CE with the death of Milo, the Archbishop of Trier and Reims, who was killed by a wild pig on a hunt in the Eifel Mountains of Germany (Schuhn 1987). Human fatalities resulting from wild pig attacks were also recorded on headstones in the Severn Temple graveyard in England dating back to 1104 CE (Severn Temple 2004). Fatal wild pig attacks on humans have continued in recent years (Chauhan 2011, Mayer 2013).

Despite the fact that such fatal attacks are known to occur, no information has been compiled on a worldwide basis to characterize these incidents, the human victims, or the animals involved. Aside from articles in either medical journals describing mostly individual human victims and their injuries resulting from such attacks (Hatake et al. 1995, Memeloni and Chand 2002, Akhade et al. 2015, Tumram et al. 2015, Bhingare et al. 2016, Pavanchandshetty et al. 2017) or recent articles describing such attacks in localized settings (Chauhan 2011, Silwal et al. 2016, de Oliveira et al. 2018), global or large-scale studies focusing on the fatal subset of these incidents are completely lacking.

To complete our study, we compiled and synthesized information on global fatal wild pig attacks on humans between 2000 and 2019. Our goal was to provide the first global-scale characterization of these incidents toward im-

proving our knowledge of the factors that increase the likelihood of such fatal attacks. A better understanding of these incidents will hopefully help reduce the occurrence of fatal human encounters with wild pigs. For the purposes of this study, we use "wild pig" to identify these animals, because it collectively encompasses all of the wild forms of "*Sus scrofa*," including Eurasian wild boar, feral pigs (e.g., wild *Sus scrofa* solely of domestic origin), and hybrids between those 2 parental stocks (Keiter et al. 2016).

We predicted that the fatal attacks would be a small percentage of the total wild pig attacks on humans worldwide. Given the recent increase in wild pig populations globally (Melletti and Meijaard 2018, VerCauteren et al. 2020), we predicted that the number of fatal wild pig attacks on humans would increase concurrently. Additionally, we predicted that most victims of fatal attacks would be older males traveling on foot and alone. Finally, we predicted that these fatal attacks would be higher in countries with large rural human populations as well as large areas of forested and agricultural lands.

Methods

We compiled worldwide data on wild pig attacks, both fatal and nonfatal, on humans during the period 2000–2019. We chose this time frame to facilitate the maximum compilation of the most recent information associated with these incidents. Similar to comparable studies of large carnivore attacks on humans (Beier 1991, Cardall and Rosen 2003, Herrero et al. 2011, Bombieri et al. 2019), we obtained reports of wild pig attacks from a variety of sources, including: news media, organizational/facility webpages, organizational reports and files, personal communications, popular books/magazines, and scientific/medical literature. To obtain these data, we searched both the scientific and popular literature and conducted extensive monthly internet searches throughout the study period. We searched for the above-mentioned sources using the search engines Google and Google Scholar. Because of the global extent of the species' range, we conducted searches in various languages including English, Arabic, Bengali, Bulgarian, Croatian, Czech, Danish, Dutch, Estonian, French, Fijian, Finnish, German, Greek, Hindi, Hungarian, Indonesian, Italian, Japanese, Korean, Latvian, Lithuanian, Malay, Polish, Portuguese, Romanian, Russian, Serbian, Spanish, Slovak, Standard Chinese, Swedish, Thai, Turkish, Ukrainian, Urdu and Vietnamese.

We conducted internet searches on Google using combinations of the following terms: "wild" or "feral" + "pig" or "boar" + "attack" + "fatal" or "died" or "killed." We translated non-English language search results into English for analysis using Google Translate. We also searched cited references of all relevant journal articles to identify any resources or other pertinent literature that were not found during the internet searches. Additional attack records were collected from personal datasets of the co-authors. In a few instances, source documents were provided to us from colleagues or members of the public who were aware of our study. Because of the use of multiple sources, several attacks recurred repeatedly during the search, but we used information such as date, locality, and sex/age of the victims to prevent duplicate records in the dataset. We compiled details from the various sources of fatal wild pig attacks into 9 categories of information (Table 1). Given the diversity of sources for reports on wild pig attacks, we were unable to obtain complete sets of information on a number of attacks, but we recorded all available information possible.

Wild pig attacks on humans typically take place in rural areas, specifically in either agricultural lands or forest areas (Chauhan et al. 2009, Mayer 2013). Accordingly, we compiled nation-specific data characterizing rural population sizes, forested land area (km^2), and agricultural land area (km^2) for each year between 2000 and 2019 from the Food and Agricultural Organization of the United Nations (FAOSTAT) database (FAOSTAT 2021). For each year between 2000 and 2019, we calculated rural population size for each nation by multiplying a nation's total population size by its percent rural population (FAOSTAT 2021). Similarly, for each year between 2000 and 2019, we calculated forested and agricultural land area for each nation by multiplying a nation's total land area (km^2) by its percent forested and agricultural land area (FAOSTAT 2021).

Data analysis

We used Pearson's correlation to examine the strength of association between the number of

Table 1. Information recorded from reports of fatal wild pig (*Sus scrofa*) attacks on humans worldwide (across 57 nations) between 2000 and 2019.

Category	Detail
Circumstances	Hunting or non-hunting
Location	Zoogeographic realm; Northern or Southern hemisphere
	Country
	Location in global range (native or introduced)
	Landscape type (rural, suburban, urban)
	Vegetation type (agricultural lands, woodland/forest, remote villages/ settlements, rural roads, open areas)
Date/time	Year
	Month
	Season (adjusted for Northern vs. Southern Hemisphere; Northern Hemisphere—winter (Dec. to Feb.), spring (Mar. to May), summer (Jun. to Aug.), and fall (Sep. to Nov.); Southern Hemisphere—winter (Jun. to Aug.), spring (Sep. to Nov.), summer (Dec. to Feb.), and fall (Mar. to May)
	General time period (day, night)
	General time of day (morning, afternoon, evening, night; either specifically reported in the source or defined as follows: morning—dawn to 1200 hours, afternoon—1200 to 1700 hours; evening—1700 to 2200 hours, night—2200 hours to dawn)
	Specific time (hour)
Cause	Unprovoked, animal threatened, sudden close encounter, animal wounded, unknown
Human victim	Sex
	Age (years)
	Age class (neonatal, minor [postnatal–10 years], adolescent [11–19 years], adult [20–59 years], senior [≥60 years])
	Transport mode (walking, etc.)
	Activity being performed (agricultural work in garden, field, or orchard/ grove; herding/tending livestock; hunting wild pigs, etc.)
	Social category (alone, in a group)
	If in group: number of others injured
	Description of injuries
	Injured region of body (upper, lower, both, unknown)
	Reported cause of death
	Location of death (scene of attack, in route to hospital, hospital, unknown)
Other animals present	Species of animal
	Was it involved in the attack?
	Fate of other animal(s) (escaped/uninjured, injured, killed)
Wild pig	Social grouping (solitary, group)
	Description (sex, size, etc.)
	Number of wild pigs
Nature of attack	Defensive, predatory, unknown (predatory determination based on reported consumption of victim tissues, attempts to carry off or drag victim away)
Investigation	Was fatality initially investigated as a homicide?

fatal wild pig attacks and the total number of wild pig attacks. We used chi-square tests to determine if the number of fatal wild pig attacks was more likely to occur for certain demographic groups (e.g., victim sex, age class), periods of the year (months and seasons), or when victims were engaged in a particular type of activity when the fatal attack occurred.

Next, we used a negative binomial generalized linear-mixed effects model (GLMM; Zuur et al. 2009) to evaluate the influence of rural population size and percent land area variables on annual counts of fatal pig attacks. We used a negative binomial error distribution to account for overdispersed counts of fatal pig attacks (Hilbe 2011). We fit annual counts of fatal pig attacks in each nation as the response and 2 interaction terms as predictors: (1) between rural population size and percent forested area and (2) between rural population size and percent agricultural area (i.e., the model was formulated as: response = rural population size + percent forested + percent agricultural + rural population size*percent forested + rural population size*percent agricultural). Thus, our model allowed inference on main effects of rural population size and each land area variable on counts of annual fatal attacks, as well as on if and how changes in either land area variable modified the main effect of rural population size. We scaled rural population size prior to analysis to improve model convergence. Following previous studies on regional or worldwide trends in wildlife attacks on humans (Herrero et al. 2011, Tan et al. 2015, Midway et al. 2019, Packer et al. 2019), we did not adopt a per capita approach, which would have focused our analysis on among-nation comparisons that were beyond the scope of our study. Finally, we fit nation and year as a random intercept term to account for differences among nations and non-independence of observations across years (Schielzeth and Forstmeier 2009).

We used marginal mean contrasts to determine if changes in rural population size and each percent land area variable affected the number of fatal pig attacks. Specifically, we estimated contrasts under scenarios representing all combinations of high and low rural population sizes and high and low percent forested and agricultural land area. We defined high and low rural population sizes using the ninetieth and tenth percentiles of observed rural population sizes, respectively. We defined high and low conditions for each of forested and agricultural percent land area variable as 10% and 45% of land area, respectively. We calculated variance inflation factors (VIF; Neter et al. 1985) to test for multicollinearity among predictors in the fitted GLMM. We conducted all analyses in the R statistical environment (R Development Core Team 2021) and used the contributed package "glmmTMB" (Brooks et al. 2017) to fit negative binomial mixed-effects models, "emmeans" (Lenth 2019) for marginal mean contrasts, and "car" (Fox and Weisberg 2019) for VIF calculations.

Results

We obtained reports of wild pig attacks primarily from news media (n = 999) and organizational/facility webpages (n = 125), followed by scientific/medical literature (n = 23), popular books/magazines (n = 7), personal communications (n = 6), and organizational reports and files (n = 4).

We discovered reports of 1,532 human victims of wild pig attacks that occurred between 2000 and 2019 across 57 nations (Table S1; Figure 1). Of the 1,532 human victims, there were 172 human fatalities from 163 individual attacks (Table S2). The number of fatal attacks worldwide was positively associated with the total number of attacks (r = 0.84, 95% CI = 0.80–0.87). Most (n = 157) fatal attacks involved a single human fatality, but 6 attacks resulted in multiple fatal victims, ranging in number from 2 to 4. Fatal attacks occurred in 18 of the 20 years examined, and the number of annual fatal attacks increased from 2000 through 2019 (Figure 2). Collectively, an average of 8.6 persons were fatally injured each year globally during this period due to wild pig attacks (annual range of 0–24; Table 2).

Most attacks (98%) occurred in the native portions of wild pigs' global distribution. Fatal attacks took place in 6 of the 7 nonpolar zoogeographic realms (Australian: n = 2, Nearctic: n = 1, Neotropical: n = 1, Oceanic: n = 1, Oriental: n = 119, and Palearctic: n = 48) and in 29 countries. Most were in the Northern Hemisphere (94%). India had the largest percentage of fatal attacks (51%), followed by China (8%), Indonesia (5%), Japan and South Korea (4% each), Cambodia,

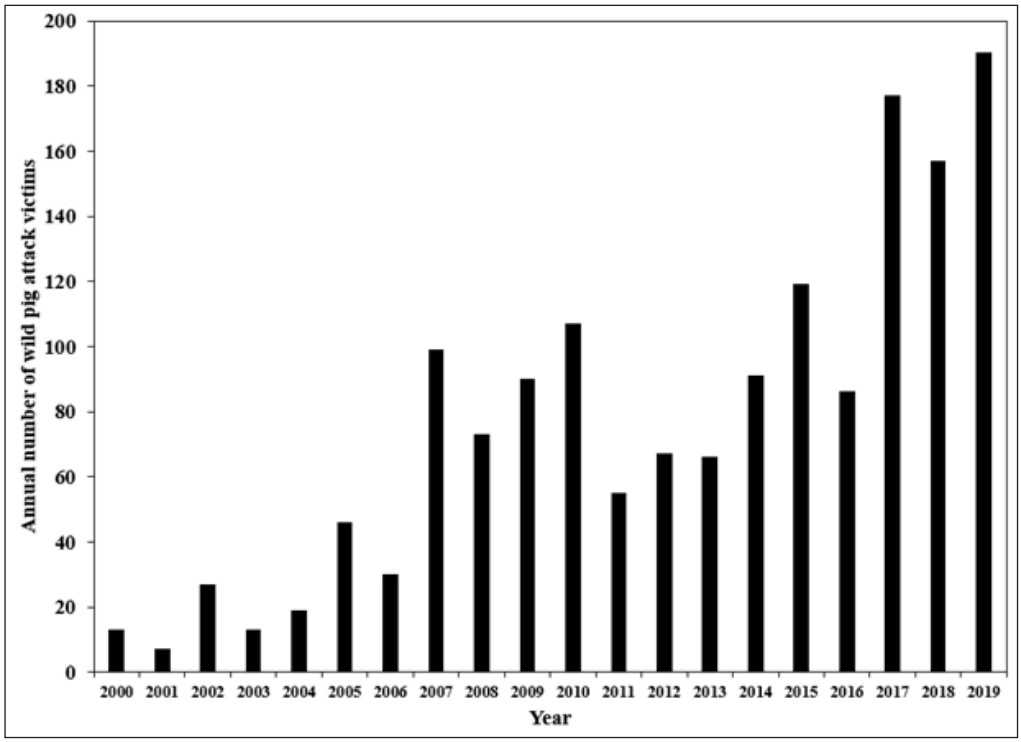

Figure 1. Annual number of all human victims (i.e., nonfatal and fatal) from wild pig (*Sus scrofa*) attacks (*N* = 1,532) worldwide (across 57 nations) between 2000 and 2019.

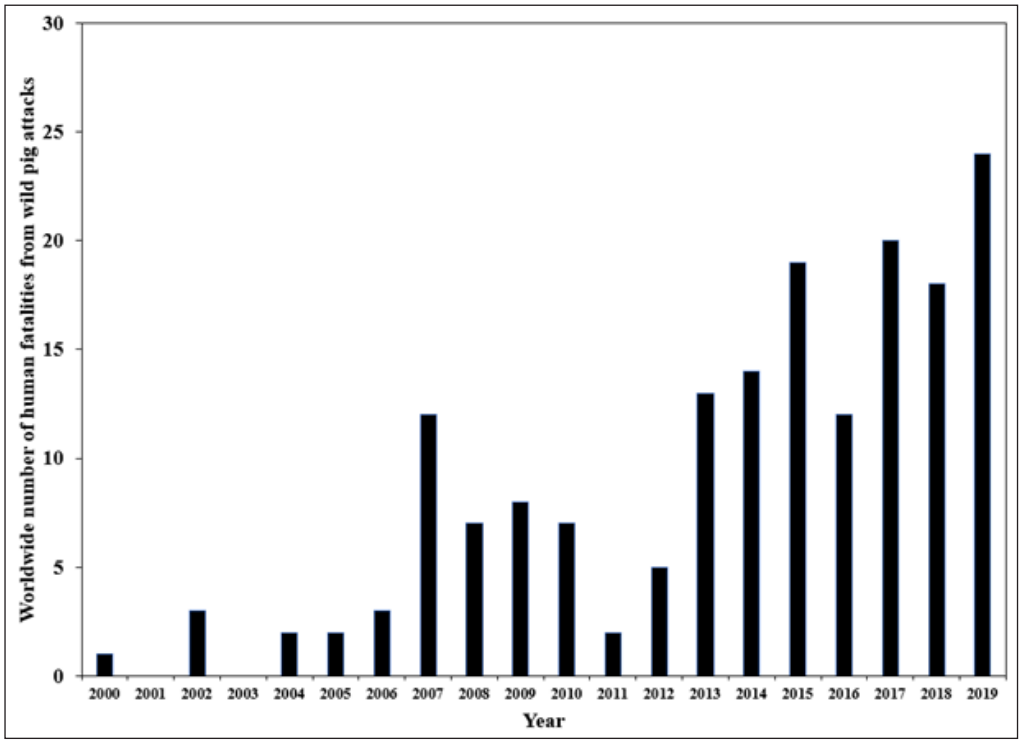

Figure 2. Annual number of human fatalities resulting from wild pig (*Sus scrofa*) attacks (*N* = 172) worldwide (across 29 nations) between 2000 and 2019.

Table 2. Comparison of mean annual number of human fatalities from attacks by wild pigs (*Sus scrofa*), sharks (Chondrichthyes), gray wolves (*Canis lupus*), brown bears (*Ursus arctos*), black bears (*U. americanus*), and tigers (*Panthera tigris*) across regional to worldwide extents for time periods ranging between 2000 and 2019.

Attacking species	Area included	Time period	Annual mean of fatal attacks	Source
Wild pig	Worldwide (29 nations)	2000–2019	8.6	This study
Shark[a]	Worldwide	2000–2019	5.4[b]	International Shark Attack File (2021)
Gray wolf	Northern Hemisphere	2002–2020	1.4[b]	Linnell et al. (2021)
Brown bear	Northern Hemisphere	2000–2015	6.3[b]	Bombieri et al. (2019)
Black bear	Canada and United States	2000–2009	1.9[b]	Herrero et al. (2011)
Tiger	20 Indian States	2015–2018	34.3[b]	Government of India (2019)

[a] Including multiple species
[b] Calculated from source document

Table 3. Parameter estimates (± standard errors; Est ± SE) and 90% confidence intervals (90% CI) for effects of percent land area types, rural population size, and their interaction on the number of fatal wild pig (*Sus scrofa*) attacks worldwide (across 29 nations) between 2000 and 2019.

Parameter	Est ± SE	90% CI
(Intercept)	-3.27 ± 0.71	-4.43, -2.1
% Forested land area	2.15 ± 0.95	0.60, 3.71
% Agricultural land area	0.61 ± 0.98	-1.01, 2.23
Rural population size	-2.60 ± 1.06	-4.34, -0.85
% Forested land area: rural population size	3.69 ± 1.35	1.47, 5.92
% Agricultural land area: rural population size	3.97 ± 1.32	1.80, 6.14

Germany, Iraq, Italy, Malaysia, Morocco, Romania, and Vietnam (2% each). Other countries with fatal attacks (Bangladesh, Bhutan, Bosnia and Herzegovina, Brazil, France, Greece, Nepal, Pakistan, Papua New Guinea, Poland, Russian Federation, Spain, Sri Lanka, Taiwan, Turkey, and United States) all had ≤1% of the total attacks.

Most attacks occurred in rural areas (97%) with a few in suburban areas. We did not discover any fatal attacks that occurred in urban areas. Of the 29 countries with fatal wild pig attacks reported, those with the largest rural human populations (India: 805,198,013; China: 559,435,594) also had the largest number of fatal attacks (Table S1). Rural population size of the remaining countries ranged from 402,250 to 112,244,201, averaging about 26,000,000 (United Nations 2019, World Bank 2020, FAOSTAT 2021; Table S1). Fatal attacks most frequently occurred in agricultural (croplands, groves/orchards; 44% of attacks) and forested (34%) areas, followed by rural settlements/villages (15%), open areas (meadow, pasture, shrub/scrub fields; 3%), and developed town/village/developed area and on rural roads (each at 2%). All countries that had ≥2% of fatal attacks had at least some incidents in agricultural lands except for Malaysia, where all attacks occurred in woodland/forest areas.

The number of fatal wild pig attacks was affected by interactions between rural population size and each of percent forested and percent agricultural land area. Differences between years (but not countries) accounted for moderate variation in the overall number of fatal pig attacks across countries (average standard deviation of random intercept for year = 0.621, or

Table 4. Odds ratios and 90% confidence intervals (90% CI), of a fatal wild pig (*Sus scrofa*) attack occurring worldwide (across 29 nations) between 2000 and 2019 under conditions representing high and low rural population sizes (30% and 10% of the total population size, respectively), percent forested land area (45% and 10% of the total land area, respectively), and percent agricultural land area (45% and 10% of the total land area, respectively).

Rural population size	% Agricultural area	% Forested land area	Odds ratio (90% CI)
10%	10	10	0.01 (<0.01, 0.06)
		45	0.12 (0.05, 0.27)
	45	10	0.07 (0.04, 0.14)
		45	0.75 (0.40, 1.40)
30%	10	10	<0.01 (<0.01, 0.02)
		45	0.06 (0.01, 0.45)
	45	10	0.04 (0.01, 0.20)
		45	8.91 (2.17, 36.45)

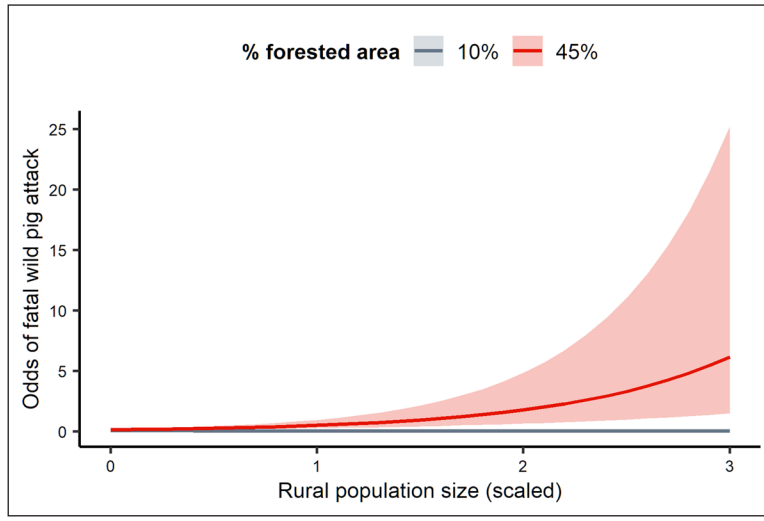

Figure 3. Predicted odds (lines) and 90% confidence bands (shaded regions) of a fatal wild pig (*Sus scrofa*) attack across rural population sizes (scaled; x-axis) and high and low percent forested land area (10% and 45% forested area, respectively), conditioned on high percent agricultural land area (45%) worldwide (across 29 nations) between 2000 and 2019.

~19% of the model intercept).

Overall, fatal pig attacks increased with rural population sizes and with each of percent forested and agricultural land area (Table 3). The odds of a fatal pig attack increased by 390% where there was a large rural population (ninetieth percentile of rural population sizes) and high percent forested and agricultural land area (45% of total land area; Table 4; Figure 3). In contrast, the odds of a fatal pig attack decreased by 70–99% across all scenarios that included low levels of either rural population sizes (tenth percentile of rural population sizes), percent forested land area (10% of total land area), or percent agricultural land area (10% of total land area; Table 4; Figure 3).

The cause of attacks was identified in 49% of all cases (Table 5). The leading cause of attack was the pig being provoked or threatened (39%), which included cases of wild pigs being chased, cornered, or attacked (e.g., by a farmer using farm tools or throwing stones to chase a pig out of agricultural fields or dogs [*Canis familiaris*] fighting a wild pig). Most fatal attacks occurred under non-hunting circumstances (88%), with a smaller number under hunting situations. Attacks under non-hunting circumstances occurred in rural and suburban areas,

Table 5. Identifiable causes of the fatal wild pig (*Sus scrofa*) attacks worldwide (across 29 nations) between 2000 and 2019, delineated by victim activity and general time of day.

	Victim activity		General time of day		
Cause of attack	Non-hunting	Hunting	Day	Night	Total
Pig threatened	36%	50%	42%	23%	39%
Unprovoked	40%	-	31%	39%	32%
Pig wounded	15%[a]	50%	25%	8%	22%
Sudden close encounter	9%	-	3%	31%	7%

[a] In all cases, pig had been shot by a hunter or a poacher.

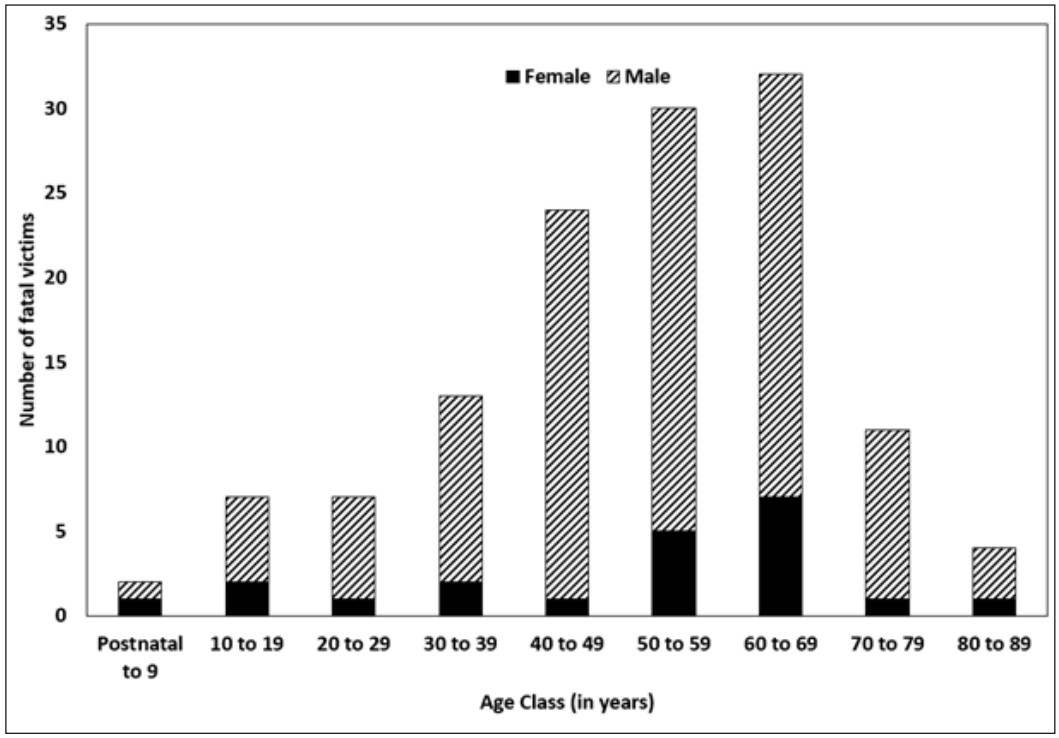

Figure 4. Age class (decades in years) frequency of female and male human fatalities (N = 130) of wild pig (*Sus scrofa*) attacks worldwide (across 29 nations) between 2000 and 2019.

whereas attacks under hunting circumstances occurred only in rural areas.

Under non-hunting circumstances, the 2 most common causes of fatal attacks were unprovoked or threatened pigs. Some victims of fatal attacks under non-hunting circumstances were indirectly related to hunting, with the most frequent cause being wild pigs that had been recently wounded or shot in the larger areas surrounding the locations of the fatal attacks. Unprovoked attacks and sudden close encounters only occurred under non-hunting circumstances. Under hunting circumstances, the causes of the attacks were evenly divided between pigs being threatened and wounded animals. The primary causes of these attacks during daylight hours were animals threatened, unprovoked, and wounded animals. At night these were unprovoked, sudden close encounter, and animal threatened.

Fatal attacks occurred throughout the year, with no differences among months or seasons. Attacks under non-hunting circumstances likewise occurred with no seasonal or monthly differences. However, fatal attacks that occurred under hunting circumstances were more fre-

quent in the winter ($\chi^2 = 8.16$, df = 3, $P = 0.043$) and in October through January, with December being the peak month ($\chi^2 = 29.20$, df = 11, $P = 0.002$), consistent with most fall-winter hunting seasons. Attacks that occurred during other activities being performed by victims did not differ seasonally or monthly. Most attacks (86%) happened during daylight hours, with attacks under hunting circumstances occurring entirely during daylight hours. Less than half (45%) of the fatal attacks occurred in the morning, followed by afternoon (29%) and then by night (13% each), and lastly by evening (12% each). Of the 47 attacks for which a specific time of day was reported, 68% occurred between 0500 and 1200 hours, with a peak between 0700 and 1000 hours, and a relatively smaller secondary peak between 1400 and 1600 hours.

Overall, victims of fatal attacks were mostly males (84%), with 100% of fatal attacks under hunting circumstances involving only males. Males were the most frequent victims across all vegetation types except for rural roads. Among female victims, the frequency of fatal attacks was relatively higher in agricultural lands, followed by woodland/forests, and remote villages/settlements compared to other vegetation types.

From a general age class grouping, most fatal victims were adults (62%), followed by seniors (32%), adolescents/teens (7%) and minors (2%). Male victims dominated each of these groupings (Figure 4) except for the minor age class, which had a small sample size ($n = 2$) and an equal sex ratio. Among the 130 victims for which a specific age was known, the mean was 51 years and ranged from a 3-year-old up to an 85-year-old victim. For both sexes combined, most were in the 60s (female victims: 33% in their 60s, 24% in their 50s; male victims: 23% in their 50s, 23% in their 60s, 21% in their 40s). All victims were walking/traveling on foot. Most (57%) were by themselves, the remainder being in groups of 2 or more people. Of those victims in a group, 69% of those groups had other people attacked and injured in addition to the fatal victim. These ranged from 1–9 other victims, with a mean of 2.3.

Of the 149 victims for whom an activity that they were performing was reported, the most common activity was agricultural work being conducted in a garden, field, or orchard/grove (Table 6). The next most common activity was traveling on foot (22%), which variously included persons walking short to long distances in a variety of vegetation types (i.e., within this subset: woodland/forest = 38%; remote villages/settlements = 31%; agricultural land = 19%; rural road = 9%; and open areas = 3%).

In 14% of the fatal attacks, the victims had animals present with them at the time. These variously included domestic livestock (e.g., cattle [*Bos taurus*], dogs, goats [*Capra* spp.], sheep [*Ovis* spp.], and chickens [*Gallus* spp.]). The hoofed stock was being herded/tended, the domestic fowl were being tended/fed, and the dogs were either walking with the victim or being used in hunting. In half of the 22 attacks where animals were present with the victim, the animals were involved in the attack in some fashion (i.e., attacking or being attacked by the wild pig). Most of those were domestic dogs (91%), while 1 other incident involved a farmer feeding his sheep and chickens when a wild pig tried to attack those domestic animals. The fates of these animals were uninjured or escaped (81%), killed (14%), and injured (5%). All fatalities were dogs and occurred under hunting circumstances. The injury involved domestic sheep under non-hunting circumstances.

Sixty-two of the fatal victims had specific listed causes of death in the source accounts, the most common of which was exsanguination/hemorrhagic shock (Table 7). Specific injuries were listed for 114 of the victims with the most frequent being punctures/lacerations (Table 7). Among the 77 victims for which the general location of injuries was given, most were on the lower portion of the body/below the waist, although 34% of the victims had injuries to both the lower and upper portions of the body. More female victims (56%) had injuries to both portions of the body compared to only 28% of the male victims. Most of the victims died at the scene of the attack (55%), following by those that died at a hospital (28%), and lastly those who died en route to a hospital or medical treatment (17%). None of the victims in suburban areas died en route to the hospital or medical treatment.

The wild pigs responsible for fatal attacks were mostly solitary animals (88%); however, groups or sounders were involved in 20 of the incidents. The specified sizes of 2 groups were reported as 2 and 6 with the rest simply de-

Table 6. Activity reported for a subset of fatal wild pig (*Sus scrofa*) attacks in which victim activities were reported ($N = 149$) worldwide (across 29 nations) between 2000 and 2019.

Activity	% of fatal victims
Agricultural work in garden, field, or orchard/grove	38
Traveling on foot	22
Hunting wild pigs	13
Gathering natural materials	7
Herding/tending livestock	7
Defecating in the open	4
Leisure	3
Miscellaneous labor	3
Combat/hiding in ambush	2

Table 7. Percentages of causes of death, specific injuries, and locations of injuries to victims of fatal wild pig (*Sus scrofa*) attacks worldwide (across 29 nations) between 2000 and 2019.

Variable	Percent (%)
Cause of death[a]	
Exsanguination/hemorrhagic shock	77
Severe injury	11
Heart attack	5
Toxemia/septicemia	3
Craniocerebral injury	2
Severe injury/disembowelment/intestinal prolapse	2
Specific injury[b]	
Punctures/lacerations	96
Severed blood vessels	45
Physical trauma/bruising	27
Fractured/broken bones	6
Intestinal prolapse	4
Pneumothorax	4
Myocardial infarction	3
Tissue consumption	3
Bacterial infection	2
Location of injury[c]	
Lower body	42
Upper body	25
Both	34

[a] Among 62 victims for which it was listed.
[b] Among 114 victims for which it was listed.
[c] Among 77 victims for which it was listed.

scribed as "group," "herd," or "several." Two groups were described as a sow with piglets. Of the 40 wild pigs involved for which a sex was either reported or discernible (based on visible genitalia or the canine morphology of yearlings through adults in photographs taken following the attack; Mayer and Brisbin [1988]), 38 were male and 2 were female. Of the 24 animals for which an estimated or actual total body mass was reported, the mean weight was 109 kg, with a range from 45–200 kg. Of the 17 wild pigs that were subjectively described by victims or witnesses, 7 were described as "adult," 7 as "large," 2 as "big," and 1 as "aged."

The nature of fatal attacks (e.g., whether predatory or defensive) was discernable for 135 of the 172 victims. Of these, 7 victims appeared to be the targets of predatory attacks. Three victims had tissue consumed by the attacking pigs after being killed, whereas the other 4 victims were being carried or dragged away by attacking pigs when companions present at the scene chased the pigs away. Of those 7 victims, the age class/sex groupings were as follows: 1 senior female, 3 senior males, 1 adult female, 1 adult male, and 1 minor female.

Three fatalities were initially investigated by law enforcement authorities as possible homicides. In each of these instances, the victims were discovered in a rural area after having been reported missing for periods ranging from several hours to 1 day. Each of these victims had multiple lacerations and punctures that were initially thought to be knife or bladed instrument wounds. All 3 cases were subsequently determined to be wild pig attacks. This determination in 1 case was based on the presence of wild pig field sign (tracks) around the victim, and in the other 2 cases (a single incident), law enforcement investigators were attacked at the scene by a wild pig with blood on its tusks, believed to be that of the 2 fatal victims. That pig was killed during this subsequent attack.

Discussion

Wild pigs clearly have the potential to be dangerous (Goulding et al. 1998, Wilson 2005). However, most wild pig attacks on humans do not result in fatalities for their victims (Memeloni and Chand 2002, Manipady et al. 2006, Gunduz et al. 2007, Pavanchandshetty et al. 2017). For example, out of 927 wild pig attack victims in 10 states in India, Chauhan (2011) reported that 4.2% were fatally injured. Mayer (2013) reported that globally, out of 665 human victims of wild pig attacks, only 64 (10%) were fatalities. In 26 wild pig attacks on humans that occurred in the vicinity of Chitwan National Park in Nepal between 2003 and 2013, only 1 (4%) was fatal (Silwal et al. 2016). de Oliveira et al. (2018) reported that, out of 309 wild pig attack victims in Brazil, none were fatally injured. Our data are generally consistent with these reports in that 11% of victims reported herein (172 of 1,532) died due to wild pig attacks.

Despite the rarity of fatal wild pig attacks on humans, the total number of these attacks worldwide has increased concurrently with all worldwide wild pig attacks on humans. Our synthesis of global annual numbers of fatal attacks by wild pigs indicates they increased from 2000–2019, consistent with other reports of increases in wild pig attacks in general for the 2000s and 2010s (Chauhan et al. 2009, Mayer 2013, Deshpande 2016, Nagasawa et al. 2017, de Oliveira et al. 2018, Okano et al. 2018). Increasing worldwide connectivity to the internet and social media during our reporting period may have biased this trend upward somewhat, as attacks that previously may have gone unreported are more easily detected by news media. However, the apparent increases in fatal attacks have also been concurrent with the globally observed increases in overall numbers of wild pigs in both native and introduced populations (Salvador and Fernandez 2014, Massei et al. 2015, Keuling et al. 2018, VerCauteren et al. 2020). Wild pig attacks on humans in general occur throughout the species global range but are far more frequent in the native portion (Mayer 2013). This higher percentage is consistent with the more widespread distribution in the native range and the greater abundance of wild pigs there (Keuling et al. 2018).

Most victims died at the scene, indicating the violent nature of those attacks. Silwal et al. (2016) noted that the fatality rate among victims of wild animal attacks in rural areas tends to be higher because of delays in rescue or treatment efforts. Indeed, most fatal wild pig attacks occurred in rural areas, with most victims not reaching medical care alive. Conversely, we found no reported fatalities in urban areas even

though wild pig attacks increased in that landscape type during our study period (Mayer 2013, Lewis et al. 2020). Barss and Ennis (1988) noted that most injured victims of wild pig attacks that reach a hospital alive do survive, although some may require prolonged hospitalization. The low probability of fatal attacks in urban areas could be related to increased presence of other humans (potential bystanders or companions who could readily help an attack victim), structures (e.g., vehicles or buildings victims could use to evade an attacking pig), as well as proximity to medical facilities.

Wild pigs attack primarily using their teeth (Freer 2004, Silwal et al. 2016), which can cause deep soft tissue injuries through bites and punctures (Gubler 1992, Attarde et al. 2011, Bury et al. 2012). Such wounds can be consistent with those produced by knives or other bladed instruments, such that the cause of death may even be mistaken for a stabbing homicide (The Star 2015), though lacerations and punctures produced during a wild pig attack have typically ragged edges, and defensive injuries (e.g., to the right hand and forearm; Katkici et al. 1994) are typically lacking. In addition, pigs have a powerful bite, capable of crushing human bones (Barss and Ennis 1988).

For adult victims of fatal wild pig attacks where most injuries are to the lower portion of the body, the typical cause of death is a lacerated femoral artery (Mayer 2013). The higher percent of fatal female victims that had injuries to both upper and lower portions of the body indicates these victims were likely knocked to the ground and then mauled. Such victims tend to sustain injuries to multiple parts of their bodies compared to the victims who were able to remain upright (Hatake et al. 1995, Mayer 2013, Nagasawa et al. 2018). Often, victims on the ground have multiple penetrating injuries, which can have fatal consequences (Akhade et al. 2015). Injuries caused by wild pigs can also become grossly contaminated (Barss and Ennis 1988, Gubler 1992, Freer 2004), though fatal complications from sepsis only accounted for 2 fatalities in our data.

Most fatal attacks occurred when victims were engaged in high-risk activities (hunting, traveling on foot alone at night, defecating in the open) or were in areas that increased their probability of attack (i.e., croplands, gardens, orchards). For example, herding/tending livestock puts humans in close contact with wild pigs that may be attempting to prey on those domestic animals. The victim, while attempting to protect or save their domestic animals, likely would put themselves at risk in trying to fend off the attacking pig. Other activities likely represented chance encounters that turned aggressive with the pig being provoked or threatened. All fatal victims were traveling on foot, which apparently rendered them more vulnerable to injury, and especially severe injury, compared to other modes of transportation used by wild pig attack victims in general (e.g., cycling, horseback, golf cart; Mayer 2013). Likewise, victims traveling alone appear to be at higher risk of fatal attack (Mayer 2013).

The vast majority of fatal wild pig attacks involved male victims in their 50s and 60s. That most fatal victims are male is consistent with males being the most frequent victims in all wild pig attacks in general (Chauhan et al. 2009, Chauhan 2011, Mayer 2013, de Oliveira et al. 2018) and in virtually all attacks that occurred under hunting circumstances (Mayer 2013). However, the age class of fatal attack victims was older than that of victims across all wild pig attacks. Previous reports indicated the most common age classes for all attacks were 35–49 years old (de Oliveira et al. 2018), 41–50 years old (Chauhan et al. 2009, Chauhan 2011), and 50–59 years old (Mayer 2013), and age classes were similar for both female and male victims (Mayer 2013, de Oliveira et al. 2018). The reported mean ages of victims in those studies were 41 (Mayer 2013) and 44 years old (de Oliveira et al. 2018). In contrast, the generally older age of fatal victims reported herein may have been attributable to reduced mobility, affecting the ability to escape the attack and possibly to underlying age-related health conditions (e.g., cardiovascular issues).

Most fatal wild pig attacks were carried out by a single animal, typically a large male, consistent with previous reports (Barss and Ennis 1988, Mayer 2013). For groups of pigs involved in an attack, often only 1 or 2 animals in the group are involved in the attack (Gunduz et al. 2007, Mayer 2013). Most social groups of 2 or more wild pigs are composed of single or multiple family groups (Mayer and Brisbin 2009), with the largest animals in such groups being

maternal females. In fact, 2 groups involved in fatal attacks in the present study each were described as a sow with her piglets, and the sow was reported to be the attacking animal.

Most attacks occurred when pigs were either threatened (e.g., by the victim or by dogs accompanying the victim) or wounded (e.g., shot during a hunt, vehicle collision), which likely elicited an aggressive defensive response, as compared to a sudden close encounter where the pig was uninjured and could escape the scene. An aggressive defensive attack would have greater potential to result in more severe injuries to the victims. In addition, the actual cause of some attacks reported as unprovoked may have been by a previously wounded animal or due to a sudden close encounter in which the pig felt threatened. For those victims found dead after the attack, it is possible that they tried to haze or chase the pig away when it appeared. Such threats to pigs (e.g., with farm tools or throwing stones) were documented in our data. In India, where half of all fatal attacks occurred, the killing of wild pigs has long been strictly controlled and generally prohibited (Indian Wild Life Protection Act, 1972, Section 9 and Schedule III), and the opportunistic killing of wild pigs by Indian farmers in defense of their crops is illegal (Nandakumar 2018). As such, Indian farmers have little recourse other than trying to chase the crop-depredating pig away without killing it.

Senthilkumar et al. (2016) reported that three-quarters of farmers interviewed in the Indian state of Tamil Nadu stated that they tried to drive wild pigs away whenever they were found on their farmland. Being aggressively threatened, such pigs might respond with an equally aggressive defensive attack. Additionally, pigs subjected to frequent hazing without ever suffering more severe consequences may become habituated to such activities and thus more emboldened. In more recent efforts to reduce wild pig–human conflict in and around farmlands, several Indian states (Goa, Uttarakhand, and Bihar) have declared wild pigs as vermin, allowing crop-depredating pigs to be hunted and killed (Mishra 2016, Ganesan 2021, Mahale 2021).

The presence of other animals accompanying humans during these attacks may elicit either defensive or predatory responses by the wild pig against those animals. In instances where humans are injured, the victims typically attempt to intercede to protect their animals and are then attacked by the pig (Mayer 2013). Domestic dogs may be considered by wild pigs to be predators, and pigs attack the dogs as a preemptive response. For example, Ingendaay et al. (2008) reported that the number of non-hunting related attacks on domestic/pet dogs by wild pigs in Berlin, Germany, has been increasing.

Mariacher et al. (2019) documented a case where wild pigs killed and consumed most of a hunting dog in Italy. The presence of a dog, either on or off leash, represents a hazard or increased risk to the human of a wild pig attack (Goulding 2003, Department for Environment, Food and Rural Affairs 2004, Wilson 2005, Mayer 2013). Wild pigs can also be voracious predators of several species of domestic livestock, including juvenile and adult goats, sheep, cattle, and fowl (Mayer and Brisbin 2009, Mayer 2018), and at least some of the attacks involving domestic livestock likely involved a predatory attack on those animals. As with dogs, when a person herding or attending those domestic animals attempts to intercede to protect their animals, they were then attacked by the wild pig.

Some fatal attacks may have been predatory in nature, based on consumption of the victim's tissues. As opportunistic omnivores, wild pigs scavenge on human corpses or remains in post-combat, rural accident (e.g., plane crash), and rural crime (e.g., homicide) situations (Barss and Ennis 1988, Williams et al. 1998, Rockenbach 2005). In addition, Elman and Peper (1975) reported a wild pig in southern France that was a confirmed repeated man-eater, and humans have been killed and eaten by domestic pigs (Ortiz 2012, Pleasance 2014, Drewett 2015, BBC News 2019).

Similar to fatal large carnivore predatory attacks on humans (e.g., Beier 1991, Cardall and Rosen 2003, Herrero et al. 2011, Bombieri et al. 2019), the victims of fatal wild pig attacks encompassed both sexes and most age classes, although an apparent tendency exists toward seniors as the victims of predatory wild pig attacks. An assumed predatory wild pig attack could have been initiated as a defensive attack, but the pig could also have perceived the victim as an easy meal, especially if the victim

was severely injured or dead. Barss and Ennis (1988) described an instance of opportunistic consumption of a fatal human victim by the attacking wild pig.

This is the first worldwide study to characterize aspects of fatal wild pig attacks on humans. Although infrequent, such attacks occur more often than is typically covered by the news media. For example, the mean annual number of fatal wild pig attacks on humans during our study period (8.6) is greater than the mean annual number of fatal shark (Chondrichthyes) attacks for the same period (5.4; International Shark Attack File 2021), yet fatal shark attacks on humans elicit much more media attention and news coverage. Except for tigers (*Panthera tigris*) in India, the recent mean annual number of human fatalities resulting from other large predator attacks is less than that for wild pigs (Table 2). We speculate that this relative lack of attention may be due to the fact that most fatal wild pig attacks occur in rural areas of Asia, distant from the spotlight of western media.

Conclusions

Although the risk of a wild pig fatally attacking a person is low, it does exist. In addition, fatal attacks by wild pigs are increasing in frequency annually. Our study can help mitigate risks to human safety and public health by enabling greater awareness of the risk factors associated with wild pig attacks. Most fatal wild pig attacks appear to be defensive in nature, likely a consequence of sudden close encounters between people and wild pigs, particularly farmers and people working in or traveling through rural areas. Increased awareness (e.g., through public outreach and education) that sudden close encounters with wild pigs may be more frequent in rural areas where forested and agricultural areas abut will help farmers and people in these areas reduce risk of a fatal wild pig attack. Additional caution should be taken by older persons, who might be at increased risk in trying to defend themselves or escape from an attacking pig. We encourage refraining from taking actions that provoke or otherwise threaten wild pigs to minimize aggressive encounters that are more likely to result in a fatal wild pig attack on humans. This would include being around domestic animals, especially dogs, in the close presence of wild pigs.

Acknowledgments

We appreciate the helpful comments from the associate editor and 3 reviewers, which improved the quality of earlier drafts of the manuscript. We would like to thank J. Miller (Chambers County Sheriff's Department, Anahuac, Texas, USA); K. Hatake (Department of Legal Medicine, Nara Medical University, Nara, Japan); and D. Napier, R. Smith, and R. Roseberry, who provided information that was used in this study. Support for this study was provided by the U.S. Department of Energy to Battelle Savannah River Alliance under contract 89303321CEM000080 and to the U.S. Forest Service Savannah River under Interagency Agreement DE-AI09-00SR22188.

Supplemental material

Supplemental material can be viewed at https://digitalcommons.usu.edu/hwi/vol17/iss1/4.

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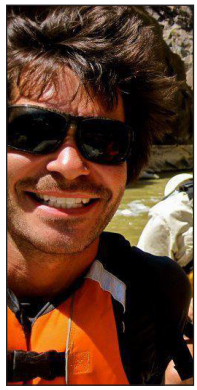

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