



**HUMANE SOCIETY  
INTERNATIONAL**

# Brown Bear

(*Ursus arctos*)



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This factsheet is part of a series highlighting species vulnerability to trophy hunting and lethal offtake.

## IMPACTS OF TROPHY HUNTING

- Unsustainable offtake
- Increased rates of infanticide
- Disruption of natural behavior

## POPULATION

The brown bear (*Ursus arctos*) is found in Europe, Asia, and North America. The broader European population, which includes western Russia, is estimated at 55,000 mature individuals as of 2018.<sup>1</sup> The European Union (EU) regional population is estimated at fewer than 10,000 mature individuals across all EU Member States as of 2018.<sup>1</sup>

The broader European population including Russia is classified by IUCN as Least Concern and the EU population as Near Threatened as of 2018.<sup>1</sup> Within the EU, there are ten populations, each with its own IUCN status (see Table 1 below). Many populations in Europe are small and isolated.<sup>1,2</sup> Brown bears in Europe are found in two large (>5,000), three medium (500-2,500), one small (100-500), and four very small (<100) subpopulations.<sup>1</sup> Two European pop-

## QUICK FACTS:

<b>Population Size:</b>	Fewer than 10,000 mature individuals in the EU (2018)
<b>Range:</b>	Unknown (2018)
<b>IUCN Red List:</b>	EU population, Near Threatened (2018)
<b>CITES:</b>	Appendix II (since 1992)
<b>International Trade:</b>	724 trophies exported from the EU from 2009-2018 (696 trophies originated in EU)
<b>Threats:</b>	Habitat loss due to infrastructure development, disturbance, low human tolerance, poor management structures, social and reproductive factors, accidental mortality, persecution

**Table 1. European population summary (IUCN)<sup>1,2</sup>**

Population	Countries	Population Size	IUCN Status (2018)
Alpine	Italy, Switzerland, Austria, Slovenia	49-69 (25-28)	Critically Endangered
Central Apennine	Italy	45-69 (20-29)	Critically Endangered
Eastern Balkans	Bulgaria, Greece, Serbia	468-665 (336)	Vulnerable
Baltic	Estonia, Latvia	700 (390)	Least Concern
Cantabrian	Spain	321-335 (107-116)	Endangered
Carpathian	Romania, Serbia, Poland, Slovakia, Ukraine	7,630 (4,455)	Least Concern
Dinaric-Pindos	Slovenia, Croatia, Bosnia & Herzegovina, Serbia, FYRO Macedonia, Montenegro Albania, Kosovo, Greece	3,940 (1,650)	Vulnerable
Finnish-Karelian	Finland, Norway	1,660	Least Concern
Pyrenean	France, Spain, Andorra	30 (14)	Critically Endangered
Scandinavian	Sweden, Norway	2,825 (1,870)	Near Threatened

ulations (the Baltic and Finnish-Karelian) are connected to the North Eurasian population in Russia.

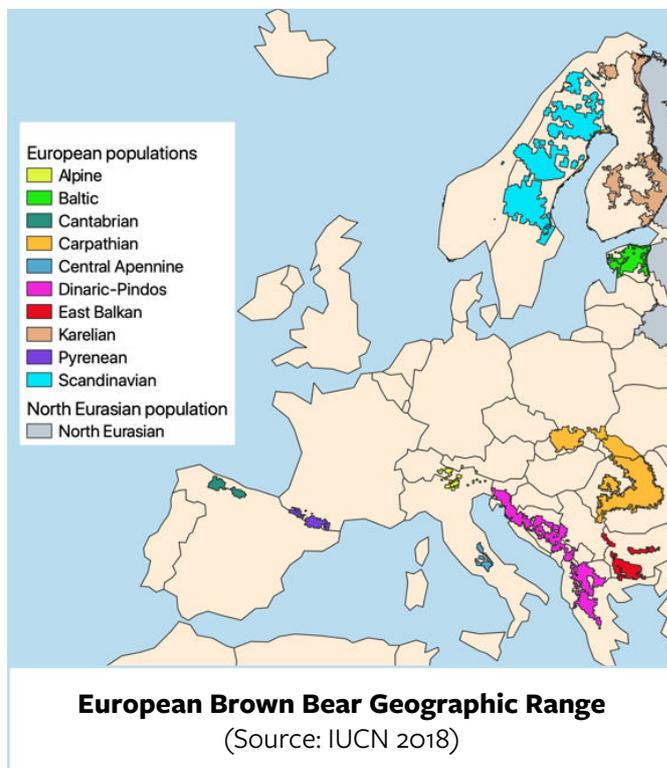
Historically brown bears were present throughout Europe; however they have disappeared from most areas due to human population growth, habitat loss, and persecution.<sup>1</sup> The brown bear has also been over hunted in the EU which has caused major population declines.<sup>3</sup> According to the 2018 IUCN Red List assessment, continued protection is required to ensure the continuing recovery of this species.<sup>1</sup>

Brown bears in the EU are designated as strictly protected by the Bern Convention and the EU Habitats Directive. Brown bears are listed on Annex II of the Bern Convention, and Annex II (except the Estonian, Finnish, and Swedish populations) and Annex IV of the EU Habitats Directive.<sup>4</sup> However, there have been many questions raised about whether bears are actually receiving these protections in light of significant hunting pressure.<sup>5,6,7,8</sup>

## RANGE

The brown bear currently occupies approximately 800,000 km<sup>2</sup> of Europe.<sup>1</sup> The total range loss compared to historical range is unknown; however, prime bear habitat has disappeared in Europe due to logging and forest clearance.<sup>1</sup>

In addition, many of populations across Europe are small and fragmented.<sup>1</sup> The Alpine population may have potential connection with the Dinaric-Pindos population in Slovenia with a few male bears moving between the two populations. The Central Apennine, Cantabrian, and Pyrenean populations have all been isolated for over a century with no opportunities to connect to other populations. The Pyrenean population is also becoming more fragmented. The Eastern Balkans population occurs in three regions, with most bears in Bulgaria but also some in Greece and Serbia. The primary challenge is maintaining connectivity across the three regions, although there is some recent evidence that there may be a potential connection with the Dinaric-Pindos population in Greece. The Dinaric-Pindos population is fracturing with limited connection between the increasingly fragmented groups of this population. The Baltic population is connected to the Russian population, although there is limited information about bears in Russia. Movement within the Carpathian population is becoming limited due to infrastructure and physical barriers. The Karelian and Scandinavian



populations have some potential genetic exchange through dispersing males. The Karelian population is also connected to the Russian populations; however, lack of reliable data from Russia makes it difficult to assess the impact of this connection.<sup>1</sup>

## LIFE HISTORY AND REPRODUCTION

European brown bears are sexually dimorphic where males are larger than females.<sup>9</sup> Males also exhibit greater variability in body size.<sup>9</sup>

Like most carnivores, brown bears exhibit slow population growth and long generation times. The average age at first birth for female European brown bears is 5.3 years.<sup>10</sup> The average litter size is 2.3 cubs<sup>10</sup> and mean litter size is positively correlated with female body mass;<sup>11</sup> this means that, on average, larger females produce larger litters. The mean interbirth interval is 2.8 years.<sup>10</sup> The mean reproductive rate, or the average number of offspring raised per adult female per year, is 0.86.<sup>10</sup>

The length of maternal care dictates reproductive rate and population growth by increasing or decreasing the time between litters. High reproductive investment and short interbirth intervals have been critically important in the recovery of brown bears in Europe.<sup>11,3</sup> However in Sweden, mothers use two maternal care tactics, a shorter period of care (1.5 years) vs a longer period (2.5 years).<sup>12</sup> There is a trade-off between these two tactics where pro-

longed maternal care provides a benefit to cubs of greater mass gain, while reducing the total number of offspring a female can birth over her lifetime.<sup>12</sup> Hunting regulations in Sweden allow solitary females to be hunted, but females with dependent cubs are protected. The tactic of longer maternal care has increased in frequency from 1993 to 2015 which coincides with increased hunting pressure.<sup>13</sup> Under these regulations and high hunting pressure, selection favors longer maternal care due to protection of mothers with dependent cubs from hunters.<sup>13</sup> However, mothers that wean their cubs later have fewer cubs over their lifetime since they cannot mate prior to weaning current offspring.<sup>13</sup> Therefore, Swedish hunting regulations that allow solitary females to be hunted promote a slower life history strategy and may reduce long-term population growth and alter future demography.<sup>13</sup> Scientists warn that these indirect effects of hunting, such as changes to life history and demography are critically important and must be considered in addition to the direct effects of offtake on population growth.<sup>13</sup>

In several European countries, both male and female bears are killed by hunters which can have detrimental impacts on populations. Adult female survival is the most important predictor of population growth rate, especially during periods of high hunting pressure.<sup>14</sup> However, adult males are also vital to growth rates, and offtake of adult males disrupts male social structure and decreases cub survival due to male infanticide.<sup>15</sup> Following territory turn overs, male brown bears commit infanticide, where they kill existing cubs in order to increase mating opportunities with females in their new territory.<sup>16</sup> Females are especially susceptible to male turnovers within 25 km which means that increased male offtake could lead to more females within susceptible range.<sup>17</sup> This male turnover is associated with high cub mortality.<sup>18</sup> Male infanticide can have long-term negative effects on population growth given that cub survival is an important predictor of population growth.<sup>14</sup> Decreased cub survival is associated with reduced population growth rate and decreased reproductive output.<sup>19</sup> Male social structure is unstable for 1.5 years after offtake of a resident male.<sup>19</sup> Therefore, maintaining established males and social structure is critical for cub survival and population growth. Due to this “additive effect,” even low rates of offtake can negatively impact populations.<sup>17</sup> Scientists suggest that is not enough to simply count the number of individuals removed from popula-

tion; it is important to consider the wide-ranging impacts that removing one individual has on the entire population and future growth.<sup>17</sup>

Sources of mortality include both natural and human-caused sources.<sup>20</sup> Young bears are especially vulnerable to natural causes of mortality and increased rates of infanticide due to offtake from hunting.<sup>19,20,21</sup> Legal hunting, even when regulated and deemed ‘sustainably managed,’ causes direct and indirect mortality and alters natural life history patterns.<sup>21</sup> In the endangered Cantabrian population, where there is no hunting, cub survival is high.<sup>22</sup> Studies in Sweden found that legal hunting accounted for over 71% of adult female mortality and 74% of adult male mortality between 1985 and 2014.<sup>21,23</sup> Female reproductive value is an indication of future population and measured as the number of future female offspring born to a female of a given age. High hunting pressure decreases life expectancy and reduces female reproductive value.<sup>21,23</sup> These demographic changes can have long-term negative impacts on populations, even if hunting pressure decreases in the future.<sup>21</sup>

## **SOCIAL STRUCTURE**

Brown bears are considered solitary and non-territorial but do exhibit spatial patterns through overlapping home ranges.<sup>24</sup> Males and females interact through these overlapping home ranges, where males roam in order to find female mates.<sup>25</sup> Consistent with this mating strategy, male home ranges are larger than female home ranges.<sup>25</sup> Lone females and females with yearlings have smaller home ranges than males, and females with cubs have the smallest home ranges.<sup>25</sup> Small cubs likely limit the movement of their mothers, restricting their home range size.<sup>25</sup>

Genetically related females share large portions of their home ranges which suggests a kin-related social structure among females of the same matriline.<sup>26</sup> Mothers and adult daughters share more than 50% of their home range with one another.<sup>26</sup> Closely related females (i.e., mothers, daughters, sisters, aunts, and grandmothers) are most often found within a distance of 40 km.<sup>26</sup> Among brown bears, there are two types of matrilineal structures: a matrilineal assemblage where females of the same matriline use one area exclusively; and a dispersed type where members of a matriline spread out.<sup>26</sup> Matrilineal clusters indicate that multiple generations of female relatives interact over their lifetime,

although no there has been no research to identify any positive effects of inclusive fitness. High rates of female offtake are associated with disrupted social structure and decreased matriline formation.<sup>23</sup> The potential negative effects of this may not be fully understood without studies on the benefits of matrilineal social structure.

## HABITAT AND ECOLOGY

Brown bears are omnivores and preferred foods include berries, fruits, hard mast, insects, and ungulates.<sup>1</sup> Hard mast (hazelnuts, beechnuts, acorns and coniferous tree seeds) and insects are particularly important for Eurasian brown bears.<sup>27</sup> They obtain most of their energetic requirements from plants, especially berries, which means they must dedicate a large portions of their day to foraging.<sup>28</sup> Bilberries play a critical role for brown bears in Sweden to gain enough fat stores before hibernating.<sup>29</sup> Bilberry abundance is closely related to female condition and reproductive success.<sup>29</sup> On average, ungulates make up only 10.5% of European brown bears' diet (including Russian populations).<sup>30</sup> There is a latitudinal gradient where southern European brown bear populations rarely prey on vertebrates, such as ungulates.<sup>30,27</sup> In addition, there is large seasonal variation in ungulate consumption with European brown bears consuming more ungulates in the spring than other times of year.<sup>30</sup> Research from Sweden indicates that although brown bears are omnivores and prey on a variety of items, they may also be dependent on a single food source.<sup>29</sup>

From mid-July to October, bears are in a period of hyperphagia where they eat more food to prepare enough food stores to last through hibernation. Because bears fast during hibernation, the importance of obtaining enough food to sustain themselves throughout the winter cannot be understated, especially for females. Female bears give birth during hibernation, which makes them incredibly unique in that they are giving birth while fasting. This also means that they must sustain themselves and their newborn cubs on fat stores they acquired prior to hibernation.<sup>31</sup> Lactation is the most energetically costly time for mammals, including bears, and obtaining enough resources to last through hibernation is critical for the survival of mothers and cubs.<sup>29,31,32</sup> Bears hibernate from late October to early spring, after which they leave the den and commence the mating season.

Home range size is dependent on sex, reproductive status, food abundance, and population density. Males have the largest home ranges, followed by lone females and females with yearlings, and then females with cubs who have the smallest home ranges.<sup>25</sup> Home range size is negatively correlated with food abundance and population density.<sup>25</sup> This indicates that home ranges are larger where food abundance and population density are low.<sup>25</sup> Scientists suggest that the inverse relationship between home range size and population density may result in overestimates in population size where bears live in low densities.<sup>25</sup>

## DIRECT ANTHROPOGENIC THREATS

The latest IUCN assessment highlights that bears are vulnerable to human mortality due to their low reproductive rate. They also require large habitat, which makes them vulnerable to changes in land use. In Eastern Europe, land has been managed with no knowledge of wildlife management. Due to intensive use (e.g., logging and forest clearance) of the most productive areas, the best bear habitat has already disappeared in Europe. Roads and infrastructure have led to habitat fragmentation and increased mortality. Poaching is a threat to many, but not all populations.

According to the 2021 Large Carnivore Initiative for Europe, the four threats to brown bears are: (1) some populations are small and isolated, (2) hunting quota sustainability, (3) human-bear conflict, and (4) roads and infrastructure which fragment habitat and increase mortality.<sup>33</sup> Most of these threats are ongoing and expected to increase in the future. Brown bears are also threatened by unsustainable exploitation, both legal and illegal. Estimating levels of sustainable exploitation is challenging due to difficulties of determining accurate population estimates, mortality rates, and reproductive output.<sup>2</sup> Europe has a centuries-long history of overexploiting brown bears, which has resulted in their extirpation from many countries. Brown bears have long been persecuted and were nearly eradicated from Norway and Sweden in the 1900s.<sup>34</sup> Brown bears in Europe have a longer history of persecution time than those in North America or Asia.<sup>11</sup>

Despite fear surrounding bears, the risk of being injured or killed by a brown bear is extraordinarily low.<sup>35,36</sup> In fact, bears are not aggressive towards hu-

mans and typically flee in order to avoid approaching humans.<sup>37,38,36</sup> There were only two fatalities in 39 years in Scandinavia.<sup>35</sup> The risk of injury is higher for hunters than non-hunters, although still extremely low.<sup>35,36</sup> Rare bear attacks in Scandinavia are defensive in nature.<sup>35</sup> In the majority of cases where brown bear attacks occurred, the bear had been shot by a hunter or harassed by hunting dogs.<sup>35</sup> Researchers consider the only truly dangerous situation is when a brown bear has been wounded.<sup>36</sup> Indeed, a study in Scandinavia analyzing data from 1977 to 2016 found that in 73% of incidents with brown bears and hunters, the hunter shot at the bear prior to the attack.<sup>35</sup> The majority of causalities for hunters occurred during bears' denning period and could be avoided by better hunter education and awareness.<sup>35</sup> Therefore, hunting can exacerbate human-bear conflict and contribute to additional fear of brown bears, both of which result in lower public acceptance of bears.

Humans also compete with bears for space and resources.<sup>39</sup> Suitable habitat for brown bears is shrinking due to human disturbance.<sup>39</sup> Bears avoid habitats disturbed by humans, especially human settlements and paved roads.<sup>39,40</sup> Importantly, cumulative use of landscape by humans drives habitat selection by bears.<sup>39</sup> Scientists have expressed concern that human disturbance limits range expansion and threatens viability of future populations (i.e., Alpine-Dinaric).<sup>39</sup> Bears can also become habituated to human presence which can make them more vulnerable to legal and illegal hunting.<sup>41</sup>

Supplemental feeding occurs across Europe in Bosnia and Herzegovina, Croatia, Finland, Romania, Serbia, Slovakia and Slovenia for the purposes of diverting bears from human settlements, reduc-

ing livestock predations, or as bait to attract bears to hunting grounds.<sup>42</sup> However, these efforts are misguided and feeding bears may actually increase human-bear conflict. Supplemental feeding with carrion does not reduce livestock predations.<sup>42</sup> Supplemental feeding may also be responsible for shortened denning time in Slovenia, given potential reliance after 100 years of supplemental feeding.<sup>43</sup> Although given the option, bears prefer natural foods over supplemental feeding.<sup>43</sup> In Slovenia, most bear hunting occurs at supplemental feeding sites.<sup>44</sup> In Croatia, the primary threat to bear conservation is conflict with humans which is mainly caused by habituation to anthropogenic food.<sup>45</sup>

Brown bear hunting occurs for various reasons and at different intensities across Europe. Bears may be killed as trophies, for population management, or to remove bears that have been involved in human or livestock conflict. Brown bear trophy hunts are offered in Estonia, Croatia, Romania, Slovenia, Sweden, Finland, Bosnia & Herzegovina, and Bulgaria. There are several populations where bears are hunted, trophy hunters are advertised online, and brown bear trophies are exported (Table 2). Brown bears are listed on Annex II (except Estonia, Finland, Sweden) and Annex IV of the Habitats Directive in all European Union countries which requires "a strict protection" of the species. However, many countries use derogations under Article 16 of the EU Habitats Directive to allow hunting of bears.<sup>46</sup> According to the Key Actions for Large Carnivore populations in Europe (2015), some concerns regarding hunting include "inappropriate hunting practices" and perturbations of hunters on females with cubs on the Pyrenean population<sup>47</sup> which is Critically Endangered.<sup>1</sup>

**Table 2. European countries where bears are killed under derogations, trophy hunting is advertised online, and trophies are exported.**

Country	Population size in country <sup>1</sup>	Population <sup>1</sup>	IUCN status (2018) <sup>1</sup>	Hunting notes <sup>48,49,50,47,51</sup>
Estonia	700	Baltic	Least Concern	Quota hunting, mothers with cubs are protected
Croatia	937	Dinaric-Pindos	Vulnerable	Culling (regular hunting) to regulate the size of the population and intervention hunting of problematic bears. Mothers with cubs are protected.
Romania	5,850-6,300	Carpathian	Least Concern	Temporarily suspended
Slovenia	564	Dinaric-Pindos	Vulnerable	Annual culling quota to enable "successful coexistence"
Sweden	2,782	Scandinavian	Near Threatened	Quota hunting and protection hunting. Mothers with cubs are protected.

Wildlife managers typically focus only on the direct effects of hunting (i.e., total number of animals killed). However, the indirect effects of hunting on age and sex structure, social organization, behavior, and selection on the population have widespread and long-term negative impacts on the population. These changes have an additive effective on population growth in addition to the initial offtake.<sup>52</sup> Without scientific evidence that hunting is not inducing these population changes, it is impossible to deem any level of hunting pressure ‘biologically sustainable.’

Brown bears are especially vulnerable to hunting pressure due to social and reproductive factors, such as infanticide, reproductive suppression, slow population growth, and long periods of cub dependency. Due to these factors, human-caused mortality in brown bears has a “super-additive” effect in which the offtake of one individual has additional indirect negative impacts on the rest of the population. Hunting pressure has direct and indirect negative effects that lead to population declines, such as lower fecundity and decreased population growth rates.<sup>14</sup> In addition, decisions about hunting offtake levels for brown bears are often based on population growth rates that are biologically unrealistic.<sup>53</sup>

Despite the existence of long-established hunting regimes, intense hunting pressure has resulted in brown bear population declines in Northern Europe.<sup>3</sup> Legal and regulated hunting alters natural life history patterns and age-specific mortality in bears.<sup>21,13</sup> Hunting was the leading cause of death for adult male and female bears (>3 years old) in Sweden from 1985 to 2014.<sup>21</sup> During this period, 74% of tracked adult male bears and 72% of adult females were killed by hunters.<sup>21</sup> Hunting accounted for 68% of human-caused deaths in Croatian brown bears and 65% in Slovenian bears.<sup>46</sup> Natural life history traits in large mammals include low mortality rates in adulthood.<sup>54</sup> However high mortality risk from hunting alters natural life history patterns and demography.<sup>21,13</sup> High rates of offtake are associated with lower adult survival for both sexes, decreased female dispersal, decreased fine scale genetic structure, and disrupted social structure.<sup>23</sup> High rates of offtake have contributed to major population declines in Scandinavian brown bears and extirpation from prime bear habitats.<sup>34</sup> Therefore, even hunting that is deemed sustainable by managers alters demographic patterns and vital rates which may cause long-term evolutionary change.<sup>21,13</sup>

## DIRECT ANTHROPOGENIC THREATS

Hunting intensity has a long-term additive effect on spatial organization by altering home range overlap after a bear is killed.<sup>24</sup> Hunting male brown bears destabilizes spatial organization of the population<sup>24</sup> for at least two years<sup>55</sup> and increases the probability of sexually selected infanticide.<sup>19,17</sup> In the second year after a neighbor is killed by a hunter, neighboring bears will begin to use the deceased bear’s former home range.<sup>55</sup> This lag in spatial reorganization is due to seasonal denning behavior.<sup>55</sup> This is the mechanism behind sexually selected infanticide.<sup>55</sup> Male removal decreases cub survival during the mating season.<sup>17</sup> Therefore, even low hunting pressure can prevent population growth through low cub survival. The degree of spatial reorganization increases with greater hunting intensity and decreases with population density.<sup>55</sup> Therefore, greater population density can help weaken reorganization and likely prevent higher rates of infanticide.

Unlike many large carnivore hunting regimes, female bears are also killed by hunters in Sweden, Croatia, and Slovenia.<sup>23,46,56,52,44</sup> Legal offtake was the cause of 71% of all adult female mortality in Sweden between 1990 and 2011.<sup>23</sup> Similarly, hunting was the primary cause of death for all females in Sweden from 1993 to 2015.<sup>13</sup> Although because females with dependent cubs are protected, the odds of dying from hunting were nearly four times higher for solitary females than adult females with dependent cubs.<sup>13</sup> From 1981 to 2015 in Sweden, males and females were hunted at nearly equal rates.<sup>56,52</sup> In the same population, the four oldest bears killed were females between 1981 and 2004. Hunting is slightly more male-biased in Slovenia and significantly more male-biased in Croatia.<sup>46</sup> Although since 2012, Croatia has implemented quotas to *increase* the number of females hunted.<sup>46</sup> Hunting female bears can have drastic effects on future populations given that adult female survival is the most important predictor of population growth.<sup>14</sup> Although females with dependent cubs present are protected by law in Sweden, it can be difficult to determine cub presence and these females are also killed by hunters. Indeed, research in Sweden has identified cases where hunters have killed mothers before observing her dependent offspring.<sup>13</sup> Anecdotal evidence suggests that cubs and females with dependent young may be more susceptible to being killed by hunters using dogs.<sup>56</sup> This may be because females with young move slower,

females may be more likely to turn and protect their cubs, or females become separated from their cubs so hunters think females are alone. In addition to hunting females, the highest proportion of brown bears hunted in Croatia and Slovenia were 3 years old or less in Slovenia and 4 years or less in Croatia for 2005 to 2010.<sup>46</sup> It is legal to shoot cubs in Slovenia and the median age of hunted bears was 2.8 years from 1998 to 2008.<sup>44</sup>

Hunting also disrupts daily activity patterns and behavior during a critical time of year.<sup>57,58</sup> Hunting seasons coincide with the hyperphagia period which is when bears must eat more than usual in order to accumulate enough fat reserves in preparation for hibernation. During this period, bears become more active during the day in order to increase foraging opportunities.<sup>57</sup> However, the onset of hunting season not only stops this behavior but even reverses it, with bears reducing activity during the day.<sup>57,58</sup> Further, they became more active at night, losing their nocturnal resting period and reducing daylight foraging hours which are essential for berry foraging.<sup>58</sup> The change in daily activity is especially strong in solitary males and females, the targets of legal hunters.<sup>58</sup> This is concerning because these behavioral responses to hunters may prevent bears from accumulating enough fat stores for hibernation. If bears do not accumulate enough fat stores, they may not survive hibernation or produce cubs. Brown bears in Europe already exhibit shorter activity hours during hyperphagia than those in the United States, likely due to greater persecution in Europe.<sup>58</sup> Therefore, trophy hunting has widespread negative effects on the population, beyond those bears killed by hunters.

Management decisions related to hunting, including quotas, are often made based on poor, incomplete, or unrealistic population data.<sup>53</sup> There is also evidence that the general public greatly overestimates brown bear population sizes.<sup>34</sup> As a result, hunting quotas are unsustainable. Scientists have requested that the Romanian government invest in data and adopt a science-based policy in place of lethal management strategies that have been based on insufficient evidence.<sup>59</sup> In Norway, overestimated population estimates encouraged management authorities to remove an unsustainable number of bears which prevented sufficient population increases.<sup>34</sup> A study in Romania found that brown bear population abundance was overestimated and estimated growth rates were “biologically unrealistic” from 2005 to 2012.<sup>53</sup> Given that counties with overestimated population esti-

mates also had high hunting levels, there is concern that economic incentives from hunting brown bears may be driving the management decisions.<sup>53</sup>

## MANAGEMENT IMPLICATIONS

Brown bears in the EU are supposed to be strictly protected by the Bern Convention and the EU Habitats Directive. However, many countries use exemptions to bypass these protections and allow bear hunting for multiple of reasons. The legality of hunting brown bears in Europe has been questioned and challenged.<sup>5,6,7,8</sup> Further, several countries still use ‘quota hunting’ as a way of population control. Yet, they clearly state that are managing bear populations below biological carrying capacity in order to encourage greater social acceptance.<sup>48</sup>

Despite restrictions from the EU Habitats Directive, bears are still killed and kept as trophies. According to Croatia’s 2019 Brown Bear Management Plan trophies may be kept and exported from intervention killings of bears.<sup>49</sup> Even though Romania banned trophy hunting of bears in 2016, hunting websites continue to advertise and encourage trophy hunting. For example, LiveOutdoors encourages foreigners to break the law by saying “[t]rophy hunting in Romania has recently been banned, but hitch your wagon to a local that maintains rights to the quotas and enjoy the hunt of a lifetime.”<sup>59</sup> In addition, according to the CITES Trade Database, brown bear trophies are still exported from Romania. In 2021, scientists raised concerns about the allowance of trophy hunting under a nuisance animal permit in Romania.<sup>61</sup> They urged the Romanian government to make sure that large carnivore management is transparent and based on the best available science.

Brown bear populations span multiple countries and bears do not know country boundaries. Therefore, countries must work together to create transboundary management plans.<sup>46</sup> However, neighboring countries often have conflicting management plans. For example, Estonia and Latvia share the Baltic population and Estonia allows bear hunting whereas Latvia does not. As a result, Estonia must incorporate a 50km buffer zone around the regions bordering Latvia.<sup>51</sup>

Indeed, there are clear management failures. Norway and Sweden share the Scandinavian population, while Norway and Finland share the Finnish-Karelian population. In 2011, Norway set a national population target of 13 annual litters in the country which

has never been reached.<sup>62</sup> In 2019, there were only 7 bear litters across all of Norway.<sup>63</sup> They say that population growth has been slow in Norway which “has a strong connection with how the bear is managed in Sweden.”<sup>62</sup> The Norwegian Environment Agency points to conflict at the Swedish border due to Sweden’s goal of reducing brown bear populations.<sup>62</sup> In fact, Norway only licensed 3 bears to be hunted the fall of 2020 due to decreased livestock losses, a population below target, and taking into consideration neighboring Sweden’s large hunting allowance (291) that year.<sup>64</sup> Adaptive management in Sweden has been unsuccessful and most population objectives have not been met.<sup>3</sup> Management decisions regarding hunting quotas and restrictions have often been based on requests from hunters and hunting organizations, rather than scientific recommendations.<sup>3</sup> In addition, scientists warn that a quota-limited system without individual bag limits gives hunters few incentives to restrain from shooting any legal bear that they encounter.<sup>20</sup>

One of the most important management decisions has been restricting the hunting of family groups (i.e., females with cubs present),<sup>21</sup> although this method is not fool-proof as females may be separated from their cubs. In addition, hunting solitary females promotes longer maternal care and greater intervals between cub births.<sup>13</sup> Hunting females is atypical among large carnivore management due to the long-term negative impacts on species survival. In addition, there are non-lethal solutions to human-bear conflict that are under-utilized, such as human behavior changes and barriers such as orchard fences.

In addition to population growth rates, managers must consider indirect effects that have additive and long-term effects on the population.<sup>52</sup> In brown bears, indirect effects of hunting that are often overlooked include changes to individual behavior,<sup>52,57,58</sup> spatial organization,<sup>24</sup> social structure,<sup>52</sup> life history patterns,<sup>13</sup> age and sex structure,<sup>52</sup> and human-induced selection.<sup>52</sup> Managers must consider these wide ranging social and demographic changes as a result of hunting when setting quotas. Scientists urge that it is important that wildlife managers consider the long-term effects of altered life history patterns, which may result in evolutionary change.<sup>21,13</sup>

## REFERENCES

1. Huber D. 2018. *Ursus arctos* (errata version published in 2019). *The IUCN Red List of Threatened Species 2018*: e.T41688A144339998.
2. McLellan B.N. et al. 2017. *Ursus arctos*. *The IUCN Red List of Threatened Species 2017*: e.T41688A121229971.
3. Swenson J.E. et al. (2017) Challenges of managing a European brown bear population; lessons from Sweden, 1943-2013. *Wildlife Biol.* 2017.
4. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora - consolidated version 01/01/2007
5. Epstein Y. et al. (2019) When is it legal to hunt strictly protected species in the European Union? *Conserv. Sci. Pract.* 1, e18.
6. Epstein Y. et al. (2019) EU Court: Science must justify future hunting. *Science.* 366, 961.
7. Linnell J.D.C. et al. (2017) When is it acceptable to kill a strictly protected carnivore? Exploring the legal constraints on wildlife management within Europe’s Bern Convention. *Nat. Conserv.* 21, 129–157.
8. Christiernsson A. (2019) Is the Swedish brown bear management in compliance with EU biodiversity law? *J. Eur. Environ. Plan. Law* 16, 237–261.
9. Swenson J.E. et al. (2007) Brown bear body mass and growth in northern and southern Europe. *Oecologia* 153, 37–47.
10. Steyaert S.M.J.G. et al. (2012) The mating system of the brown bear *Ursus arctos*. *Mamm. Rev.* 42, 12–34.
11. Zedrosser A. et al. (2011) Brown bear conservation and the ghost of persecution past. *Biol. Conserv.* 144, 2163–2170.
12. Dahle B. & Swenson J.E. (2003) Factors influencing length of maternal care in brown bears (*Ursus arctos*) and its effect on offspring. *Behav. Ecol. Sociobiol.* 54, 352–358.
13. Van de Walle J. et al. (2018) Hunting regulation favors slow life histories in a large carnivore. *Nat. Commun.* 9, 1–10.
14. Gosselin J. et al. (2015) The relative importance of direct and indirect effects of hunting mortality on the population dynamics of brown bears. *Proc. R. Soc. B Biol. Sci.* 282.
15. Swenson J.E. (2003) Implications of sexually selected infanticide for the hunting of large carnivores. In *Animal behavior and wildlife conservation* (Festa-Bianchet M. & Apollonio M., eds.), pp. 171–190. Island Press, Washington.
16. Swenson J.E. et al. (2001) Factors associated with loss of brown bear cubs in Sweden. *Ursus*, 69–80.
17. Gosselin J. et al. (2017) Hunting promotes sexual conflict in brown bears. *J. Anim. Ecol.* 86, 35–42.
18. Zedrosser A. et al. (2009) The effects of primiparity on reproductive performance in the brown bear.

- Oecologia* 160, 847–854.
19. Swenson J.E. *et al.* (1997) Infanticide caused by hunting of male bears. *Nature* 386, 450–451.
  20. Bischof R. *et al.* (2009) The magnitude and selectivity of natural and multiple anthropogenic mortality causes in hunted brown bears. *J. Anim. Ecol.* 78, 656–665.
  21. Bischof R. *et al.* (2018) Regulated hunting re-shapes the life history of brown bears. *Nat. Ecol. Evol.* 2, 116–123.
  22. Planella A. *et al.* (2019) Integrating critical periods for bear cub survival into temporal regulations of human activities. *Biol. Conserv.* 236, 489–495.
  23. Frank S.C. *et al.* (2020) Harvest is associated with the disruption of social and fine-scale genetic structure among matrilineal of a solitary large carnivore. *Evol. Appl.*, 1–13.
  24. Frank S.C. *et al.* (2018) Sociodemographic factors modulate the spatial response of brown bears to vacancies created by hunting. *J. Anim. Ecol.* 87, 247–258.
  25. Dahle B. & Swenson J.E. (2003) Home ranges in adult Scandinavian brown bears (*Ursus arctos*): effect of mass, sex, reproductive category, population density and habitat type. *J. Zool.* 260, 329–335.
  26. Støen O.G. *et al.* (2005) Kin-related spatial structure in brown bears *Ursus arctos*. *Behav. Ecol. Sociobiol.* 59, 191–197.
  27. Bojarska K. & Selva N. (2012) Spatial patterns in brown bear *Ursus arctos* diet: The role of geographical and environmental factors. *Mamm. Rev.* 42, 120–143.
  28. Naves J. *et al.* (2006) Brown bear food habits at the border of its range: A long-term study. *J. Mammal.* 87, 899–908.
  29. Hertel A.G. *et al.* (2018) Berry production drives bottom-up effects on body mass and reproductive success in an omnivore. *Oikos* 127, 197–207.
  30. Niedziałkowska M. *et al.* (2019) A meta-analysis of ungulate predation and prey selection by the brown bear *Ursus arctos* in Eurasia. *Mammal Res.* 64, 1–9.
  31. Friebe A. *et al.* (2001) Denning chronology of female brown bears in central Sweden. *Int. Assoc. Bear Res. Manag.* 12, 37–45.
  32. López-Alfaro C. *et al.* (2013) Energetics of hibernation and reproductive trade-offs in brown bears. *Ecol. Modell.* 270, 1–10.
  33. Large Carnivore Initiative for Europe: Brown bear - *Ursus arctos*. (2021). Available at: <https://www.lcie.org/Large-carnivores/Brown-bear>.
  34. Swenson J.E. *et al.* (1995) The near extinction and recovery of brown bears in Scandinavia in relation to the bear management policies of Norway and Sweden. *Wildlife Biol.* 1, 11–25.
  35. Støen O.G. *et al.* (2018) Brown bear (*Ursus arctos*) attacks resulting in human casualties in Scandinavia 1977–2016; management implications and recommendations. *PLoS One* 13, 1–14.
  36. Swenson J. *et al.* (1999) Interactions between brown bears and humans in Scandinavia. *Biosph. Conserv. nature, wildlife, humans* 2, 1–9.
  37. Moen G.K. *et al.* (2012) Behaviour of solitary adult Scandinavian brown bears (*Ursus arctos*) when approached by humans on foot. *PLoS One* 7.
  38. Sahlén V. *et al.* (2015) Behavioural differences between single scandinavian brown bears (*Ursus arctos*) and females with dependent young when experimentally approached by humans. *PLoS One* 10, 1–16.
  39. Corradini A. *et al.* (2020) Effects of cumulated outdoor activity on wildlife habitat use. *Biol. Conserv.*, 108818.
  40. Oberosler V. *et al.* (2017) The influence of human disturbance on occupancy and activity patterns of mammals in the Italian Alps from systematic camera trapping. *Mamm. Biol.* 87, 50–61.
  41. McLellan B.N. & Shackleton D.M. (1989) Immediate reactions of grizzly bears to human activities. *Wildl. Soc. Bull.* 17, 269–274.
  42. Kavčič I. *et al.* (2013) Supplemental feeding with carrion is not reducing brown bear depredations on sheep in Slovenia. *Ursus* 24, 111–119.
  43. Kavčič I. *et al.* (2015) Fast food bears: brown bear diet in a human-dominated landscape with intensive supplemental feeding. *Wildlife Biol.* 21, 1–8.
  44. Krofel M. *et al.* (2012) Demography and mortality patterns of removed brown bears in a heavily exploited population. *Ursus* 23, 91–103.
  45. Skrbinšek T. *et al.* (2019) 2019 Annual Population Status Report for Brown Bears in South-Eastern Alps.
  46. Reljic S. *et al.* (2018) Challenges for transboundary management of a European brown bear population. *Glob. Ecol. Conserv.* 16, e00488.
  47. Boitani L. *et al.* (2015) *Key actions for Large Carnivore populations in Europe*.
  48. International workshop on brown bears management across the Alps, the Dinaric Mountains and beyond (2017)
  49. Huber Đ. *et al.* (2019) *Plan gospodarenja smeđim medvjedom (Ursus arctos L.) u Republici Hrvatskoj*.
  50. Action Plan for the Conservation of the Brown Bear Population in Romania (2018)
  51. Looduskaitse arengukava aastani 2020 [Nature protection development plan until the year 2020]. (2012).
  52. Frank S.C. *et al.* (2017) Indirect effects of bear hunting: a review from Scandinavia. *Ursus* 28, 150–164.
  53. Popescu V.D. *et al.* (2016) Assessing biological real-

- ism of wildlife population estimates in data-poor systems. *J. Appl. Ecol.* 53, 1248–1259.
54. Promislow D.E.L. & Harvey P.H. (1990) Living fast and dying young: A comparative analysis of life-history variation among mammals. *J. Zool.* 220, 417–437.
  55. Leclerc M. et al. (2017) Hunting promotes spatial reorganization and sexually selected infanticide. *Sci. Rep.* 7, 1–6.
  56. Bischof R. et al. (2008) Hunting patterns, ban on baiting, and harvest demographics of brown bears in Sweden. *J. Wildl. Manage.* 72, 79–88.
  57. Leclerc M. et al. (2019) Hunters select for behavioral traits in a large carnivore. *Sci. Rep.* 9, 1–8.
  58. Ordiz A. et al. (2012) Do bears know they are being hunted? *Biol. Conserv.* 152, 21–28.
  59. Popescu V. et al. (2019) Romanian carnivores at a crossroads. *Science* 364, 1041.
  60. 5 Best Bear Hunting Destinations in the World *Live-Outdoors*.
  61. Popescu V.D. et al. (2021) Trophy hunting undermines public trust. *Science* 372, 1049–1049.
  62. The Norwegian Environment Agency: Bear Management. Available at: <https://www.miljodirektoratet.no/ansvarsomrader/arter-naturtyper/vilt/rovvilt/bjorn/>.
  63. Miljostatus. Bjørn in Norway. (2021). Available at: <https://miljostatus.miljodirektoratet.no/tema/arter/rovdyr-og-rovfugler/bjorn/>. (Accessed: 5th March 2021)
  64. The Norwegian Environment Agency: Limited license felling of bears this autumn. Published 20.08.2020. Available at: <https://www.miljodirektoratet.no/aktuelt/nyheter/2020/august-2020/begrenset-lisensfelling-av-bjorn-i-host/>.