First described cases of cannibalism in the brown bear (*Ursus arctos* Linnaeus, 1758) in Bulgaria

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Abstract:
Intraspecific predation or cannibalism in brown bears (*Ursus arctos*) is becoming increasingly reported in the literature. Cases of infanticidal behaviour and killing of juvenile individuals by adult males are most common, while adult-on-adult predation is rare. We report three cases of intraspecific predation or cannibalism in Bulgaria, spanning a period from 2000 to 2021. The first case (2000) involved the likely killing and partial consumption of an adult female by an adult male individual at a supplementary feeding site for game. The second (2020) was a case of infanticide where a male was directly observed consuming the carcass of a cub of the year (COY). The third (2021) was confirmed through the identification of juvenile bear body parts (claw, fur) in an adult bear's excrement. These observations contribute to the understanding of intraspecific aggression in brown bears and highlight the importance of monitoring such behaviours in relation to food availability, population density and other environmental and behavioural variables.

Keywords: Bulgaria, brown bear, cannibalism.

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Intraspecific predation or cannibalism in Brown Bears (*Ursus arctos*) is becoming increasingly reported in the literature. Cases of infanticidal behaviour and killing of juvenile individuals by adult males are most common, while adult-on-adult predation is rare. We report three cases of intraspecific predation or cannibalism in Bulgaria, spanning a period from 2000 to 2021. The first case (2000) involved the likely killing and partial consumption of an adult female by an adult male individual at a supplementary feeding site for game. The second (2020) was a case of infanticide where a male was directly observed consuming the carcass of a cub of the year (COY). The third (2021) was confirmed through the identification of juvenile bear body parts (claw, fur) in an adult bear's excrement. These observations contribute to the understanding of intraspecific aggression in brown bears and highlight the importance of monitoring such behaviours in relation to food availability, population density and other environmental and behavioural variables.

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Introduction

Cannibalism, defined as the killing and/or consumption of a conspecific individual, occurs across a wide range of taxa and is shaped by a complex interplay of ecological, nutritional, and reproductive factors. While beneficial in terms of caloric intake, consumption of conspecifics carries the risk of parasite transmission, which is believed to be the reason that carnivores generally avoid cannibalism or consumption of other carnivore species (Moleón et al., 2017). Consequently, documented cases of intraspecific predation or cannibalism in bears are rare. However, as opportunistic omnivores with a wide range of feeding habits including scavenging (Bojarska & Selva, 2012; Narita et al., 2006), bears occasionally engage in this behaviour, either through scavenging of already dead conspecifics or following active intraspecific predation.

Cannibalism is most common in polar bears (*Ursus maritimus* Phipps, 1774) (n=107), while recorded cases in brown bears (*Ursus arctos* Linnaeus, 1758) appear less common (n=44) (Allen et al., 2022). Across all documented bear cases, cannibalism involves victims of varying ages, from cubs of the year to adults, with cubs being most frequently reported (Allen et al., 2022). Available evidence suggests that cannibalism in bears may represent largely opportunistic behaviour rather than a dedicated evolved strategy (Allen et al., 2022). In Europe, reports are primarily concentrated in Scandinavian populations and in Greece (Karamanlidis et al., 2015; Bischof et al., 2009; Swenson et al., 2001), though isolated cases have been documented elsewhere in the species' range (Hessing & Aumiller, 1994; Mattson et al., 1992).

Intraspecific predation in brown bears is a complex behaviour, typically studied in the context of reproductive strategies or ecological conditions, and debated as to whether it represents a foraging tactic or a life history trait. Several factors have been proposed to explain this behavior. Sexually selected infanticide (SSI) is considered a primary driver in social mammals, where males kill unrelated offspring to accelerate the female's return to estrus (Lukas & Huchard, 2014; Wolff & Macdonald, 2004), a pattern that has coevolved with a range of female counterstrategies (Palombit, 2015). This behaviour has also been observed in bears and is

mostly associated with adult males (Ito et al., 2022; Zedrosser et al., 2009; Bellemain et al., 2006; Swenson et al., 2001, 1997). Cannibalism may also be driven by nutritional stress during periods of food scarcity (Shimozuru et al., 2017) or density-dependent population regulation (Dyck & Daley, 2002).

Documenting intraspecific predation and distinguishing between these possible motivations is challenging. Field observations are rare and fragmentary, while identifying the perpetrator and their relationship to the victim individual is difficult (Bellemain et al., 2005). Furthermore, many infanticide studies do not specify whether victims are consumed after being killed, which may lead to an underestimation of actual cannibalism incidence. Here we report three independently and incidentally documented cases of cannibalism in brown bears in Bulgaria and discuss their possible motivations considering the proposed explanatory frameworks.

Results

In the present study, three observations of bear cannibalism and/or intraspecific predation are reported, which were made opportunistically during field work related to another research. The study sites include two mountain ranges in Bulgaria — the Central Balkan region of Stara Planina (cases 1 and 2), and the Western Rhodope mountains (case 3), near the town of Devin — the two areas with highest brown bear population density in Bulgaria (Executive Environmental Agency, 2021; Kaczensky et al., 2013), predisposing to a higher frequency of individual interactions. Stara Planina is characterized by a large national park, surrounded by a network of Natura 2000 areas as well as hunting and forestry enterprises, with predominantly old-growth beech (*Fagus sylvatica*) forests. The Western Rhodope mountains are characterized by mixed forest and a high density of small villages.

On 11 October 2000, a carcass of an adult female bear was found by a forest worker at a supplementary feeding site within Mazalat hunting enterprise (N42.74° E25.15°), estimated to have been killed shortly before discovery. The likely perpetrator was a large male, as evidenced by the tracks found around the animal's carcass (length of hind paw >24 cm, excluding claws). A part of the left thigh of the female was consumed (Fig. 1). The post-mortem inspection report carried out by inspectors of the Executive Environmental Agency indicated the presence of pre-mortem injuries (hemorrhages and teeth marks on multiple locations) as well as signs of struggle around the carcass, leading to the conclusion that death most likely occurred as a result of an attack by another bear. Additional photographic documentation of the carcass further supports the presence of pre-mortem bite wounds (Figs. 2, 3). Supplementary feeding sites are often monitored as they are commonly used for year-round feeding of game species and are opportunistically exploited by bears as a valuable food source.

On 29 June 2020, a male was directly observed feeding from the carcass of a cub of the year (COY) near the town of Gabrovo (N42.79° E25.32°) in Stara Planina. The cub was estimated to be approximately 4–5 months old and weighing around 10 kg, consistent with a COY born earlier that year. The cub was freshly killed, as evidenced by the unspoiled state of its remains (Fig. 4), ruling out the possibility that the male was scavenging a cub that had died earlier. With the case occurring during the mating season, it can potentially be attributed to sexually selected infanticide.

On 14 September 2021, near the town of Devin (41.56°N, 24.48°E) in the Rhodope Mountains, a large bear scat was collected by a worker of the hunting enterprise, containing the claw of a young bear (Fig. 5). It also included bear fur and a part of a bear jaw, potentially from the same individual. The absence of other food items in the scat suggests that the consumption of the cub was the primary feeding event for that period. However, in this case there is no evidence

to determine whether the cub was killed and cannibalised or consumed after being found dead from another cause. As the scat was already old when found, no adequate attempt at the approximate timing of the cannibalism event can be made.

Discussion

The cases reported here add to the growing body of evidence indicating that cannibalism, while not common, occurs in brown bear populations. The observation of a male killing an adult female (case 1) is of particular interest, as it presents a rare case of adult-on-adult cannibalism, similar to cases documented in Alaskan brown bear populations (Hessing & Aumiller, 1994) and in Yellowstone grizzlies (Mattson et al., 1992). This case can potentially be attributed to factors such as nutritional stress, social dominance, or territorial dispute over the highly valuable supplementary feeding site. The presence of supplementary feeding sites may play a role in facilitating intraspecific encounters and aggression, as they concentrate individuals in a limited area, potentially increasing competition over a predictable food resource. However, further research is needed to clarify the relationship between supplementary feeding practices and intraspecific aggression in bears.

The observed cases of potential infanticide (cases 2 and 3) are consistent with previous research identifying SSI as the primary form of cannibalism in the species (Swenson et al., 1997; Bellemain et al., 2006; Allen et al., 2022). Case 2, involving a male directly observed consuming a freshly killed COY during the mating season, aligns well with the SSI hypothesis. Case 3, documented indirectly through scat analysis, does not allow for a definitive determination of whether predation or scavenging preceded consumption, and should therefore be interpreted with caution.

The potential impact of cannibalism on population dynamics, especially in small and isolated populations, should not be overlooked. Infanticide can negatively affect population growth rates (Davoli et al., 2018; Gosselin et al., 2015; Wielgus et al., 1994).

More direct observational data are needed to understand the complex dynamics of intraspecific predation in brown bears. Future studies should clearly distinguish predation from cannibalism and report whether bear cubs are consumed (fully or partially) after infanticide, in order to avoid underestimation of actual cannibalism incidence.

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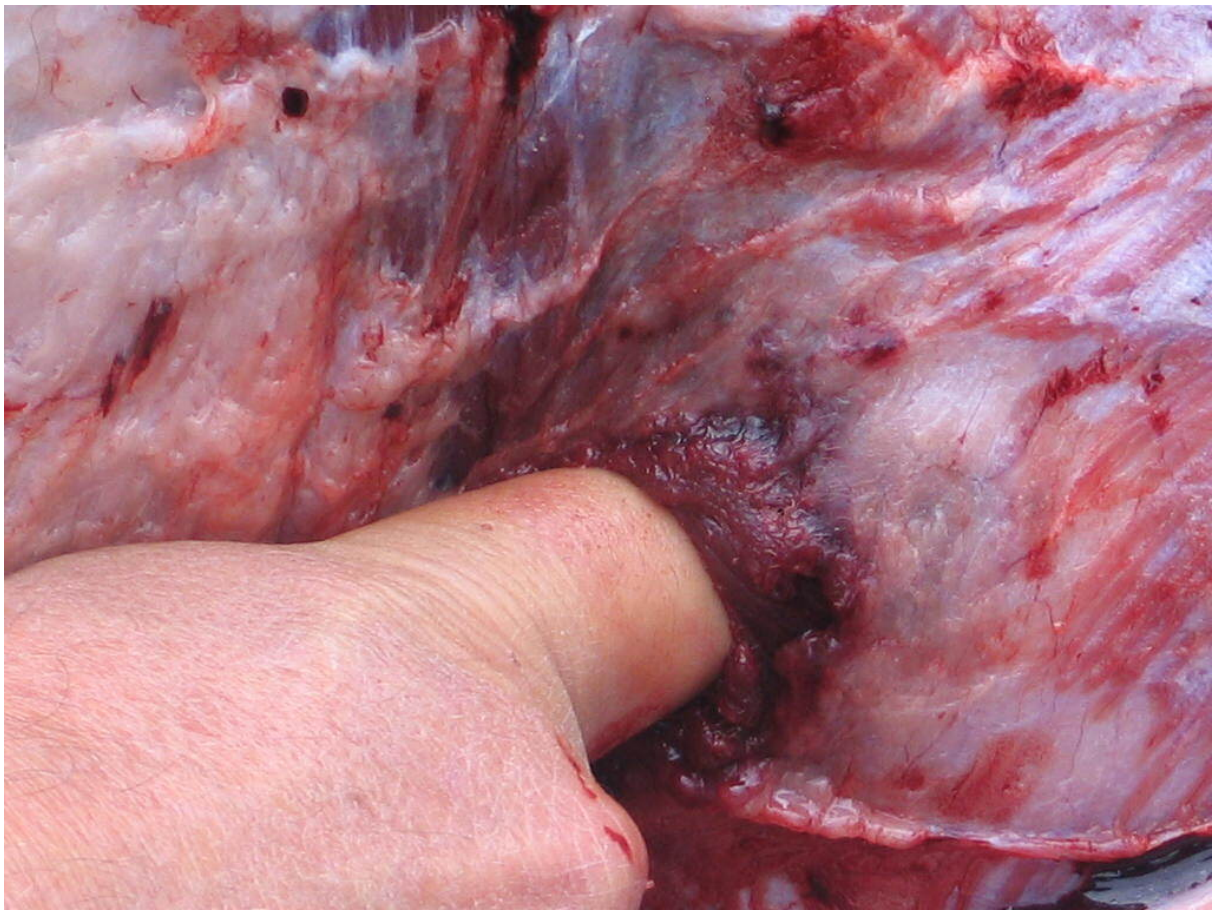

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