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**Photo Credit:** Subadult male brown bear fitted with GPS collar in northern Greece (credit: A. A. Karamanlidis).


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# Intraspecific predation on a subadult brown bear in Greece

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***Abstract:*** Intraspecific predation (cannibalism) in brown bears (*Ursus arctos*) is a behavior rarely documented, and it remains poorly understood. In April 2010 we documented the probable killing and partial consumption of a subadult female bear by a subadult male bear; both bears had been captured during a telemetry study in northern Greece. Intraspecific killing was supported by a match between the inter-canine distance of the male, fatal wounds on the female, and the absence of other bear tracks at the trap site; consumption of the subadult female by the subadult male was witnessed directly by the trapping team. This is the first reported case of probable intraspecific killing and predation of a subadult female by a subadult male brown bear. Though intraspecific predation appears to be a rare phenomenon, trapping teams should always strive to reduce the time an animal is captured in a trap, such as by using trap alarms.

***Key words:*** brown bear, cannibalism, Greece, management, trapping, *Ursus arctos*

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Intraspecific predation (i.e., cannibalism), the process of killing and eating an individual of the same species, is an important and widespread process (Fox 1975) documented in >1,300 species (Polis 1981), including large carnivores (e.g., mountain lions [*Puma concolor;* Galentine and Swift 2007] and wolverines [*Gulo gulo;* Persson et al. 2003]). In bears, intraspecific predation has been documented in American black bears (*Ursus americanus;* Garshelis 1994), polar bears (*U. maritimus;* Lunn and Stenhouse 1985, Derocher and Wiig 1999, Stone and Derocher 2007), and brown bears (*U. arctos*) in North America and the Russian Far East (Smirnov and Shurygin 1991, Mattson et al. 1992, Zhiryakov 1993, McLellan et al. 1999, Amstrup et al. 2006). In Europe, intraspecific predation has been reported only from brown bears in Scandinavia (Swenson et al. 2001, Bischof et al. 2009).

Intraspecific predation among bears generally is considered rare and is poorly understood (Mattson et al. 1992, Garshelis 1994, Swenson et al. 2001). This led Mattson et al. (1992) to encourage researchers to report cases to better understand this behavior and evaluate its potential effects on bear population dynamics. We describe here the first probable case of intraspecific killing and predation by a brown bear in Greece and try to answer 4 fundamental questions regarding this behavior (see Swenson et al. 2001).

Brown bears in Greece are classified as endangered (Mertzanis et al. 2009), but the population has increased substantially in recent years (A. A. Karamanlidis, unpublished data). This observation was part of a larger study evaluating the effects of a highway on a wild brown bear population in the Prefecture of Kastoria in northern Greece (40°26′34.0″N, 21°13′18.0″E; Karamanlidis 2011). The study was carried out in an area of high human activity (i.e., several human settlements and agricultural activities). Major land-cover types included sparse lowland oak (*Quercus* spp.) forests and agricultural fields. Aldrich leg-hold snares (Johnson and Pelton 1980) were used to catch bears so they could be fitted with Global Positioning System (GPS) satellite collars (GPS Plus, Vectronic Aerospace GmbH, Berlin, Germany). Traps were monitored using very high frequency alarms that were checked every 2 hours and snares were visually checked each morning.

On 28 April 2010 at 0200 hours, the trapping team found that 1 of 3 separate trap alarms at a trap site had been activated. The researchers encountered a bear moving freely around the trap site and feeding on an unidentified prey at 0220 hours, before being captured in a trap other than the one transmitting the original alarm. The bear was tranquilized with an

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initial intramuscular injection of 3 mL mixture of tiletamine and zolazepam (Zoletil 50; Virbac SA, Carros Cedex, France), using a $CO_2$ injection rifle (Model I.M.; DANiNJECT Aps, Børkop, Denmark) and a second injection by hand of 2 mL Zoletil 50. Based on researcher experience and tooth wear, this bear was identified as a subadult male (approx. 3 yr of age). The research team took standard body measurements, weighed the bear (80 kg), and attached a GPS collar programmed to take locations every hour. The bear was released at the capture site following recovery and was monitored until 6 October 2010 when the collar signal was abruptly lost. We speculate that the bear was killed by locals for causing damage to agricultural property; 13.7% of the telemetry locations of this bear were obtained $<$500 m from human settlements and the bear was occasionally seen by local residents.

The research team found a recently killed subadult female bear, approximately 20 m from the capture location of the subadult male, in the trap that emitted the initial active signal. The female had been fed upon in the groin area (Fig. 1A). The research team took standard measurements, weighed the carcass (approx. 60 kg), and estimated the female to be 2–3 years old. Based on body measurements and weight, both bears appeared to be typical-sized bears for this part of the species' distribution. The fatal wounds on the throat of the subadult female bear (Fig. 1B) were consistent with the inter-canine distance of the subadult male, and no tracks of other bears were found at the trap site.

Reconstructing the events surrounding the death of the subadult female, we concluded that she initially triggered the trap alarm between 0000 hours and 0200 hours. The female was subsequently attacked, killed, and fed upon by the subadult male between 0000 hours and 0220 hours, when the trapping team arrived on site. The subadult male was caught in the second trap while the trapping team was observing his movements at the trap site.

In Scandinavia, Swenson et al. (2001) documented 13 intraspecific predatory attacks and raised 4 fundamental questions in their attempt to understand the mechanisms behind intraspecific predation.

### *Are bears in certain age or sex categories particularly vulnerable to intraspecific predation?*

The limited information available indicates that, excluding cubs of the year and yearlings, young male bears are more vulnerable to intra-species predation (Mattson et al. 1992, Swenson et al. 2001). Although killings of subadult female American black bears have been reported (Garshelis 1994), this appears to be the first account of a subadult female brown bear dying from intraspecific predation.

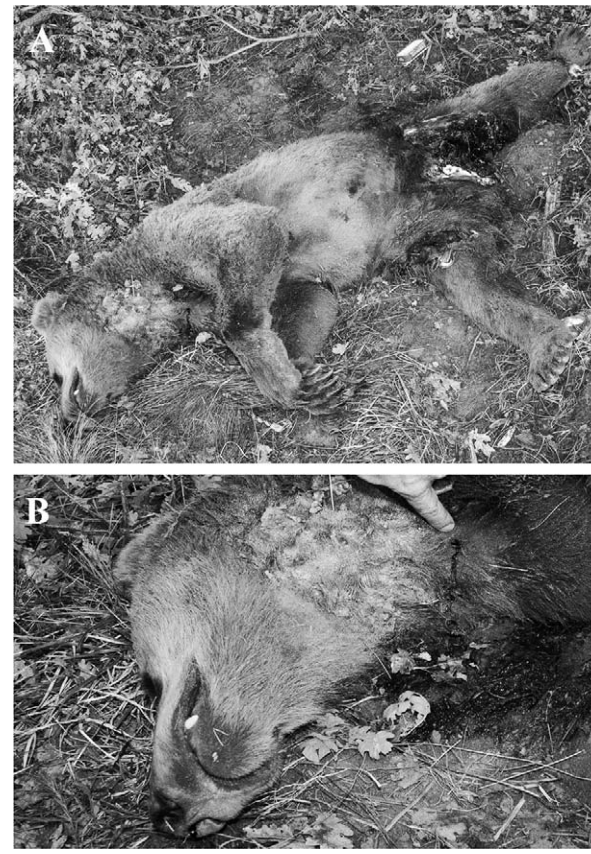


**Fig. 1. (A) Subadult female brown bear probably killed by a subadult male brown bear during a trapping session in northern Greece in 2010. The subadult male eventually fed on the subadult female, consuming parts of the groin area. (B) Close-up image of the head and neck region; the wounds to the carotid artery are visible.**

### *Who are the perpetrators?*

It has been suggested that adult males are predominantly the perpetrators of intraspecific predation (Garshelis 1994, McLellan 1994, Swenson et al. 2001), but conclusive evidence to support this is still lacking. In this study we provide strong evidence of a subadult male bear being the perpetrator.

### When does intraspecific mortality occur?

Intraspecific predation has been recorded throughout the year, but several researchers have associated this behavior with the breeding season (Mattson et al. 1992, Swenson et al. 2001). Although our observation occurred during the spring breeding season, both individuals involved were subadults and we cannot conclusively associate this observation with the breeding behavior of brown bears.

### What is the reason for intraspecific predation?

The reasons for intraspecific predation considered by Swenson et al. (2001) include (a) killing unrelated conspecifics of the same sex to remove future competitors to themselves and their own offspring for space, food, and mates; (b) increased bear density as an ecological trigger for increased intraspecific predation; and (c) killing conspecifics for food when other food is scarce. In the present observation the strongly aberrant behavior of the trapped female should be considered a fourth possible explanation for this intraspecific predation.

The first and second suggested reasons appear improbable because the bears were not of the same sex and the study area has one of the lower bear densities in Greece (A. A. Karamanlidis, unpublished data), thus leaving the strongly aberrant behavior of the subadult female and killing for predation as the only possible reasons. The evidence we obtained is not conclusive enough to decide which of the latter 2 explanations is most plausible.

Intraspecific killing for the purpose of predation is supported by the fact that, although natural foods are available in large quantities during spring, they are often nutritionally deficient foods (i.e., low in carbohydrates) that result in bears having difficulty maintaining their weights until late summer and autumn when higher quality foods become available (Swenson et al. 2007). In addition, 5 months of telemetry data showed that the male was frequently close to human settlements and on 2 occasions a collared bear caused damages to agricultural property, suggesting that the male may have also been using anthropogenic food resources to compensate for low-quality natural foods in the area.

Documentation of intraspecific predation in wild bears is rare (Mattson et al. 1992, Garshelis 1994, McLellan 1994, Swenson et al. 2001). We acknowledge that the present observation may not be directly related to what occurs in the wild, because the female bear in this case was restrained and unable to fully interact with the male. We also do not know if the intention of the male was to cannibalize the female bear, but he was observed feeding on the carcass.

An informal email enquiry in 2015 among bear researchers (Europe: $n = 8$; North America: $n = 13$; see Acknowledgments for detailed list of enquiry participants) indicated that intraspecific predation during trapping has been extremely rare, both in Europe (0.86% of 232 captures of brown bears have resulted in intraspecific predation in >25 yr of trapping) and North America (0.53% of 10,222 captures of black bears and 0.47% of 1,268 captures of brown bears have resulted in intraspecific predation in >25 yr of trapping). This notwithstanding, trapping teams should always strive to reduce the time during which an animal is restrained in a trap, such as by using trap alarms. Recent advances in technology provide opportunities to substantially reduce capture times of animals in leg-hold traps (Larkin et al. 2003, Ó Néill et al. 2007).

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