

A CASE OF AUTUMN MATING IN THE APENNINE BROWN BEAR (*URSUS ARCTOS MARSICANUS*)

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Received 21 January 2011; accepted 4 April 2011

ABSTRACT - Although the breeding season of brown bears generally occurs during early spring or summer, a few incidents of autumn mating have been recently documented in British Columbia and Japan. Considering the rarity, yet the relevance, of these events, we report a case of autumn courtship and mating in the Apennine brown bear observed as late as 3 November 2010 in the Abruzzo Lazio and Molise National Park, central Italy. Mating was preceded and followed by muzzle sniffing and play fighting, and involved an adult female associated with a cub. During the 20-min observation, the female did not display cub defence behaviour, nor the adult male acted aggressively toward the cub. We briefly discuss this observation on theoretical grounds, including the potential meaning of late breeding for this small bear population.

Key words: Apennine brown bear, late breeding, Italy, *Ursus arctos*

DOI: 10.4404/Hystrix-22.2-4563

Bears are considered to be obligate seasonal reproducers at temperate latitudes (Spady et al. 2007), breeding generally occurring during early spring or summer and ovulation peaking between April and July (Herrero and Hamer 1977; Hamer and Herrero 1990; Clevenger et al. 1992; Craighead et al. 1995; Palomero et al. 1997; Dahle and Swenson 2003; Stenhouse et al. 2005; Fernández-Gil et al. 2006; Spady et al. 2007). However, matings outside the usual breeding season are being increasingly reported, with observations made in September (Palomero et al. 1997; Stenhouse et al. 2005; Spady et al. 2007), or even later into autumn (Nevin and Gilbert 2005; Kohira and Mori 2010). Alt-

hough rare, these cases are relevant not only to improve our knowledge on bear breeding patterns at a local scale (e.g. Kohira and Mori 2010), but also because they may contribute to the debate concerning the adaptive value of social mating tactics (Emlen and Oring 1977; Ims 1990), the evolutionary meaning of infanticide (Wielgus et al. 2001; Miller et al. 2003; McLellan 2005; Nevin and Gilbert 2005; Bellemain et al. 2006a; 2006b; Fernández-Gil et al. 2010), and the possible effect of climate correlates on bear productivity (Spady et al. 2007; Bronson et al. 2009).

The study area (1300 km²) was located on the central Apennines and included the fully protected Abruzzo, Lazio and Molise

National Park (PNALM, 41° 48' 0" N, 13° 47' 0" E, 500 km²), and its external buffer zone (ca. 800 km²) where resource extraction and recreational activities such as hunting are allowed (Ciucci and Boitani 2008). Elevation ranges 986–2249 m asl, and the area is typically mountainous with rough topography, offering a variety of bear habitats, from sub-alpine meadows to low elevation grasslands. Deciduous forests (mostly *Quercus* spp. and *Fagus sylvatica*) cover about 56% of the study area. Once distributed along most of the central and southern Apennines, the endemic Apennine brown bear (*Ursus arctos marsicanus*) is now restricted to an area almost limited to the PNALM, where about 40 bears have been recently estimated to live at a density of about 33 bears/1000 km² (Ciucci and Boitani 2008; Gervasi et al. 2008). Since 2006, based on unduplicated counts of females with cubs (Knight et al. 1995), from 3 to 7 reproducing females have been estimated each year in the population (Tosoni 2010). Compiling occasional observations gathered from the Park wardens and from our study team in the last decade, courtship behaviour has been observed in the PNALM from the last week of April until the end of June, and most cases of actual mating were reported in May.

On 3 November 2010, at 6:15 am two experienced guardian officers (E.Tr., G.P), while patrolling high elevation mountain ridges, spotted some bears at a distance of about 1 km. Using a 20-60X scope (Swarovski STS-80-HD), they observed one adult bear intently walking toward a family unit, composed by an adult female and a cub of the year, as estimated by their relative size. The single bear, which later was identified as a male from his behaviour and relative size, was initially observed at about 200 m from the female and the cub. As later revealed by field investigation, the family unit was foraging on forbs and acorns, in a pasture interspersed with oak-tree patches. When the male approached the family

unit to as close as 50 m, the two bears paused foraging and stared in the direction of the approaching male. When this got closer than 10 m, the cub ran away toward the edge of the pasture and disappeared from sight into the oak forest. At that point, the female calmly moved toward the approaching male, whose size was obviously larger than that of the female. The two adult bears then engaged in muzzle sniffing and play fighting for about 5-6 min, then the female offered no resistance to mounting. The couple mated in a standing position for about 1 min, even though pelvic thrusts were not observable due to the frontal perspective toward the observers. Then, the male dismounted and remained still, looking at the female while walking away in the direction of the cub. The female moved out of sight in about 10 m. After 2 min, the female came back into sight approaching the male again, and the two engaged in a play interaction while slowly moving definitively into the forest in the same direction previously followed by the cub. Altogether, the observation lasted about 20 min (6:15 - 6:35 am).

To our knowledge, this is the latest case of fall courtship and mating reported for brown bears, previous cases having been observed from September to October (Nevin and Gilbert 2005; Kohira and Mori 2010). The length of our observation does not allow to definitively classify the observed mating event as a complete or aborted copulation (*sensu* Craighead et al. 1995), even though it is very likely that courtship behaviour and mating preceded and followed what the wardens were able to observe. Moreover, successful mating does not necessarily imply reproductive success (see Spady et al. 2007).

Late-season breeding could represent just a trait of the reproductive flexibility of female bears (Spady et al. 2007). In bears at temperate latitudes, follicular activity generally decreases markedly since July, but fall estrous have been documented in cap-

tivity, and year-round reproduction has been reported in tropical areas (Spady et al. 2007). Female bears are considered to be induced ovulators (Craighead et al. 1995; Boone et al. 2004), and they may delay breeding due to association with cubs (Craighead et al. 1995; Dahle and Swenson 2003) or social inhibition by older females (Ordiz et al. 2008). However, brown bear females may also experience estrous as soon as 24 hours after cub killing (Swenson and Haroldson 2008), and mixed aged litters have been rarely reported (LeCount 1983; Swenson and Haroldson 2008). In these cases, however, the youngest cubs died or disappeared during the first year of life, leading researchers to speculate that concomitant pregnancy and lactation (Farley and Robbins 1995) could negatively affect the nutritional condition of the reproducing females, the growth and survival of the cubs, and ultimately reproductive success.

Female bears may experience estrous up to 2-3 times per breeding season, and multiple, asynchronous periods of sexual receptivity are common traits in different Ursid species and populations (see Spady et al. 2007). With males free from parental duties, and solitary individuals living at low densities, receptivity asynchrony in female bears can be an adaptive strategy to accumulate mates and maximize reproduction (Ims 1990; Bellemain et al. 2006b). In addition, along with polygamy and large promiscuity in both sexes (Craighead et al. 1995; Kovach and Powell 2003; Zedrosser et al. 2007; Costello et al. 2008), asynchrony in females might also reduce the risk of infanticide by confusing paternity (Bellemain et al. 2006a; 2006b). Compared to females, male bears experience a prolonged sexual activity and, although testicular function diminishes after the end of the mating season, fertilization is still possible later in the year due to sperm accumulation (Spady et al. 2007). Due to embryonic dia-

pause, fall breeding is not in conflict with delayed implantation, even though late mating implies a shorter gestation and, possibly, smaller litter size (Tumanov 1998). It should be noted, however, that for all reported cases of late breeding in bears, actual reproduction was successively certified only for Giant Panda in captivity (Spady et al. 2007).

In southern Europe, seasonal breeding outliers have also been reported also in Spain, where at least two male-female interactions were observed starting as earlier as the first half of April, therefore involving earlier breeding (Fernández-Gil et al. 2006). Accordingly, one would be tempted to speculate that, especially at southern latitudes, climate change could be a factor potentially affecting the spread of seasonal breeding. However, this hypothesis does not seem to hold, as bear reproduction is mainly regulated by the photoperiod (Spady et al. 2007; Bronson et al. 2009). Nevertheless, also in obligate seasonal breeders annual climatic fluctuations at the local scale might depress productivity by altering the phenology and availability of critical resources (Spady et al. 2007; Bronson 2009).

Population density, resource distribution, and dispersion of mates can affect mating tactics in mammals (Emlen and Oring 1977; Ims 1990), bears being not an exception (Kovach and Powell 2003; Zedrosser et al. 2007; Costello et al. 2008; Kohira and Mori 2010). In any case, late or prolonged breeding might potentially increase the chances of reproduction of the less competitive segment of the population (e.g. younger males), and ultimately affect population dynamics in small bear populations. However, more evidence on the frequency of fall breeding, in our as well as in other bear populations, is needed to better understand if this phenomenon is actually becoming more frequent and its role in the reproductive physiology of brown bears (Steyaert et al. 2011).

ACKNOWLEDGEMENTS

We thank the Abruzzo Lazio and Molise National Park authority for logistical support. Mario Posillico and another anonymous reviewer provided valuable comments on an earlier version of this note.

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