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SHORT COMMUNICATION

First recorded case of tiger killing Eurasian lynx

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Abstract Interspecific interference competition including lethal interactions are notoriously difficult to document. While lethal interactions between Amur tigers, Amur leopards, and wolves have all been recorded, no records of such incidents between tigers and the Eurasian lynx exist. Following tiger tracks in Bastak Nature Reserve (Russia), we recorded the first documented case of a tiger stalking and killing a lynx.

Keywords Amur tiger · European lynx · Interference competition

Niche partitioning according to diet, space use, or activity patterns may reduce competition, but interspecific interference is nonetheless common among carnivorous mammals, with the probability of lethal interactions increasing with taxonomic relatedness and dietary overlap (Palomares and Caro 1999; Donadio and Buskirk 2006). However, opportunities to document competitive interactions between large carnivores are relatively rare.

The Amur tiger (*Panthera tigris altaica*) currently co-exists with three other large obligate carnivores: Amur leopards (*Panthera pardus orientalis*), Eurasian lynx (*Lynx lynx*), and gray wolves (*Canis lupus*). There exist multiple assessments of the relationship between tigers and leopards across their overlapping ranges (Seidensticker 1976; Karanth and Sunquist 1995; Harihar et al. 2011; Kalle et al. 2011; Ramesh et al. 2012; Steinmetz et al. 2013;, Lovari et al. 2015). In Russia, predation by tigers on leopards (three cases: Aramilev 2003; no author 2008) and wolves (three cases: Miquelle et al. 1996; Makovkin 1999) has been reported. Snow tracking has also revealed an unsuccessful predation attempt by a tiger on a leopard which escaped by climbing a tree (Pikunov and Korkishko 1992).

Records of direct competitive interactions between tigers and lynx are exceedingly rare, even though the two co-exist throughout nearly the entire range of Amur tigers in Russia. Microscopic analyses of hair from tiger feces revealed the presence of lynx remains in two of 235 scats (Tkachenko 2008; Mukhacheva et al. 2014). Yudakov and Nikolaev (2012) reported from snow-tracking evidence that a tiger drove a lynx away from a kill. Kaplanov (1948) observed (via tracks in the snow) how a tiger approached the remains of a lynx but did not eat it, and speculated that the tiger may have killed the lynx earlier. Goodrich and Kerley (pers comm) recorded a lynx that escaped from an attacking tiger by climbing a tree. But to date, there has been no conclusive record of a tiger killing a lynx. Here, we report on the first clear predation of an Amur tiger on a European lynx.

On March 4, 2014 in Bastak Nature Reserve (48°56′37 N 133°07′13 E), located in the Jewish Autonomous Region of the Russian Far East, we found the remains of a lynx surrounded by tiger tracks. The lynx carcass was in a mixed

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coniferous-deciduous forest with fir, Korean pine, and birch the dominant tree species. An understory of fir was thick in some places, but the hunt took place in a fairly open understory. Pad size of the tiger's front paw was 10.5 cm, suggesting that it was most likely a male (Kerley et al. 2005). The attack took place approximately 2–3 days before we discovered the carcass (based on estimated age of tracks). We were able to backtrack the tracks of the tiger approximately 345 m. From that point, the tiger was following tracks of the lynx downhill at a normal pace for at least 150 m. It was not clear whether the tiger was intentionally pursuing the lynx or simply following its footsteps as an easy trail through the snow (approximately 40 cm deep). When the tiger appeared to be approximately 50–70 m from the lynx, it stopped (front paws parallel to each other), walked at a normal gait for another 10 m, and then progressed in a stalking mode (short steps in the snow) for approximately 19 m, twice stopping over that distance, once hiding behind a tree, and a second time hiding behind a mound of snow. The tiger approached another 20–25 m and then began its final rush (bounding) without stopping or crouching. Tracks of the lynx indicated that at this point it began leaping downhill, angling slightly to its right side. The tiger chased the victim in the same direction but having initiated his attack from the right side was able to cut the angle and gain ground. The lynx reached a forest road that was almost perpendicular to its line of movement, and turned sharply to its right, apparently planning on running up the road to escape the tiger. Despite this maneuver, the tiger caught the lynx 5 m up the road, and in a jumble of snow, they slid/rolled together 4 m further where a blood spot suggested the tiger killed the lynx. The final rush by the tiger covered 97 m, which required 28 bounds. From the kill site alongside the road, the tiger dragged the lynx several meters under a small, brushy fir tree where, based on the amount of melting under the tiger, he spent at least 30 min near the prey before dragging the lynx back up the hill 51 m (31 m straight-line), with one stop where the tiger removed hair from the lynx carcass. The tiger ate only from the right back hip of the lynx (approximately 2–3 kg of meat and internal organs were missing). We estimated the tiger remained at the kill site approximately 1 day before moving off.

We collected the lynx carcass and kept the remains frozen at −20 °C until May 9, 2014, when we conducted a necropsy. The carcass showed little sign of decomposition. The animal's sex could not be determined with certainty as external genitalia were not present due to feeding of the tiger on the right pelvis and adjacent perineal region, but it was likely a male based on overall body size and the lack of evident internal genitalia. The animal was in good body condition, weighed 20 kg (excluding the estimated 2–3 kg of muscle and tissue which was missing) and showed extensive deposits of subcutaneous, abdominal, and cardiac fat. Teeth showed signs of extensive wear, fractures, and complete loss indicating advanced age.

A large number of punctures and lacerations were evident across the animal's body, some of which had clearly been inflicted post mortem due to the lack of associated hemorrhage. Other wounds showed signs of hemorrhage, but not of a scale that could have led to the animal's death. Concentrations of these injuries included three punctures and a 5-cm laceration on the right shoulder (accompanied by a fractured spinous process of the scapula inflicted post mortem) and a series of five punctures and subcutaneous hemorrhaging over the left lumbar region extending down onto the left flank. The most extensive hemorrhage was observed over the animal's neck with a large puncture on the right throat, lateral to the trachea, which penetrated the underlying muscle, but did not disrupt any major blood vessels. A larger puncture was observed on the dorsal aspect of the spine at the level of the junction between the axis and atlas. A roughly circular perforation (~12–15 mm diameter—presumably made by the tiger's canine) was observed through the dorsal arch of the atlas, extending into the cranial aspect of the axis. The cranial third of the dorsal spinal process of the axis was fractured and displaced. The underlying spinal cord was severely disrupted and nearly completely severed—and was likely the cause of death. Three ribs on the left and right sides had been fractured, but the lack of hemorrhage indicated that this had likely occurred post mortem. No abnormalities were evident on gross examination of the internal viscera.

Although Amur tigers, Amur leopards, and lynx co-exist over most of their overlapping ranges in Russian and China, it is not clear whether tigers depress numbers of these smaller cats, as has been suggested elsewhere (Harihar et al. 2011). While parameters influencing habitat use by both tigers and leopards in this region have been studied (Hebblewhite et al, 2011, 2012, 2014), the differences in spatial, temporal, and environmental parameters that separate the two have not been well defined. Similarly, there appears to be an inverse relationship between tigers and wolves (Gromov and Matyushkin 1974; Yudin 1992; Miquelle et al. 2005) with the mechanism for this relationship at least partially due to direct predation, e.g., a young tigress recently released into an area devoid of other tigers killed multiple wolves over its first year after release (Kastrikin, V., pers. comm.). Even less is known of the relationships between tigers and lynx. Preliminary data from a small telemetry project on lynx in the Russian Far East suggested that lynx densities were extremely low (lower, even, than tigers) and that lynx more commonly used higher elevation habitats with deeper snow (Soutyrina et al. 2005). Thus, while documentation of this episode of direct competition between a tiger and lynx is compelling, there is still much to be learned about the complex interrelationships of large carnivores in this ecosystem.

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