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Documentation of an Asiatic black bear preying on a living sika deer caught in a leg-hold snare trap

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Abstract: Asiatic black bears (*Ursus thibetanus*) rarely prey on living adult deer. We report video documentation, obtained May 2024, of a bear subduing and killing a sika deer (*Cervus nippon*) that was captured in a leg-hold snare trap, then staying in the area for repeated feeding visits. Leg-hold snare traps for deer capture are widely used in Japan for population control of high deer densities. The predation by bears on deer with restricted movements in this study shows that deer trapping by humans may be providing bears with a new form of deer as a food resource. If bears perceive such a deer as a regular food resource, it may have some effect on bears' ecology (e.g., feeding habits, behavior). In addition, through foraging on captive deer, bears could endanger trappers and the general population. Our record highlights the necessity of evaluating trap management practices to mitigate risks to humans and wildlife.

要旨: ツキノワグマ（*Ursus thibetanus*）がニホンジカ（*Cervus nippon*）成獣を捕食することは稀である。本研究では、くくり罠で捕獲されたシカにクマが襲い掛かり、その後死亡した個体に繰り返し訪問し、シカを採食する様子を捉えた一連の動画を報告する。シカの高密度化に伴うシカの捕獲強化に際して、くくり罠は広く使用されている。本事例において身動きが制限されたものの、生きた成獣のシカをクマが捕食したことは、人によるシカの捕獲行為がクマに新たな形態の食物資源としてのシカを提供していることを示唆する。さらに、クマがこのような状態のシカを通常の食物資源として認識している場合、クマの生態（たとえば、食性や行動など）に何かしらの影響を及ぼしている可能性がある。また、捕獲されたシカのクマによる採食行動は、罠周辺でのクマの長時間の滞在や錯誤捕獲の危険性を高めることで、捕獲従事者および周辺住民との人身事故の可能性を高める可能性がある。本事例は人と野生動物へのリスクを軽減するためにも、適切なくくり罠の運用を検討する必要性を示唆している。

Key words: Asiatic black bears, Japan, population control, predation, predator–prey, trap, *Ursus thibetanus*, wildlife management

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The increase in ungulate populations and the resulting damage to agriculture, forestry, and ecosystem health are significant issues in the northern hemisphere (Côté et al. 2004, Putman et al. 2011, Kaji et al. 2022). To address this problem, culling ungulates (sometimes including live capture) is sometimes implemented for population management. However, live capture methods cause issues such as accidental capture, risks to animal welfare (Iossa and Harris 2007, Proulx et al. 2020), and managing the carrion resulting from culled animals (Fielding et al. 2014). Therefore, assessing the existing challenges and appropriate practices for different capture methods is crucial for advancing ecosystem management through appropriate wildlife management.

In Japan, the overpopulation of sika deer (*Cervus nippon*; hereafter, "deer") is a notable problem, with approximately 569,200 deer culled and 147,600 deer hunted in 2022 (Ministry of the Environment 2023). Capture methods include guns or traps (leg-hold snare traps, box traps, and corral traps). Among these, leg-hold snares are widely used because of their ease of transportation and installation, as well as their cost-effectiveness; leg-hold snare use has been increasing annually (e.g., Ohba 2020). However, in recent years, there have been reports of Asiatic black bears (*Ursus thibetanus*; hereafter, "bear") feeding on deer captured by leg-hold snare traps in Honshu, Japan (Anezaki 2019, Minami et al. 2021). Such incidents not only increase the risk of accidental capture of bears in other traps set around captured deer but also pose safety risks for trappers (Minami et al. 2021), which can lead to a

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decrease in motivation for trappers (Yamazaki et al. 2020).

Asiatic black bears traditionally have been thought to not regularly prey on adult deer (Hashimoto and Takatsuki 1997), but previous experiments and studies have suggested that Asiatic black bears consume carcass remains of culled deer (Koike et al. 2013; Inagaki et al. 2020, 2023; Naganuma et al. 2022; Tezuka et al. 2023). The scavenging indicates that culled remains are a food source with nutritional value for bears, but little is known about the instances of predation by bears on deer captured by traps. Reports of bear feeding behavior on deer captured by traps are often limited to newspaper articles and web news in Japan, with only one scientific report (Minami et al. 2021). Minami et al. (2021) summarized the number and location of deer and wild boar (*Sus scrofa*) caught in leg-hold snare traps and their consumption by bears during daily trap patrols, and cases of human–bear encounters. However, there are no specific records of bear predatory behavior. Thus, it was unclear whether the bears feed on deer that have died in traps, prey on weakened deer, or attack and kill healthy deer. This study is the first record to report the entire process of a bear preying on a deer captured by a leg-hold snare trap while the deer is still alive. Our documentation provides new facts about bear predation on deer captured by traps and discussion for improvements of trap operation.

Study area

The incident documented was recorded in a Nikko City, Tochigi Prefecture, Japan (1,450 km^2). Nikko City is a forest-dominated area with 91.4% of its land area covered by forests, 3.9% by farmlands, and 1.7% by residential areas (Tochigi Prefecture 2022). Large mammals (mean body weight >15.0 kg) in this study area are Asiatic black bear, sika deer, wild boar, and Japanese serow (*Capricornis crispus*); and the midsized mammals (mean body weight: 1.0–15.0 kg) are Japanese macaque (*Macaca fuscata*), red fox (*Vulpes vulpes*), Japanese badger (*Meles anakuma*), raccoon dog (*Nyctereutes procyonoides*), masked palm civet (*Paguma larvata*), Japanese hare (*Lepus brachyurus*), Japanese marten (*Martes melampus*), and Japanese giant flying squirrel (*Petaurista leucogenys*).

In the study area, deer and wild boar are permitted to be captured by licensed workers throughout the year to prevent damage to agricultural crops, forestry, and ecosystem (Nikko City 2022). Deer densities are 8.22–45.75 deer/km^2 of protected area and 0.92–14.86 deer/km^2 of unprotected area in 2022, with an average annual capture of 3,850 (±1,587 standard deviation) deer during 2018–2022. The use of leg-hold snare traps accounted for 53% (2,083 of 3,897 deer) of the trapping methods (guns, box traps, and leg-hold snare traps) in 2022 (Tochigi Prefecture 2023). The catch per unit effort of box traps was 0.17 deer/100 trap-days and that of leg-hold snare traps was 0.67 deer/100 trap-days in 2022 (Tochigi Prefecture 2023), indicating that the leg-hold snare traps are heavily used as an efficient capture method in the study area.

The trap site was located at the edge of the canopy-closed coniferous forest (*Cryptomeria japonica* plantation) adjacent to small farmland, with residential houses within a 100-m radius. The exact location details are not disclosed to protect the personal information of the trapper. Leg-hold snare traps had been continuously set year-round in this site for 4 years, capturing >10 deer and wild boars).

Methods

On 18 May 2024, at 14:00 hours, the trapper set a leg-hold snare trap with the aim to prevent damage from deer and wild boar (Table 1). Rice bran and dent corn were used as bait. An automatic camera trap (Moultrie, MFH-DGS-D55IRXT) was used to monitor the animals visiting the trap. The camera was configured to capture 30-second videos and one photograph at 15-second intervals, but a camera malfunction caused it to capture 10-second videos and one photograph at 15-second intervals during the night (at least 18:00–05:00 hr).

On the morning of 19 May 2024, the trapper approached the trap for inspection but sensed the presence of a bear and stopped the inspection for safety reasons. On the afternoon of 20 May 2024, the trapper checked the trap and found that a deer had been consumed. At that time, the deer carcass and the camera were retrieved by the trapper (Table 1).

We identified the vertebrate species that visited the trap from the videos and photographs obtained. For sequential recording data, visits separated by >15 minutes from the previous visit were considered different visits. No animal was recorded that was just passing in front of the camera randomly. We assigned individual identification based on the video data (e.g., body size and body shape).

Table 1. A series of events in which a sika deer (*Cervus nippon*) is captured in a trap and preyed upon by an Asiatic black bear (*Ursus thibetanus*).

Date	Time (military; 24 hr)	Event	Record
18 May	14:00	The trapper sets up leg-hold snare trap.	
19 May	01:06–01:20	Deer A attracted to bait, stayed around the trap.	
	01:30	Raccoon dog visited the trap.	
	01:38–01:47	Deer A returned to the trap.	
	03:07–03:17	Deer A returned to the trap.	
	03:17	Deer A was captured by the trap.	Video S1 (*Supplemental material*)
	03:18–03:26	Raccoon dog seen behind deer A.	
	03:56–	Bear B attacked deer A.	Fig. 1; Video S2, Video S3 (*Supplemental material*)
	04:05–	Deer A alive but immobile.	
	04:06–04:34	Bear B dragged deer A to the camera edge. Deer A died after this, and bear B likely began feeding.	Video S4 (*Supplemental material*)
	08:09–08:12	Bear B temporarily visited; no feeding observed.	
	AM	The trapper approached the trap for inspection but sensed the presence of a bear and stopped the inspection.	
	18:54–19:08	Bear B visited. It is considered to be feeding on deer A at the edge of the camera's field of view.	
	22:26–22:57	Bear B visited. It is feeding on deer A at the edge of the camera's field of view.	Video S5 (*Supplemental material*)
20 May	02:50	Bear B visited.	
	13:56	The trapper retrieved the trap and the deer carcass.	Fig. 2

Results

We recorded 120 photographs and 120 videos, and provide a summary of the recorded events in Table 1. On 19 May 2024, from 01:06 to 01:20 hours and from 01:38 to 01:47 hours, an adult female deer (hereafter, "deer A") was attracted to the bait near the trap and stayed around the trap. A raccoon dog visited near the trap at 01:30 hours. Deer A returned to the trap at 03:07 hours and was captured by the right forefoot at 03:17 hours (Video S1, *Supplemental material*). After deer A was captured, a raccoon dog (individual identification unknown) appeared behind deer A from 03:18 to 03:26 hours.

At 03:55 hours, deer A was recorded struggling intensely against the trap. Shortly thereafter, at 03:56 hours, an adult Asiatic black bear (hereafter, "bear B"; sex unknown) subdued the living deer A, primarily attacking its neck (Fig. 1; Videos S2 and S3, *Supplemental material*). Before this record, no bears had been recorded. The predation behavior by bear B continued, and 9 minutes after the first attack, at 04:05 hours, deer A appeared to be subdued (alive with eyes glowing, but immobile). At 04:06 hours, bear B dragged deer A ~2 m to the edge of the camera's field of view (Video S4, *Supplemental material*). Bear B was recorded at the edge of the camera's field of view until 04:34 hours, during which time deer A likely died (assessed by a lack of motion), and bear B likely began feeding (e.g., behavior was recorded with the bear

Fig. 1. On 19 May 2024, at 03:56 hours (am), an Asiatic black bear (*Ursus thibetanus*; bear B) subdued a sika deer (*Cervus nippon*; deer A), which was caught in the leg-hold snare trap.

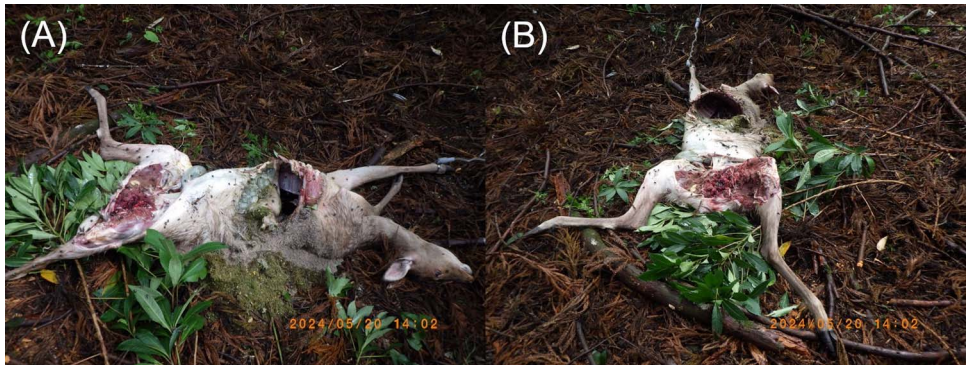

Fig. 2. Sika deer (*Cervus nippon*) carcass at the time of inspection on 20 May 2024. (A) lateral view, (B) vertical view. The viscera and the hindquarters were consumed.

mouth close to the deer's buttocks and some movement outside of the camera's field of view). Bear B made intermittent visits from 08:09 to 08:12 hours, 18:54 to 19:08 hours, 22:26 to 22:57 hours, and at 02:50 hours on 20 May, but specific feeding behavior could not be evaluated because the deer carcass was at the edge of the camera's field of view. However, we confirmed 3 video recordings of bear B certainly feeding on the carcass during these visits (Video S5, *Supplemental material*).

On 20 May 2024, at 13:56 hours, the trapper retrieved the trap and the deer carcass. Deer A had been consumed from the viscera and hindquarters (from the lower abdomen to the base of the hind legs), with most of the viscera missing except for some intestines and stomach contents (Fig. 2).

Discussion

This study is the first record of bear predation (killing) on a living deer captured in a leg-hold snare. From the sequence of videos, it was revealed that the deer was attacked by the bear approximately 40 minutes after being captured. The deer struggled to escape the trap 2 or 3 times after capture, but we did not confirm any signs of apparent weakness (e.g., sitting or physical injury). Approximately 10 minutes after the bear first attacked, the deer, although still alive, was immobilized. These results indicated that bears have the ability to quickly prey on healthy deer caught in traps. On the other hand, Minami et al. (2021) showed that all deer fed on by bears were females and juveniles but no adult male deer nor wild boar were fed on, suggesting that bears may be selecting their prey. The bear attacked the base of the deer's neck and consumed it primarily from the viscera and hindquarters, which was similar to the predation patterns of brown bears (*Ursus arctos*; Niedziałkowska et al. 2019). It has been thought that Asiatic black bears rarely have opportunities to prey on ungulates (Hashimoto and Takatsuki 1997). However, recent studies have shown that they frequently and dominantly scavenge deer carcasses (Inagaki et al. 2020, 2023) and prey on newborn deer in early summer (Fujiwara et al. 2013), suggesting that deer are a valuable nutritional resource (Naganuma et al. 2020). Bears often adapt their diet to changes in the availability of food resources in their habitat (Koike et al. 2013, Naganuma et al. 2022). The present study showed that bears are able to prey on immobilized deer provided by human trapping, showing that human actions associated with deer overabundance may provide bears with a new form of deer resource.

Our records showed that the bear subdued the deer quickly and without hesitation. An experiment with artificially placed deer carcasses in the same study area showed that bears visited within an average of 4.9 days (Inagaki et al. 2022), but the response in the present study was much faster. This rapid response might be an individual-specific case, but bears could have learned to associate the presence of trapped deer with an opportunity for easy foraging, particularly in areas with intense deer capturing. In fact, Minami et al. (2021) reported that 36% of captured deer were eaten by bears within 24 hours, and similar situations (i.e., bears feeding on trapped deer, although there was no evidence of whether bears killed live deer or scavenged dead deer) have occurred in several areas, including this study area (A. Inagaki, unpublished data). It is unclear whether these bears are learning and patrolling the trap locations, or whether the bears are responding to signals such as the scent or sound of the trapped deer. It would be important to clarify such bear behavior at the individual level in future studies.

In addition, if bears associate the presence of trapped deer with an opportunity for easy foraging, this could

also cause a change in their diet. Bears have a high capacity for learning about food resources (Gilbert 1999, Mazur and Seher 2008). Furthermore, bears may initially be wary of unfamiliar food, but gradually learn and switch to new food resources if these foods best meet their nutritional needs (Ditmer et al. 2015). Consequently, if bears come to recognize captured deer as an available food resource year-round at the population level, this could increase the proportion of deer in their diet and potentially affect their behavior (e.g., habitat selection, diurnal activity) and physiology (e.g., reproduction, growth). Future research on the impact of human-captured deer on bear ecology is therefore needed.

Our observation highlights the issues for the management of live capture including leg-hold snare traps (e.g., Fukue et al. 2018, Suzuki et al. 2018, Yamazaki et al. 2020). First, the rapid predation by the bear, within 40 minutes of the deer's capture, suggests that even daily trap patrols may not be sufficient to prevent such incidents. Leg-hold snares are a type of restraining traps designed hold the animal unharmed and with minimum stress until the trap is checked (Iossa et al. 2007). In cases like lethal capture in Japanese wildlife management, it is essential to minimize physical damage and stress until the animal is killed. However, it has been suggested that patrols conducted within 24 hours of trap-set do not sufficiently address these concerns (Yamada et al. 2013, Ohba 2020), and our observation supports that. We suggest the need to review practices, including increasing the frequency of trap checks or restricting the use of traps in areas where animals that can attack the trapped animals are present. Second, deer caught in leg-hold snares are tethered by wire ropes; thus, bears cannot easily carry them away. This could encourage bears to remain at the site to feed, possibly resulting in prolonged stays near the trap (e.g., bear caching behavior; Allen et al. 2021). We observed that the bear visited the trap $\geq$4 times within 24 hours after the initial predation, suggesting it may have stayed around the trap site during unrecorded periods. Considering the presence of human residences and small farmlands near such traps, bears staying for prolonged times poses significant risks to both trappers and residents (Minami et al. 2021). Additionally, leg-hold snare traps are often set in close proximity to each other for effective capture, increasing the risks and conservation concerns of accidental captures of bears as well as other scavenger species (e.g., raccoon dogs, red foxes, Japanese martens; Inagaki et al. 2020). It is therefore imperative to accumulate further knowledge of bear predation on captured deer and to evaluate the conditions that cause, and occur during, such events.

Considering that Asiatic black bears typically do not prey on adult deer, our records indicate that the anthropogenic activities including wildlife management may induce behavioral changes in nontarget species (e.g., Uchida et al. 2023). It is important in wildlife management and its related research, especially when using restraining traps, to consider the impact not only on the target species but also on higher trophic level species (i.e., consumers). Additionally, secondary impacts that exacerbate human–wildlife conflicts should not be ignored. Apex consumers, including bears, are more likely to cause significant human–wildlife conflicts, and similar issues could arise in other countries. It is essential to discuss appropriate trapping methods based on these management issues and to develop and practice management techniques that minimize risks for both people and wildlife.

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Supplemental material

Video S1. The moment deer A was captured in a leg-hold snare trap.

Video S2. On 19 May 2024, at 03:56 hours (am), bear B attacks and subdues deer A.

Video S3. On 19 May 2024, at 03:57 hours (am), bear B attacked the deer A. Bear B was holding deer A down by the base of the neck.

Video S4. On 19 May 2024, at 04:06 hours (am), bear B used its mouth to drag deer A (still alive but immobile) by its neck to the edge of the camera's field of view.

Video S5. On 19 May 2024, at 22:40 hours (pm), bear B fed on dead deer A.