

ARTICLE

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Predation of cougar kittens following the aggregation of American black bears

Marcus D. Bianco¹  | Joel Ruprecht²  | Darren A. Clark¹  |
Tavis Forrester¹  | Taal Levi² 

¹Oregon Department of Fish and Wildlife,
La Grande, Oregon, USA

²Department of Fisheries and Wildlife,
Oregon State University, Corvallis,
Oregon, USA

Correspondence

Marcus D. Bianco

Email: marcus.d.bianco@odfw.oregon.gov

Present address

Tavis Forrester, US Forest Service,
Missoula, Montana, USA.

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Abstract

The prevalence, intensity, or outcome of interference competition and inter-specific killing between predominantly solitary species operating on large spatial scales is challenging to document or test. Here, we present a detailed account of inter- and intraspecific interactions from contemporaneous GPS location data and in-field investigation. In June 2018, a GPS-collared female cougar (*Puma concolor*) maintained strong site fidelity for a period of 19 days, indicative of parturition behavior and establishment of a nursery site. In early July 2018, three GPS-collared black bears (*Ursus americanus*) arrived at the nursery site, after which the female cougar abandoned the site. Site investigation showed that one or more bears preyed on an unknown number of cougar kittens. The evidence supports ecological theory suggesting that body size, mass, or group number is an important predictor of outcome. Our observation provides an example of bears potentially making risk–reward trade-offs by eliminating a potential competitor that at the same time provisions carrion as critical food resources. These real-time inter- and intraspecific competitive interactions as documented using GPS collars allow for greater insight into individual fitness and community-level effects.

KEYWORDS

carnivore community, competition, interspecific killing, *Puma concolor*, species interaction, *Ursus americanus*

Direct interactions among carnivores, and not simply between predators and prey, have widespread consequences for ecological systems. Such interactions include facilitation through scavenging, kleptoparasitism, and direct killing (Allen et al., 2021; Prugh & Sivy, 2020; Ruprecht et al., 2021). The outcomes of these events are largely driven by body mass, group size, defensive capabilities, or aggression (Donadio & Buskirk, 2006; Palomares & Caro, 1999). For example, African lions

(*Panthera leo*), by virtue of being territorial, large-bodied, and gregarious, dominate interspecific interactions involving a suite of other carnivores including leopards (*Panthera pardus pardus*) (Balme et al., 2017), hyenas (*Hyaenidae* spp.) (Mills, 1990), wild dogs (*Lycaon pictus*) (Fuller et al., 1992), and cheetahs (*Acinonyx jubatus* spp.) (Laurenson, 1995). Even among predominantly solitary large-bodied carnivores with similar body size, there is substantial risk in engaging in aggressive one-on-one

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interactions. However, a change in sociality causing conspecifics to aggregate could reduce risk when engaging in aggressive interspecific interactions.

In North America, cougars (*Puma concolor*) are typically subordinate in confrontations with larger bodied adult American black bears (*Ursus americanus*, hereafter “bears”) (Elbroch & Kusler, 2018). However, cougars have also occasionally been recorded killing and consuming bears (Clark et al., 2014; Elbroch & Kusler, 2018; Knopff et al., 2010; LeCount, 1987). Reports of cougars killed by bears are rare (Elbroch & Kusler, 2018), and the

behavioral details surrounding such interactions have not been previously described in the scientific literature. Here, we provide a detailed account of an unusual predation event in which three bears deviated from their characteristic solitary nature and were implicated in the predation of a cougar nursery site and consumption of kittens at the Starkey Experimental Forest and Range in northeast Oregon, USA (IACUC No. 64 92-F-0004; protocol number STKY-16-01).

Data from a GPS collar worn by a 45-kg (Table 1) female cougar (C256) indicated it first arrived at the

TABLE 1 Animal mass and collar programming.

Animal ID	Species	Sex	Mass (kg)	Collar model; make	Programmed GPS fix interval
C256	Cougar	F	45	VERTEX Lite; Vetronics Aerospace, Berlin, Germany	3 h
C262	Cougar	M	69	IridiumTrack M Basic; Lotek Wireless, Newmarket, Ontario, Canada	3 h
U2	Bear	M	120	GPS 7000 Series Ultra High Frequency; Lotek Wireless, Newmarket, Ontario, Canada	2 h
U3	Bear	M	109	GPS 7000 Series Ultra High Frequency; Lotek Wireless, Newmarket, Ontario, Canada	2 h
U9	Bear	F	64	LiteTrack 420 Iridium; Lotek Wireless, Newmarket, Ontario, Canada	0:15 h
U12	Bear	F	75	LiteTrack 420 Iridium; Lotek Wireless, Newmarket, Ontario, Canada	0:15 h

Abbreviations: F, female; M, male.

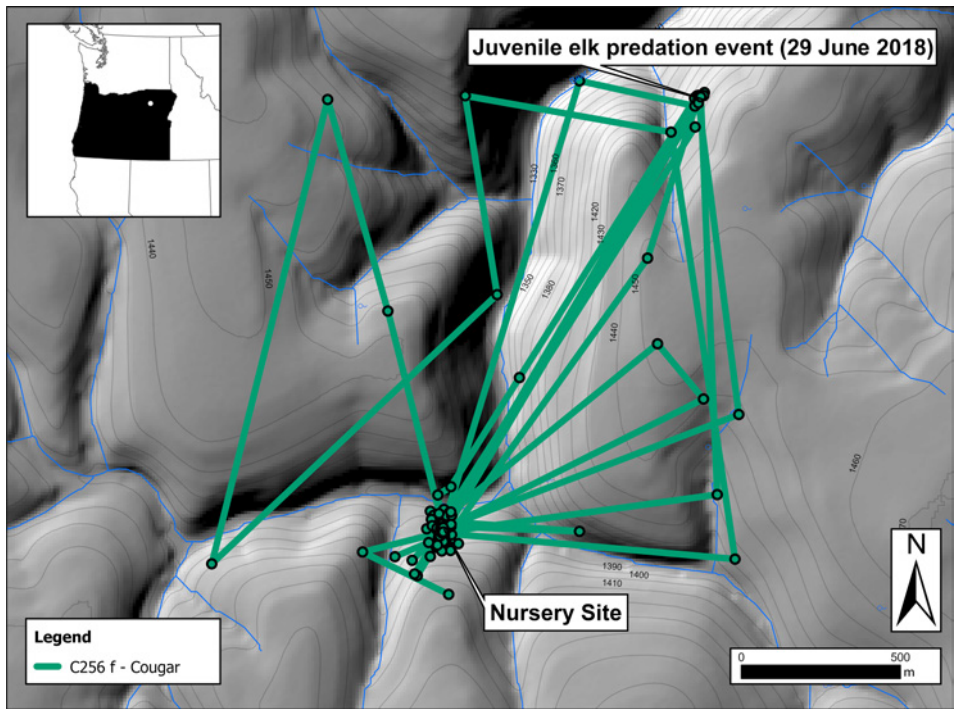


FIGURE 1 Locations for C256 during the 19-day birth event and rearing period (14 June 2018 through 3 July 2018).

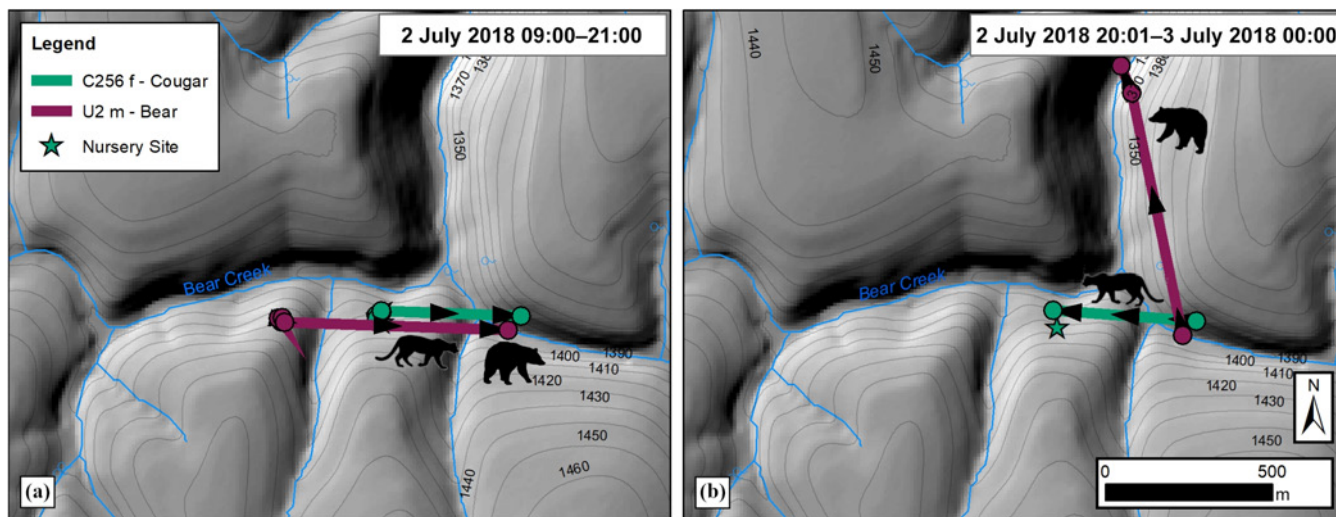


FIGURE 2 Geospatial timeline of an interaction between an adult male black bear and an adult female cougar at its nursery site in northeast Oregon, USA (Table 2): (a) male bear, U2, passes through the cougar nursery site and is pursued by cougar mother C256; (b) cougar mother returns to nursery while U2 flees to the north.



FIGURE 3 Female, U12 (left), and male, U3 (right), captured on remote camera approximately 3.45 km from the cougar nursery site 12 h after departing. Photo credit: Oregon Department of Fish and Wildlife.

parturition site, which later became the nursery, on 14 June 2018. The nursery was in a patch of regenerating mixed conifer with several larger scattered logs at the ground level, which provided some cover, but did not

contain barriers for other predators to access the kittens. During the following 19 days, C256 maintained strong site fidelity to the nursery and only traveled between one documented elk calf feeding site and the nursery

(Figure 1). On 2 July 2018, a 120-kg male bear (U2), also monitored with a GPS collar, visited the cougar's elk calf feeding site. Later that day, U2 approached within 290 m west of the cougar nursery site (Figure 2a). Subsequent GPS fixes suggest that C256 successfully displaced U2 from the nursery site as indicated by the cougar and bear in close proximity (60 m; Figure 2b) east of the nursery followed by a 738 m move north by U2 as C256 retreated back to the nursery.

On 2 July at 22:15, during the interaction between the presumed solitary bear (U2) and C256, locations from a GPS-collared 64-kg female bear (U9) indicated a pass through C256's elk calf feeding site. On 3 July at 20:00, U9 convened with two other GPS-collared bears (75-kg female, U12, and 109-kg male, U3; Figure 3) approximately 270–430 m of one another 1 km

northwest of the nursery site within a 1-h period (Figure 4a). Bear U9 was the first to arrive at the nursery by 21:00 the evening of 3 July 2018 (Figure 4a). Within 15 min of arrival, U9 was displaced by the larger bodied female (U12) who remained at the nursery site for 6.25 h (Figure 4b). GPS data placed larger bodied male bear (U3) at the site no later than 22:00 (though possibly the same time as U12) where he remained for 8 h, including a minimum of 6 h spent alongside U12 (Figure 4c,d). The cougar fled the nursery and moved 3.4 km between 21:00 and 00:00, which was a distance approximately 20 times longer than the mean cougar movement rate in our study (Table 2). On 18 July 2018, the subsequent investigation of the nursery site yielded blood on ground litter and surrounding vegetation, densely matted vegetation, tufts of cougar fur, and

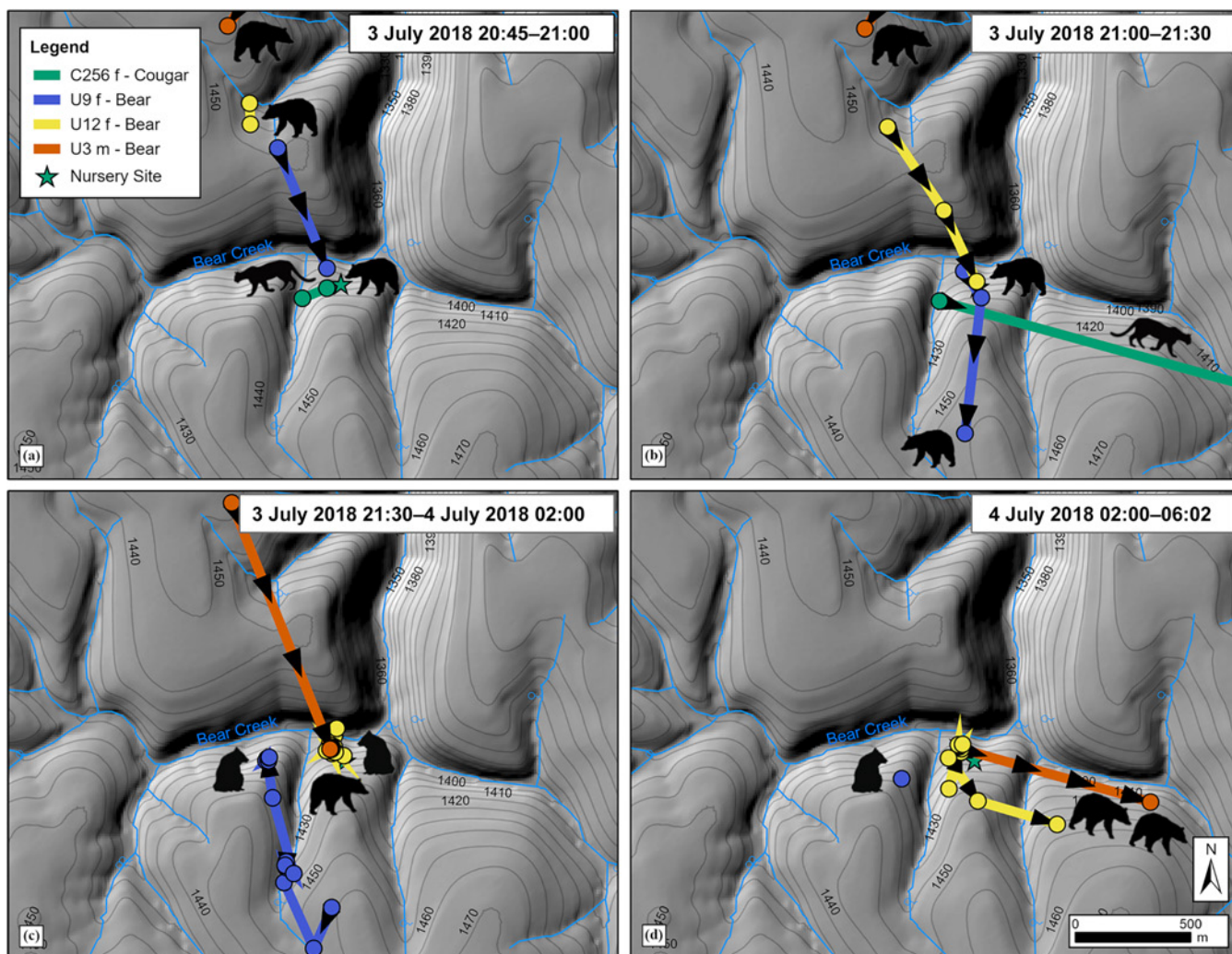


FIGURE 4 Geospatial timeline of interactions of three adult black bears at a cougar nursery site in northeast Oregon, USA: (a) female bear U9 moved to nursery site and displaced female cougar C256 170 m west; (b) older and larger female bear, U12, displaced U9 from nursery site. C256 retreated SSE and departed the main study area; (c) male bear, U3, joined U12 at nursery site. U9 looped north back toward the nursery, but kept distance from other bears. (d) U3 and U12 left the nursery site.

TABLE 2 Timeline of events at C256 2018 nursery site.

Date	LMT (PDT)	Event
14 June 2018		C256 established parturition site.
2 July 2018	10:00	U2 arrived 290 m west of the nursery site and remained clustered for 8 h.
	20:00	U2 moved 670 m east.
	21:00	C256 has moved to within 60 m of U2 420 m east of nursery.
	22:00	U2 has moved 738 m north.
3 July 2018	00:00	C256 back at nursery site.
	20:00	Bears U3, U9, and U12 congregated 1 km north-northwest of the nursery site.
	21:00	U9 arrived at nursery site and displaced C256 170 m west.
	21:15	U9 moved 80 m south of the nursery.
	21:30	U12 arrived at the cougar nursery site. U9 was displaced 670 m south. U12 remained at the nursery site for another 6.25 h.
	22:00	U3 arrived at the nursery site with U12. U9 circled back to the northwest maintaining 290 m distance from U12 and U3.
4 July 2018	00:00	C256 moved 3.4 km (mean distance for 3-h interval during 19-day denning period = 171 m; SD = 354 m; max = 1.6 km) to the southeast.
	00:53	C256 departed main area of study; furthest location since start of kitten rearing period (Appendix S1: Figure S1).
	03:46	U12 departed the nursery site.
	06:02	U3 departed the nursery site.
	17:27	U3 and U12 detected on motion-sensor camera after departing nursery site (Figure 3).
5 July 2018	00:18	C256 returned to main study area.
	03:00	C256 revisited the vicinity of nursery site.
	07:25	C256 departed the nursery site and main study area.

Abbreviations: LMT, Local Mean Time; PDT, Pacific Daylight Time.

keratinous claw sheaths from cougar kittens (Figure 5). Though the total number of offspring was not confirmed for this parturition event, a mean litter size of 3 for C256 was documented from three events (mean litter size for study area = 2.5; min = 1, max = 4).

The loss of the litter to bears allowed C256 to enter estrous on 10 July 2018, 6 days and 9 h following the nursery predation; C256 spatially overlapped with a colored male cougar (C262) southeast of the previous nursery site for at least 2 days and 21 h. C256 gave birth to a new litter 92 days later.

On 10 October 2018, C256 established a new nursery site 12.2 km from the previous June nursery (birth interval = 3.8 months; subsequent birth interval = 14.9 months). This distance greatly exceeded the mean distance between consecutive nursery sites (including those predated by bears or conspecifics) of six other adult female cougars documented in northeast Oregon ($\bar{x}$ = 4.0 km, SD = 3.1 km; ODFW, unpublished data). On 13 November 2018, three male kittens were observed at the subsequent nursery site. With conception

occurring on or around 15 March 2018 and subsequent conception occurring on 10 July, the disruption to C256's production of offspring was 117 days.

Coevolution between sympatric bears and cougars has been occurring for at least 2 million years (Culver et al., 2000; Kumar et al., 2017). Cougar life history appears to be adapted for the spontaneous loss of offspring from intra- and interspecific sources (e.g., male cougars, wolves, and bears), which can lead to a rapid onset of a second estrus (Logan & Sweanor, 2001; Ruth et al., 2019). Regardless of photoperiod or prey abundance, the poly-estrus and aseasonal nature of cougars allows for birth to occur during all months of the year (Brown, 2011). As sensory stimulation-induced reflex ovulators (Bonney et al., 1981), female cougars can come into estrus upon copulation with males. The ability of cougars to rapidly produce a new litter of kittens is likely an evolutionary adaptation to account for potential predation of vulnerable young by competitors, particularly when the female must leave kittens unattended at nursery sites while hunting.

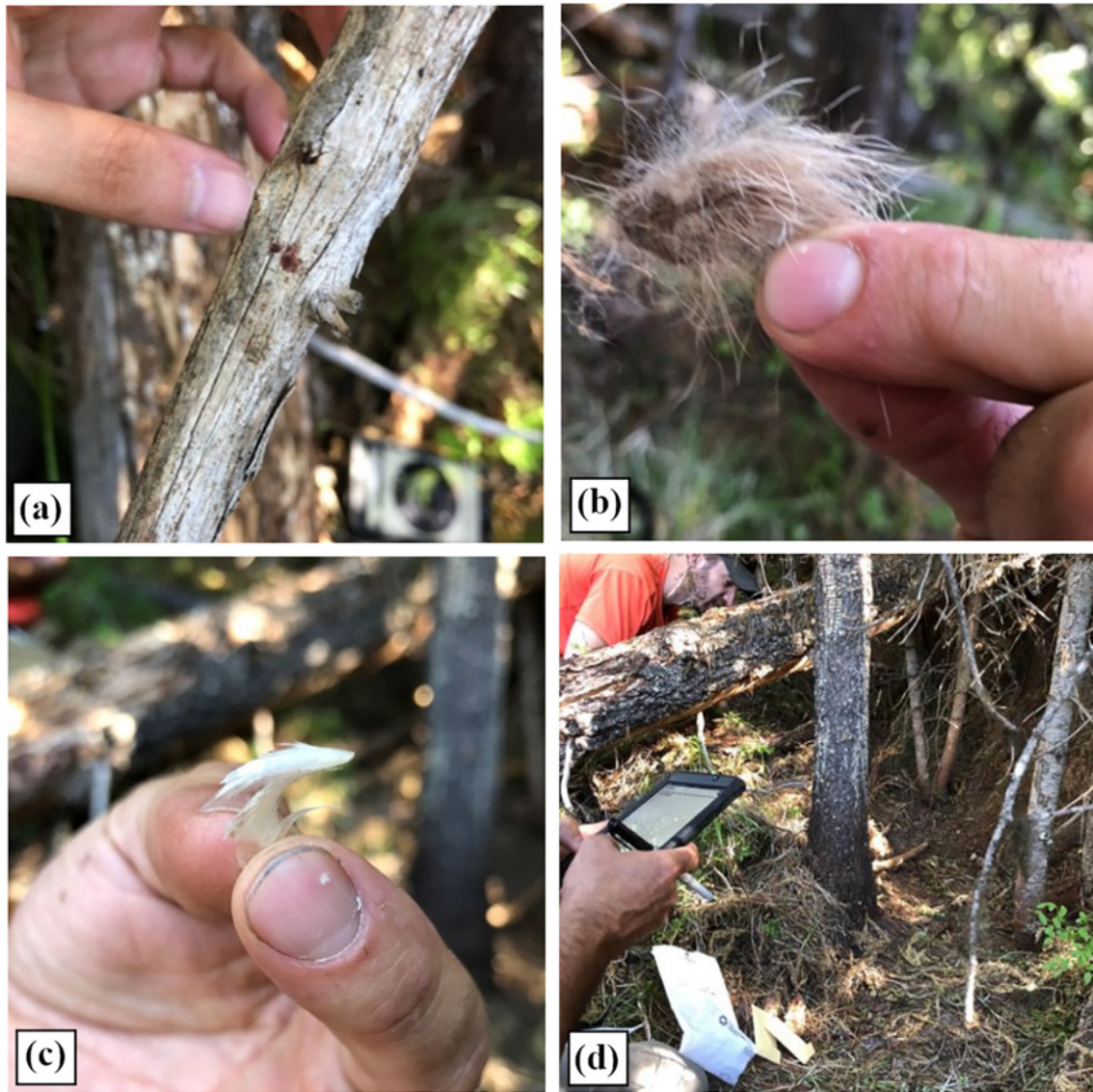


FIGURE 5 Physical evidence from 18 July 2018 in-field investigation of the nursery predation site: (a) blood on ground litter and surrounding vegetation, (b) tufts of cougar fur, (c) keratinous claw sheaths from cougar kittens, and (d) nursery site. Photo credit: Oregon Department of Fish and Wildlife.

Although our observation of four GPS-collared bears passing through the same site in a 24-h period might suggest a high density of bears, Ruprecht et al. (2021) found bear density for our study area in 2017 to be 9.9 bears/100 km². Compared with previous estimates of 15–17 bears/100 km² in northeast Oregon (Johnson et al., 2019) and more recent estimates of 19.2 bears/100 km² (range: 7.1–33.6 bears/100 km²) in the eastern North Cascades of Washington State (Welfelt et al., 2019), bear density in our study area was relatively low. Having three bears present at the nursery within 1 h is a stark deviation from the typical solitary nature of bears.

While bears possess acute senses, it is unlikely there was sufficient time for olfactory cues to alert multiple bears within such a short time, and because the event

occurred at night, visual cues would have been limited. Recent analysis has shown vocalizations by young cougars are highly audible (Allen et al., 2016) and attract rather than repel bears (Suraci et al., 2017), which likely prompted the aggregation of bears and increased threat of predation (Hughes et al., 2012). The first bear to arrive at the nursery, U9, may have been alerted because of vocalizations made by either nurslings or C256. The resulting interaction between a single bear and C256 may have ended with the cougar displacing U9 from the nursery as it did to the larger bodied U2 the day prior. However, within 15 min another bear arrived (U12), perhaps reacting to auditory cues created by the interaction between U9 and C256. The male bear (U3) may have arrived with U12, or may have arrived separately, but

was present within 45 min. We posit that 15 min would not have been adequate time for U9 to displace C256, kill nurslings, and consume them. Unlike the previous defense of C256's nursery 1 day prior, these bears successfully displaced the mother and consumed the litter.

The motivations of bears in this account are unclear. There was risk of injury from maternal defense for a small, but nutritionally dense reward. Was the action driven by the momentary urge to remove a potential predator competitor instead? We cannot confirm, nor suggest, bears exercise executive function, but it is worth pointing out that from a long-term resource acquisition standpoint, it may not be optimal for bears to kill cougars given that bears are often the beneficiaries of carrion from prey killed by the more subordinate cougars (Allen et al., 2021; Elbroch & Kusler, 2018; Ruth et al., 2019). In the short term, gains from the opportunistic detection of a cougar nursery by a generalist omnivore may have created additional attraction to the site, particularly with the reduced risk associated with a larger body and group size. Perhaps the risk–reward trade-off was influenced by synergy of three bears (e.g., grouped individuals taking on more challenging prey), the frenzy of the bear breeding season, or because a seasonal resource pulse of neonate ungulates increased spatial and dietary overlap resulting in the increased competition between these two species. While the provocation for this phenomenon may never fully be known, this explanation provides a detailed glimpse into the intricacies surrounding interactions within carnivore communities and raise further questions about their effects on ecosystems.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data supporting this research are sensitive and not available publicly as directed by state law (ORS 496.182). Data are of a species listed as a game species that has black market value and contains sites used for breeding, denning, or other sensitive or vulnerable life stages. Data may be disclosed to the federal government, a tribal government, a public body as defined in ORS 174.109, a

public utility or an accredited college or university by contacting Oregon Department of Fish and Wildlife's East Wildlife Research Project Leader, Darren A. Clark, darren.a.clark@odfw.oregon.gov.

ORCID

Marcus D. Bianco  <https://orcid.org/0000-0002-5300-5855>

Joel Ruprecht  <https://orcid.org/0000-0002-9443-7582>

Darren A. Clark  <https://orcid.org/0000-0002-8738-9826>

Tavis Forrester  <https://orcid.org/0000-0001-6762-4115>

Taal Levi  <https://orcid.org/0000-0003-1853-8311>

REFERENCES

- Allen, M. L., L. M. Elbroch, and H. U. Wittmer. 2021. "Can't Bear the Competition: Energetic Losses from Kleptoparasitism by a Dominant Scavenger May Alter Foraging Behaviors of an Apex Predator." *Basic and Applied Ecology* 51: 1–10.
- Allen, M. L., Y. Wang, and C. C. Wilmers. 2016. "Exploring the Adaptive Significance of Five Types of Puma (*Puma concolor*) Vocalizations." *Canadian Field-Naturalist* 130: 289–294.
- Balme, G. A., R. T. Pitman, H. S. Robinson, J. R. B. Miller, P. J. Funston, and L. T. B. Hunter. 2017. "Leopard Distribution and Abundance Is Unaffected by Interference Competition with Lions." *Behavioral Ecology* 28: 1348–58.
- Bonney, R. C., H. D. M. Moore, and D. M. Jones. 1981. "Plasma Concentrations of Oestradiol-17 β and Progesterone, and Laparoscopic Observations of the Ovary in the Puma (*Felis concolor*) during Oestrus, Pseudopregnancy and Pregnancy." *Reproduction* 63: 523–531.
- Brown, J. L. 2011. "Female Reproductive Cycles of Wild Female Felids." *Animal Reproduction Science* 124: 155–162.
- Clark, D. A., G. A. Davidson, B. K. Johnson, and R. G. Anthony. 2014. "Cougar Kill Rates and Prey Selection in a Multiple-Prey System in Northeast Oregon." *The Journal of Wildlife Management* 78: 1161–76.
- Culver, M., W. Johnson, J. Pecon-Slattey, and S. O'Brien. 2000. "Genomic Ancestry of the American Puma (*Puma concolor*)." *The Journal of Heredity* 91: 186–197.
- Donadio, E., and S. W. Buskirk. 2006. "Diet, Morphology, and Interspecific Killing in Carnivora." *The American Naturalist* 167: 524–536.
- Elbroch, L. M., and A. Kusler. 2018. "Are Pumas Subordinate Carnivores, and Does it Matter?" *PeerJ* 6: e4293.
- Fuller, T. K., P. W. Kat, J. B. Bulger, A. H. Maddock, J. R. Ginsberg, R. Burrows, J. W. McNutt, and M. G. L. Mills. 1992. "Population Dynamics of African Wild Dogs." In *Wildlife 2001: Populations*, edited by D. R. McCullough and R. H. Barrett, 1125–39. Dordrecht: Springer Netherlands.
- Hughes, N. K., J. L. Kelley, and P. B. Banks. 2012. "Dangerous Liaisons: The Predation Risks of Receiving Social Signals." *Ecology Letters* 15: 1326–39.
- Johnson, B. K., D. H. Jackson, R. C. Cook, D. A. Clark, P. K. Coe, J. G. Cook, S. N. Rearden, S. L. Findholt, and J. H. Noyes. 2019. "Roles of Maternal Condition and Predation in Survival of Juvenile Elk in Oregon." *Wildlife Monographs* 201: 3–60.

- Knopff, K. H., A. A. Knopff, A. Kortello, and M. S. Boyce. 2010. "Cougar Kill Rate and Prey Composition in a Multiprey System." *The Journal of Wildlife Management* 74: 1435–47.
- Kumar, V., F. Lammers, T. Bidon, M. Pfenninger, L. Kolter, M. A. Nilsson, and A. Janke. 2017. "The Evolutionary History of Bears Is Characterized by Gene Flow across Species." *Scientific Reports* 7: 46487.
- Laurenson, M. K. 1995. "Implications of High Offspring Mortality for Cheetah Population Dynamics." In *Serengeti II: Dynamics, Management and Conservation of an Ecosystem*, edited by A. R. E. Sinclair and P. Arcese, 385–399. Chicago: University of Chicago Press.
- LeCount, A. L. 1987. "Causes of Black Bear Cub Mortality." *Bears: Their Biology and Management* 7: 75–82.
- Logan, K. A., and L. L. Sweanor. 2001. *Desert Puma: Evolutionary Ecology and Conservation of an Enduring Carnivore*. Covelo, CA: Island Press.
- Mills, M. G. L. 1990. *Kalahari Hyenas: Comparative Behavioural Ecology of Two Species*, 1st ed. London: Unwin Hyman.
- Palomares, F., and T. M. Caro. 1999. "Interspecific Killing among Mammalian Carnivores." *The American Naturalist* 153: 492–508.
- Prugh, L. R., and K. J. Sivy. 2020. "Enemies with Benefits: Integrating Positive and Negative Interactions among Terrestrial Carnivores." *Ecology Letters* 23: 902–918.
- Ruprecht, J., C. E. Eriksson, T. D. Forrester, D. B. Spitz, D. A. Clark, M. J. Wisdom, M. Bianco, M. M. Rowland, J. B. Smith, and B. K. Johnson. 2021. "Variable Strategies to Solve Risk–Reward Tradeoffs in Carnivore Communities." *Proceedings of the National Academy of Sciences* 118: e2101614118.
- Ruth, T. K., P. C. Buotte, and M. G. Hornocker. 2019. *Yellowstone Cougars: Ecology before and during Wolf Restoration*. Louisville, CO: University Press of Colorado.
- Suraci, J. P., M. Clinchy, D. J. Roberts, and L. Y. Zanette. 2017. "Eavesdropping in Solitary Large Carnivores: Black Bears Advance and Vocalize toward Cougar Playbacks." *Ethology* 123: 593–99.
- Welfelt, L. S., R. A. Beausoleil, and R. B. Wielgus. 2019. "Factors Associated with Black Bear Density and Implications for Management." *The Journal of Wildlife Management* 83: 1527–39.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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