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Authors: Reynolds-Hogland, Melissa, Ramsey, Alan B., Muench, Carly, Terkildsen, Kirsten, Pilgrim, Kristine L., et al.

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Video-documentation of true and borderline tool use by wild American black bears

Melissa Reynolds-Hogland[1,4], Alan B. Ramsey[2], Carly Muench[2], Kirsten Terkildsen[2], Kristine L. Pilgrim[3], Cory Engkjer[3], and Philip W. Ramsey[2]

[1] *Wildlife Research and Education Foundation, Frenchtown, MT 59834, USA*
[2] *MPG Ranch, Florence, MT 59833, USA*
[3] *USDA National Genomics Center, USFS Rocky Mountain Research Station, Missoula, MT 59801, USA*

Abstract: Animal tool use has been documented for a variety of wildlife, but few studies have evaluated tool use by bears. We used long-term video data to observe and classify behaviors of wild American black bears (*Ursus americanus*) in western Montana, USA, during 2012–2022. We present video-documentation of true and borderline tool use by multiple individuals. Six bears (4F:2M) picked up sticks from the bottom of a creek pool and then manipulated the sticks with their forepaws to scratch and/or rub themselves. In addition, one bear manipulated a tree sapling near a cage trap in an apparent attempt to reach hanging food. We identified several parent–offspring relationships among our small sample size of tool users, indicating that tool use behavior may have partially developed via social learning and/or genetic inheritance. Our findings build on the limited research on ursid tool use and demonstrate the value of long-term video data to document wild bear behavior.

Key words: American black bear, behavior, Montana, noninvasive, social learning, tool use, *Ursus americanus,* video data

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Animal tool use has been documented for a variety of wildlife, including species of birds, primates, nonprimate mammals, insects, snails, crabs, and fish (Bandini and Tennie 2020). Various definitions of animal tool use exist, all of which include some level of subjectivity (Bentley-Condit and Smith 2010). In efforts to increase definition clarity and minimize subjectivity, Shumaker et al. (2011) revised the definition of animal tool use as "the external employment of an unattached or manipulable attached environmental object to alter more efficiently the form, position, or condition of another object, another organism, or the user itself when the user holds and directly manipulates the tool during or prior to use and is responsible for the proper and effective orientation of the tool."

Animals use tools for different reasons (e.g., food extraction, food capture, physical maintenance, etc.; Bentley-Condit and Smith 2010) and tool use behaviors vary in terms of complexity and sophistication. Some tool use behaviors include the acquisition of an object like a stick for physical maintenance (e.g., Asian elephants [*Elephas maximus*]; Chevalier-Skolnikoff and Liska 1993), whereas other tool use behaviors include tool manufacture, which requires active modification of an object before manipulating it as a tool (Beck 1980). For example, New Caledonian crows (*Corvus moneduloides*) modify wire into hooks for food extraction (Weir 2002). Some researchers also distinguish between "true" tool use and "borderline" tool use, where the former involves the manipulation of objects that are not part of the substrate and the latter involves the manipulation of objects that are part of the substrate (Boswall 1977, 1978, 1983; Bentley-Condit and Smith 2010).

Research on animal tool use has largely focused on birds and nonhuman primates; both demonstrate relatively sophisticated true tool use. For example, Goffin cockatoos (*Cacatua goffiniana*) modify sticks for food capture (Auersperg et al. 2012), rooks (*Corvus frugilegus*) manipulate stones to raise the water level for food capture (Bird and Emery 2009), and northern blue jays (*Cyanocitta cristata*) crumple newspaper for food extraction (Jones and Kamil 1973). Chimpanzees (*Pan troglodytes*), capuchins (*Cebus libidinosus*, *C. apella*), and long-tailed macaques (*Macaca fascicularis*) use hammer and anvil stones to crack open nuts or shells (food extraction; Antinucci and Visalberghi 1986; Inoue-Nakamura and Matsuzawa 1997; Morgan and Abwe 2006; Waga et al. 2006; Tan 2017), orangutans (*Pongo pygmaeus abelii*) manufacture tools by stripping leaves from branches and then use them to extract food (Nakamichi 2004), and gorillas (*Gorilla gorilla gorilla*) use branches to test water depth and to build bridges (Breuer et al. 2005). Examples of nonprimate mammals that demonstrate true tool use include Asian elephants who use cubes for food capture (Foerder et al. 2011), sea

[4] email: mjreynoldshogland@gmail.com

otters (*Enhydra lutris nereis*) who use hammer stones for food extraction (Nicholson et al. 2007, Ralls et al. 2017), and bottlenose dolphins (*Tursiops* spp.) who use sponges during food capture (Mann et al. 2008, Patterson and Mann 2011).

In the Ursidae family, only 3 studies have evaluated tool use by bears. Waroff et al. (2017) reported that 6 of 8 captive brown bears (*Ursus arctos*) rolled a log >2 m, tipped the log onto its flat side, and then stood on the log to reach hanging food. Stirling et al. (2021) photo-documented one captive polar bear (*U. maritimus*) using branches, logs, and a round object to slap hanging meat off a hook. To date, the only published observation of tool use by wild bears was reported by Deecke (2012), who video-documented a single wild brown bear using barnacle-encrusted rocks for physical maintenance (i.e., self-scratching).

The paucity of research on tool use by wild bears is largely due to the challenge of observing wild bears for extended periods of time (Stirling et al. 2021) and the inability to control experiences of wild animals in natural areas (Whitehead 2003). Video cameras offer an alternative method of observing wild bears that does not require researchers to be in the field for extended periods. Also, video-based observation removes observer effects on the individuals of study. We installed video cameras on a conservation property in western Montana to document wild bear behaviors. Here, we present the first video-documentation of multiple wild American black bears (*U. americanus*; hereafter, black bears) holding and manipulating sticks as tools to scratch (i.e., physical maintenance) or to rub themselves (i.e., chemical communication) and of one wild black bear manipulating a tree sapling in an apparent attempt to reach a hanging bag of food near a cage trap (i.e., food capture).

Study area

We conducted our research on MPG Ranch (46°42′26″N, 114°00′16″W), a 6,191-ha conservation property located in the Northern Sapphire Mountains in western Montana, USA. Prior to 2009, the ranch had been intensively managed for livestock for >100 years. In 2009, MPG Ranch was purchased and immediately transitioned into a conservation property with a mission to restore ecological processes (Lekberg et al. 2013, Herget et al. 2015, Mummey and Ramsey 2017). The western and southern portions of the study site consist primarily of open, grass-covered slopes with narrow deciduous woody draws that lead to bottomland riparian cover in the Bitterroot River floodplain. Dominant tree species on the eastern and northern portions of the study site include Douglas fir (*Pseudotsuga menziesii*), subalpine fir (*Abies lasiocarpa*), Ponderosa pine (*Pinus ponderosa*), and quaking aspen (*Populus tremuloides*; Durham et al. 2017). Conservation goals for our study site include minimizing human disturbance in forested areas that provide habitat for bears and other wildlife. Thus, only a few researchers occasionally collect data in areas where bears spend time. Beginning in 2011, sturdy gates were installed on perimeter roads and a security officer patrolled our study site to prevent public access. Other large mammals on the study site include elk (*Cervus canadensis*), white tailed deer (*Odocoileus virginianus*), mule deer (*O. hemionus*), and mountain lions (*Puma concolor*). There are no resident gray wolves (*Canis lupus*) on the ranch, but we video-captured 14 visits by approximately 8 solitary gray wolves, and 1 visit by 2 wolves, during January 2011–August 2022. The climate is temperate with relatively long, snowy winters and short sunny summers (Sawaya et al. 2016). Elk and deer hunting occur on MPG Ranch, but black bear hunting is prohibited on the ranch and on ~4,000 ha of adjoining private lands. Black bear hunting is permitted on some adjoining public lands as well as on nearby lands held in block management by The Nature Conservancy.

Methods

We used the following video camera systems to observe bears and document their behaviors: Stealth Cam model STC-DVIRHD, Stealth Cam model STC-G42NG (Grand Prairie, Texas, USA); Bushnell model 1197678 (Overland Park, Kansas, USA); Reconyx XR6 UltraFire (Grand Prairie, Texas, USA); and Browning models 8FHD-P and BTC-7A (Morgan, Utah, USA). During 2011, we placed video cameras at 26 stations on MPG Ranch to determine which areas were most frequented by bears. We added video cameras and video camera stations and adjusted the location of some video camera stations during 2012–2016 to maximize the detection of black bears. We removed unproductive video camera stations in 2017 and 2018. During January 2018–August 2022, the number ($n = 88$) and placement of video camera stations were consistent. We defined a station as one or more video cameras aimed at an unique feature, such as a water source (creek pool, stock tank, etc.), rub post, rub tree, wildlife trail, gated gravel road, etc. We often placed multiple video cameras at different angles at a single video camera station to maximize individual identification (Karanth and Nichols 1998, Rich et al. 2014). We placed cameras

~0.3–1.0 m off the ground to view black bear characteristics. The video cameras were motion-activated, recorded videos for 1-minute intervals at up to 60 frames/second, and were functional 24 hours daily. We checked video cameras every 2–3 weeks during summers 2011–2014 and replaced camera batteries ≥4–5 times annually. During 2015–2021, we checked cameras and replaced camera batteries every 6 weeks during March–November, annually.

In addition to collecting video data, we installed hair collection stations (Mulders et al. 2007, Kendall et al. 2009, Ramsey et al. 2019) in 2013 and began live-capturing research bears in 2020. During 2013–2022, we collected >1,350 bear hair samples at 36 rub trees and rub posts to determine individual genetic identity, maternity, and paternity (Reynolds-Hogland et al. 2022a, 2022b). Detailed methods of genetic analyses, conducted by the National Genomics Center for Wildlife and Fish Conservation (Missoula, Montana, USA), are provided in Ramsey et al. (2019). During 2020–2022, we live-captured 38 black bears using cage traps that were modified with remote photography and remotely triggered trap doors (Seward et al. 2022). We fitted bears that weighed ≥55 lbs (>25 kg) with Global Positioning System collars that bore unique symbols, which we used to help identify individuals during video captures. To help differentiate males from females during video-captures, females received one ear tag in the right ear and males received one ear tag in the left ear. We pulled a premolar to determine age using cementum annuli (Willey 1974, McLaughlin et al. 1990). We also installed 3 trail cameras at each cage trap location to document bear behaviors near traps.

We meticulously scrutinized all videos of bears by carefully watching every second of each video to identify individuals and to document bear behaviors during each capture event. We defined a capture event as a video, or series of videos, in which a bear (or multiple bears) were observed at a video camera station. We used a 1-hour threshold to separate capture events when an individual moved out of the camera frame and then returned. When multiple cameras captured an individual at a single station during a single event, we used video data from all cameras to identify the individual and record behaviors, but only one video was counted as a capture event.

The vast majority of bears on our study site had unique traits (e.g., collars with unique symbols, ear tags, chest blazes, ear notches, relative ear sizes, profile snout shapes, distinct coat patterns, eyebrow colors, snout and head shapes, snout moustaches, snout scars and lines, snout colors, bare spots and scars, temporalis and masseter sizes, etc.), which we used to help identify individuals (Reynolds-Hogland et al. 2022a, 2022b). We also linked visual markers of individuals with their genetic identifications, following Ramsey et al. (2019).

For each capture event of individual bears, we classified bear behaviors as follows: rubbing, investigating (i.e., sniffing), urinating, defecating, swimming, walking, foraging, vocalizing, sitting, lying, sleeping, picking up sticks, and tool use. When we observed ≥2 bears in a video at the same time, we classified bear behaviors as follows: chasing, playing, foraging, drinking, sitting, rubbing, investigating, mating, nursing, swimming, and walking. A full analysis of bear behavior is beyond the scope of this paper. Herein, we focus on wild bear behaviors related to tool use.

Results and discussion

During January 2011–August 2022, we documented >9,200 video-capture events of an estimated 121 individual black bears (63M:40F:18 Unknown gender). We observed bears manipulating objects as tools at 2 locations on the study site: 1) the creek pool; and 2) near one bear cage trap.

True tool use at the creek pool

We collected 689 video-capture events of 48 bears (19F:28M:1U) that visited the creek pool (Table 1). It appears that bears visited the creek pool primarily to thermoregulate (Sawaya et al. 2016), but we also documented 18 events of tool use at the creek pool by 6 different bears (4F:2M; Table 2). In each video documentation of tool use, the bear picked up a stick from the bottom of the creek pool, held the stick with its forepaws, and then manipulated the stick to scratch its head or neck (Fig. 1). One bear (Bear M2; Fig. 1C) used both his forepaws and hind paws to hold and manipulate the stick. Bear F2 was documented using a stick as a tool 5 different times during 2014–2020 and Bear F11 used a stick as a tool 6 different times during 2018–2021 (Table 2). Videos of bears holding sticks with their paws and manipulating sticks to scratch are available at https://mpgcloud.egnyte.com/fl/YkIuaVZJoR.

Similar to elephants (Chevalier-Skolnikoff and Liska 1993) and orangutans (van Schaik et al. 2003), who manipulate sticks to scratch themselves, the manipulation of sticks by bears at the creek pool were examples of true tool use. All 6 bears employed an unattached environmental object (i.e., sticks that were not part of the substrate) to alter their condition (i.e., to scratch) while holding and directly manipulating the tool. The sticks that were manipulated as tools were already unattached and in the creek pool, so bears did not manufacture tools by

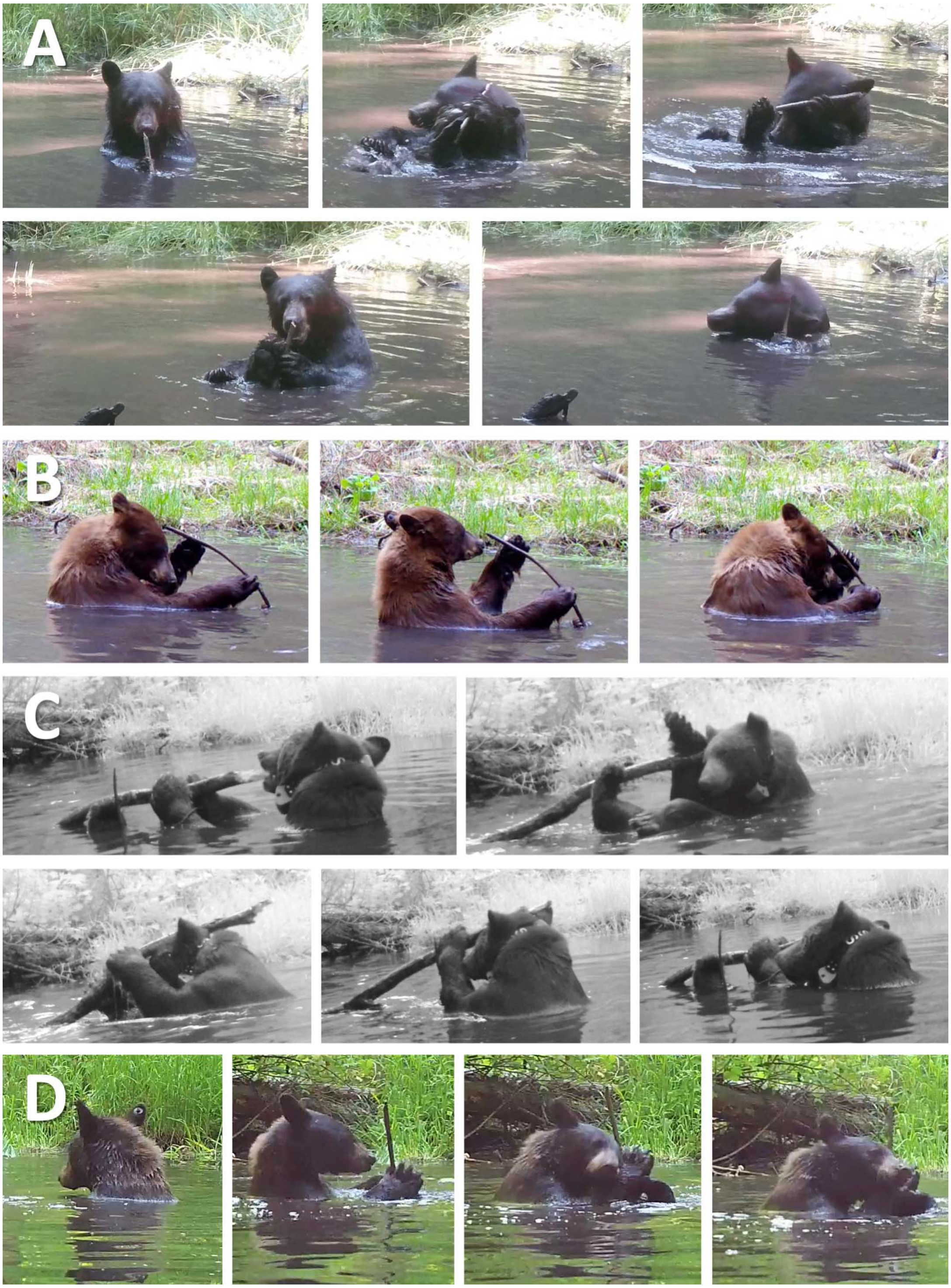

Fig. 1. Photo frames taken from videos of American black bears (*Ursus americanus*) holding and manipulating sticks as tools to scratch or rub on MPG Ranch in western Montana, USA, during 2012–2022. Video examples of 4 different bears during 4 different pool visits: (A) Bear F11 on 5 September 2018, (B) Bear M48 on 17 May 2021, (C) Bear M2 on 7 June 2021, and (D) Bear F2 on 9 July 2020.

Table 1. Individual wild American black bears (*Ursus americanus*) that visited the natural creek pool, their maternal and paternal relationships (if known), the number of capture events at the pool, the number of capture events during which the individual picked up a stick but did not use it as a tool, and the number of capture events during which the individual picked up a stick and manipulated it as a tool, on MPG Ranch in western Montana, USA, 2011–2022.

Bear ID	Gender	Mother	Father	Total no. capture events at pool	No. capture events picked up stick	No. capture events used stick as tool
F1	F			29	0	1
F2	F	F1		101	24	5
F11	F	F1	M2	69	13	6
F17	F	F4	M2	25	8	1
M2	M			56	7	3
M48	M			21	8	2
F4	F	F1		52	7	0
F6	F	F4		96	9	0
F7	F	F3		2	1	0
F22	F	F4		11	1	0
M12	M	F1	M2	15	2	0
M8	M	F4	M2	2	1	0
M52	M			3	1	0
M21	M			7	1	0
M50	M			8	2	0
F10	F			4	0	0
F13	F	F4	M2	2	0	0
F14	F	F7	M5	2	0	0
F15	F	F6	M5	22	0	0
F16	F	F2		3	0	0
F18	F	F7		1	0	0
F19	F	F11	M21	4	0	0
F20	F	F2	M15	5	0	0
F21	F	F11	M21	3	0	0
F23	F	F4	M2	2	0	0
F24	F			2	0	0
M1	M	F1		10	0	0
M3	M			3	0	0
M4	M			3	0	0
M5	M			33	0	0
M6	M			12	0	0
M11	M	F2	M2	14	0	0
M13	M	F4	M2	2	0	0
M14	M			9	0	0
M15	M			11	0	0
M16	M	F7		2	0	0
M17	M			1	0	0
M20	M	F6		6	0	0
M22	M	F2	M2	9	0	0
M32	M			1	0	0
M23	M	F4	M5	7	0	0
M33	M	F11	M21	2	0	0
M34	M	F2		5	0	0
M35	M			1	0	0
M45	M	F6	M14	8	0	0
M53	M	F2		1	0	0
M54	M			1	0	0
U10	U			1	0	0

breaking branches off trees. Two bears (Bears F11 and M2; Fig. 1A and 1C) did bite the stick end several times, possibly to shape the stick end before using it to scratch (i.e., tool manufacture). This behavior was most pronounced for Bear F11, who bit the stick end, inspected the bitten stick end with her nose and eyes, and then scratched her head with the bitten end of the stick. We documented Bear F11 performing this series of behaviors twice. Still,

Table 2. Video-documented observations of individual American black bears (*Ursus americanus*) that manipulated a stick as a tool while visiting the creek pool on MPG Ranch in western Montana, USA, 2011–2022.

Bear ID	Gender	Age	Date bear used stick as a tool
F1	F	5+	7 Aug 2013
F2	F	4	17 Aug 2014
F2	F	6	30 Jul 2016
F2	F	10	9 Jul 2020
F2	F	10	20 Jul 2020
F2	F	10	16 Sep 2020
F11	F	4	5 Sep 2018
F11	F	4	1 Nov 2018
F11	F	5	23 Oct 2019
F11	F	6	31 Jul 2020
F11	F	6	28 Aug 2020
F11	F	7	28 Jun 2021
F17	F	5	31 Jul 2022
M2	M	15	7 Jun 2021
M2	M	16	25 May 2022
M2	M	16	18 Jun 2022
M48	M	3	17 May 2021
M48	M	3	3 Oct 2021

bears regularly chew the ends of sticks without thereafter using them to scratch (P.W. Ramsey, unpublished data), so it is also plausible that the 2 bears bit the stick ends for reasons other than tool manufacture.

There were several parent–offspring relationships among our sample of tool-using bears. In fact, all 4 females that used a stick as a tool were genetically related—Bear F2 (born in 2010) and Bear F11 (born in 2014) were offspring of Bear F1, who also manipulated a stick as a tool (Table 1). Bear F17 (born in 2017) was the offspring of Bear F4 and cousin to Bears F2 and F11. In addition, 2 of these females (Bears F11 and F17) were daughters of male Bear M2, who manipulated sticks to scratch himself. Our sample size of tool-using bears was relatively small, which made it impossible to rigorously evaluate whether social learning and/or genetic inheritance represented the probable mechanism for transmission of the observed behavior. However, the most likely context for social learning in ursids is during the relatively prolonged mother–offspring association (Gilbert 1999). Previous research reported that food-conditioned foraging behavior (i.e., foraging on human foods in developed areas) by American black bears (Mazur and Seher 2008, Hopkins 2013) and on-shore behavior by polar bears (Lillie et al. 2018) were predominantly transferred via social learning from mother to offspring. In nonhuman primates, chimpanzees show tool-use behavior transmission through observational learning, where juveniles closely observe adults who successfully crack nuts using hammer stones (Biro et al. 2003) and individuals switch tool-use method after observing conspecifics using a more efficient method (Yamamoto et al. 2013).

Alternatively, tool use behavior by bears at the creek pool may have developed through individual learning (Bandini and Tennie 2020, Bernstein-Kurtycz et al. 2020) or transferred via social learning among unrelated bears. The latter seemed unlikely because independent-aged bears generally did not congregate at the creek pool. Of the 701 capture events we documented at the creek pool, only 6 capture events (<1%) included 2 independent-aged bears. Two sets of siblings swam in the creek pool post–family break-up during 2 events, and 4 sets of 2 unrelated, independent-aged bears visited the creek pool during 4 events. During all 6 capture events, no individual manipulated a stick as a tool.

Most tool use behaviors by wildlife species have their origin in the novel use of a preexisting behavior (Alcock 1972). For example, infant capuchins pound inanimate objects against a substratum (Fragaszy 1990) and long-tailed macaques manipulate stones and oysters (Tan 2017), both of which are precursor behaviors of later tool use where stones are used to crack open nuts or motile shellfish (Vauclair and Anderson 1995, Tan 2017). For our study, we similarly observed bear behaviors that may have been precursor to tool use behavior. Fifteen individuals on our study site, including all 6 bears that manipulated sticks to scratch themselves, picked up a stick from the bottom of the creek pool, held the stick with their forepaws and/or in their mouths, played with the stick, and then dropped the stick (Table 1). Moreover, the 2 females that repeatedly used sticks as tools when they were ≥4 years old (Bears F2 and F11; Table 2) frequently picked up sticks (but did not use sticks as tools) when they were <4 years old (Table S1, *Supplemental material*). Bear F2 picked up sticks and played with them during 5 capture events when she was 2 years old and during 10 capture events when she was 3 years old (Table S1). Later, Bear F2 picked up sticks and manipulated sticks to scratch herself when she was 4, 6, and 10 years old (Table 2). Similarly, Bear F11 picked up sticks and played with them during 2 capture events when she was 2 years old and during 5 capture events when she was 3 years old (Table S1). Bear F11 then picked up sticks and used sticks as tools when she was 4, 5, 6, and 7 years old (Table 2). We observed Bear F17 manipulate a stick to scratch herself only once when she was 5 years old (Table 2), and she also picked up sticks and played with them when she was 3 years old and when she was 4 years old (Table S1). We do not fully understand the ontogeny of this tool use behavior by ursids, but our observations suggest that picking up and playing with sticks with forepaws may be a precursor behavior to that of manipulating sticks as tools for scratching.

Notably, all 4 females that used a stick as a tool did so only after they had aged ≥4 years. Thus, it may be that the level of object manipulation needed to pick up a stick and use it to scratch requires dexterity and/or skill mastery that is relatively underdeveloped in younger bears. Previous research on tool use by chimpanzees similarly reported that different tool use skills were mastered at variable rates (Vauclair and Anderson 1995), where cracking nuts with stones was observed only in individuals that were >3.5 years old (Inoue-Nakamura and Matsuzawa 1997) and using tools to dip for ants was observed only in individuals >5 years old (McGrew 1977). Likewise, long-tailed macaques successfully cracked open shellfish only when they were ≥2.5 years of age (Tan 2017).

We suggest that the 6 bears that manipulated sticks to scratch themselves did so for physical maintenance (i.e., to alleviate skin irritation), but it is also possible that bears rubbed themselves with sticks to scent-mark. Bears rub against conspicuous objects like trees (Burst and Pelton 1983, Rogers 1987, Karamanlidis et al. 2007, Clapham et al. 2013) to communicate dominance, assess competitors, self-advertise for mating opportunities, investigate other social cues, and to alleviate skin irritation (Green and Mattson 2003; Clapham et al. 2012, 2014; Noyce and Garshelis 2014; Sato et al. 2014; Lamb et al. 2017; Revilla et al. 2021). On our study site, ≥20 individuals that visited the creek pool scratched, rubbed, and/or investigated (i.e., sniffed) stationary objects such as stumps at the edge of the creek pool. Thus, stationary objects at the creek pool may have been used as communication posts, and the tool use behavior we documented may have been an extension of bears' broader scratching and/or rubbing behaviors that we observed.

Borderline tool use near a cage trap

During May 2020–August 2022, we collected 631 video-capture events of 47 bears (27F:19M:1U) visiting cage traps on our study site. One individual that manipulated a stick at the creek pool to scratch or rub (Bear M48) also manipulated a tree sapling near a cage trap in an apparent attempt to capture food, which was hung near the cage trap to lure bears to the trap location. (Fig. 2; video: https://mpgcloud.egnyte.com/fl/nsWRMZM2vy). Trail cameras near the cage trap did not record behaviors during the moments leading up to Bear M48's manipulation of the tree sapling, which may have provided additional information about Bear M48's intent. However, we did video-record Bear M48 watching the hanging food as he grabbed the tree sapling. Bear M48 also looked at the hanging food after the tree sapling failed to free the hanging food, indicating Bear M48's intent was likely to manipulate the tree sapling for the purpose of accessing the hanging food (i.e., food capture). Bear M48 had previously demonstrated intent to reach hanging food near a different trap location by standing on the cage trap, standing on his hind legs directly beneath the hanging food, and climbing a nearby tree (videos available at: https://mpgcloud.egnyte.com/fl/fqw6W8Lweg).

Although Bear M48 did not successfully capture the hanging food, his manipulation of the tree sapling was an example of tool use. Bear M48 employed a manipulable attached environmental object (i.e., the tree sapling) to alter the position of another object (i.e., hanging food) while he directly manipulated the tree sapling with his forepaws (Shumaker et al. 2011). Bear M48's behavior was borderline tool use because he did not remove the tree sapling from the substrate (Boswall 1983, Bentley-Condit and Smith 2010). Nonetheless, Bear M48's behavior demonstrated complexity because it required managing dynamic spatial relations (Visalberghi and Fragaszy 2006) between the moving food target and the moving tree sapling. The conceptual creativity that Bear M48 demonstrated by manipulating the tree sapling in attempt to access hanging food was similar to that demonstrated by one captive polar bear who successfully manipulated a branch and a small log as tools to slap hanging meat off a hook (Stirling et al. 2021).

Our data have some possible shortcomings that need to be considered. Not all areas in our study site were in view of our camera network and, therefore, it is possible that we missed tool use behaviors by some bears. At the creek pool location, we installed 4 cameras near the water at 2 different angles, 1 camera at a wildlife trail along the entrance to the creek pool, and 4 cameras at a rub tree ~50 m from the creek pool. Even so, some areas near the creek pool location were not covered by our cameras so some bears that visited, but did not go into, the creek pool may have gone undetected. Our study design may have been biased toward male video-captures at the creek pool, given that female bears often avoid areas that are frequented by males, particularly when females have cubs at heel (Mattson et al. 1987; McLellan and Shackleton 1988; Wielgus and Bunnell 1994, 2000). More males ($n = 28$) than females ($n = 19$) did visit the creek pool; however, the proportion of total males (that we video-captured across the entire study site) that visited the creek pool (44%) was similar to the proportion of total females (that we video-captured across the

Fig. 2. Photo series of Bear M48 (*Ursus americanus*) manipulating a tree sapling in an apparent attempt to reach hanging food near a cage trap on 25 June 2022 on MPG Ranch in western Montana, USA.

Table 3. Examples of distinguishing traits of the individual American black bear (*Ursus americanus*) that demonstrated tool use at MPG Ranch in western Montana, USA, 2011–2022. R = ear tag in right ear. L = ear tag in left ear.

Bear ID	Sex	Collar w/unique symbols	Distinct chest blaze	Distinct rumpled coat	Coat color	Ear tag	Fur in-dentation at neck	Moustache	Ear tag
F1	F	N	Y	N	Black	NA	N	N	N
F2	F	N	N	Y	Dark brown	R[a]	Y[b]	N	N
F11	F	N	Y	N	Dark brown	R[a]	N	Y	N
F17	F	Y	N	N	Light brown	R	N	N	Y
M2	M	Y	N	N	Dark brown	R[c]	N	N	Y
M48	M	Y[d]	N	N	Cinnamon	L	Y	Y	N

[a]Ear-tagged during summer 2020.
[b]Bear had indentation at neck during summer 2020 after she dropped her collar on 11 Jun 2020.
[c]Bear is a male, but his left ear was ripped so he was ear-tagged in his right ear.
[d]Bear wore unique collar in summer and autumn 2021.

entire study site) that visited the creek pool (48%). Also, 6 females with cubs at heel visited the creek pool during times when males were not present. Thus, any bias toward male video-captures at the creek pool was likely minimal. It is possible that we misidentified some individuals that visited the creek pool and cage traps; however, our individual identifications were highly reliable (Ramsey et al. 2019; Reynolds-Hogland et al. 2022a, 2022b). For example, the 6 individuals that we observed manipulating a stick as a tool and the 1 bear that manipulated a tree sapling in an attempt to access hanging food were easily identified based on distinct physical traits (Table 3).

Our findings build on the limited research on ursid tool use and demonstrate the value of long-term video data to observe bear behaviors in the wild. Large terrestrial carnivores like bears are relatively wary, have extensive home ranges, and their populations occur at low densities (Balme et al. 2010), which makes observing their behaviors in the wild challenging. Nonetheless, Deecke (2012) documented one tool use event in the wild by a single brown bear who manipulated stones as tools for physical maintenance. We observed 19 different occasions of tool use by 6 wild American black bears, which was possible because we used noninvasive video cameras over a relatively long study duration.

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Supplemental material

Table S1. Video-documented capture events of individual American black bears (*Ursus americanus*) that picked up and played with sticks, but did not manipulate sticks as tools, on MPG Ranch in western Montana, USA, 2011–2022.