URSUS

Volume 24(2) 2013

An Official Publication of the International Association for Bear Research and Management

The fate of transported American black bears in Yosemite National Park

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Abstract: Wildlife management personnel often transport human food-conditioned (FC) bears (Ursidae) from developed areas (areas with high human-use) to undeveloped areas to reduce the number of bear incidents and property damage in developed areas. Our goal was to determine if American black bears (*Ursus americanus*) return to developed areas after being transported to undeveloped areas in Yosemite National Park. Using capture records (1992–2011) for 29 bears transported in 2006–08, we determined if FC ($n = 20$) and not human food-conditioned (NFC; $n = 9$) bears were equally likely to return to developed areas following transport. We also reported the fate of these transported bears through 2011. We found that FC bears were more likely to return to developed areas than NFC bears. Of the 16 returning bears, 15 were FC (9 juveniles, 6 adults) and one was NFC. The other 8 NFC bears were never reported as entering developed areas, and no NFC bears were reported as killed. By 2011, 65% of FC bears (13 of 20) were euthanized by wildlife management personnel ($n = 10$) or harvested near developed areas ($n = 3$). We recommend that Yosemite National Park discontinue the transport of FC bears and consider removing problem bears from the population.

Key words: American black bear, bear management, food-conditioned, human–bear conflict, relocation, translocation, *Ursus americanus*, Yosemite National Park

Ursus 24(2):120–126 (2013)

Yosemite National Park exemplifies many of the challenges faced by human–bear management programs throughout North America. Since the early 1990s, American black bears (*Ursus americanus*) have been involved in over 12,000 reported incidents and have caused more than $3.7 million in property damage (Yosemite National Park, California, USA, unpublished data). Most of these incidents result from humans inadvertently providing human foods to bears (Yosemite National Park, unpublished data). This exposure to human foods has altered foraging behavior (Graber and White 1983, Greenleaf et al. 2009), activity patterns (Graber 1981, Hastings et al. 1981, Hastings and Gilbert 1987, Mathews et al. 2006), and vital rates (Harms 1977, 1980; Graber 1981; Keay and Webb 1989; Keay 1995) of black bears in Yosemite.

Wildlife management personnel in Yosemite have long sought to reduce the number of bear incidents in Yosemite. Early bear management in Yosemite focused on transporting bears (the general act of moving bears from one site to another) from developed areas to undeveloped areas or killing human food-conditioned (FC) bears (bears that seek out anthropogenic foods; Hopkins et al. 2010). From 1960 to 1972, management personnel killed 300 FC bears in Yosemite (Thompson and McCurdy 1995; Fig. 1). In 1973, newspapers in California published articles describing Yosemite's management strategy of killing bears (Runte 1990). In response to public criticism, Yosemite restructured their bear management program and developed the *Human–bear management plan* in 1975 (National Park Service 1975). This plan outlined steps to redirect human–bear management efforts from primarily reactive management (individual-level management such as killing bears) to proactive management (population-level management such as installing food storage receptacles and educating visitors; National Park Service 1975, 2002).

New challenges arose as a result of the park switching to primarily non-lethal human–bear management methods. For example, the number of FC bears likely increased following the implementation

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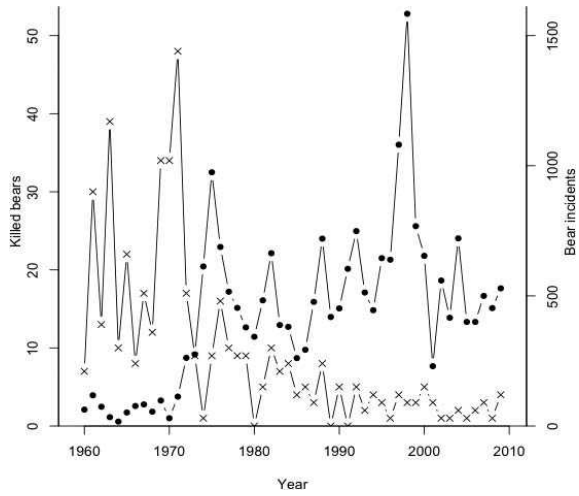

Fig. 1. American black bears euthanized by management personnel (x) and bear incidents (circles), Yosemite National Park, California, USA, 1960–2009. Data provided by Yosemite National Park, California, USA.

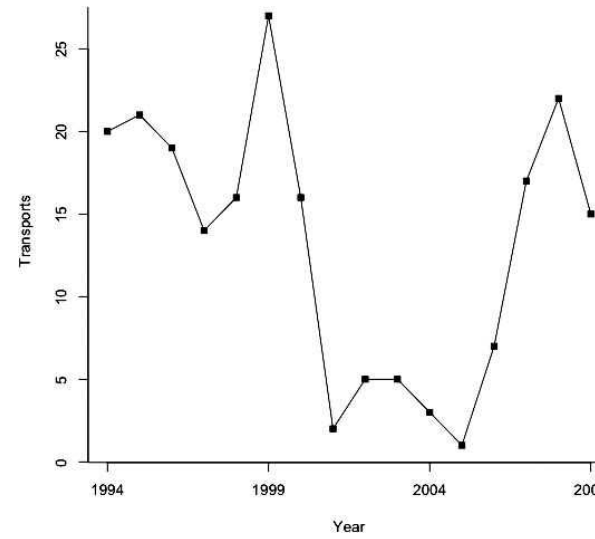

Fig. 2. The number of American black bears transported annually in Yosemite National Park, California, USA, 1994–2009. Data provided by Yosemite National Park, California, USA.

of the plan, which led to an increase in the number of bear incidents (Fig. 1). Instead of killing FC bears to mitigate incidents, the park increasingly relied on transporting bears from developed areas to undeveloped areas, a reactive management method used by Yosemite staff, beginning in 1929 (Runte 1990). For instance, from 1974 to 1976, 221 bears were captured and transported on 281 occasions (Harms 1980).

Research in the mid-1970s showed that bears transported from developed areas in Yosemite often returned and had lower survival than conspecifics (Harms 1980, Graber 1981). Consequently, use of transporting bears declined in the following years. From 1989–93, 124 bears were transported, of which approximately 80% returned to their capture areas (Thompson and McCurdy 1995). This high rate of homing is common for black bears throughout North America (Harger 1970, Beeman and Pelton 1976, Rogers 1986), especially for FC black bears (Wasem 1968, Massopust and Anderson 1984, Beckman and Lackey 2004, Landriault et al. 2009).

Wildlife management personnel continue to transport bears in Yosemite, though the *Human–bear management plan* (National Park Service 1975) states that relocation does not provide a long-term solution to mitigating incidents in the park (Fig. 2): ''[transports] will be used only as a last resort to mitigate immediate human–bear conflicts. [Transporting bears] may be used to determine which bears are involved in incidents… [transports] will not be used as a long-term solution to human–bear problems'' (National Park Service 2002:28–29). The main reason this method continues to be used in Yosemite is that transporting bears is the preferred management alternative to killing these bears and their offspring (Thompson and McCurdy 1995). In addition, juvenile bears are routinely transported from Yosemite Valley to other locations in the park because past research suggests these bears do not return to capture areas as often as adults (Harms 1980). Transported juveniles are generally not fitted with radiocollars because of potential for injury due to growth (J. Hopkins, Yosemite National Park, personal observation). As a result, the fates of these bears are often unknown unless they return to a developed areas in Yosemite or are harvested outside the park. Bears that do not return to developed areas in Yosemite are considered management successes.

Our goal was to determine if Yosemite black bears return to developed areas after being transported to undeveloped areas. Our purpose was to determine if this human–bear management method should be used in the park. We used capture records (1992–2011) and foraging behavior classifications (FC and not human food-conditioned, NFC) for bears transported in Yosemite from 2006 through 2008 to accomplish 2 main objectives. First, we determined if FC and NFC bears (juveniles and adults)

are equally likely to return to developed areas following transport. Second, we reported the fate of all transported bears in 2011.

Study area

Yosemite National Park encompasses approximately 3,080 km^2 on the western slope of the Sierra Nevada mountain range in east-central California. Ninety-five percent of the park is designated as wilderness. Elevation ranges from 648 to 3,997 m. The climate is Mediterranean, with cool, moist winters, and warm, dry summers.

Black bears in Yosemite tend to forage at lower elevations in the spring, such as Yosemite Valley (1,200 m), and follow snowmelt and sprouting vegetation upslope in June; bears then return to lower elevations in September to feed on acorns (*Quercus* spp.) and berries (Graber 1981). Each year, about four million people visit Yosemite Valley (Yosemite National Park, http://www.nature.nps.gov/stats/viewReport.cfm), an area that comprises <1% of the park and is considered good black bear habitat (Graber 1981).

Methods

Wildlife management personnel captured and transported 29 bears (15 males, 14 females) in 2006–08 (Table 1). Twenty bears were juveniles (≤3 years old) and 9 were adults (≥4 years old). Management personnel classified 20 transported bears as FC bears because they were observed foraging on human foods; they also classified 9 bears as NFC because they were never observed foraging on human foods. Management personnel followed standard Yosemite protocol for collaring and monitoring adult bears. Management personnel fitted adult bears with TR-5 radiocollars (Telonics, Mesa, Arizona, USA); affixed tags to their ears for visual identification; and implanted subcutaneous PIT tags to identify unmarked bears during subsequent captures (Avid Power Tracker II Multi-Mode Reader, Norco, California, USA). For this study, management personnel also fitted yearlings (1-year olds) and subadult bears (2- and 3-year olds) captured in 2006 and 2007 with breakaway TR-5 radiocollars with degradable canvas inserts; this system ensured collars would expand and eventually fall off bears. We attempted to locate transported bears each month from May through October using ground-based or aerial radio-telemetry. We discontinued monitoring when a bear was killed or entered Yosemite Valley; in the latter case, wildlife management personnel monitored bears as part of their daily patrols.

We searched Yosemite's capture records for bears transported in 2006–08. Some bears captured in 2006–08 were also captured before 2006; in such instances, we included these capture records in our analysis. We also included capture records for these bears if they were recaptured in 2009–11.

We summarized capture records in contingency tables (Table 2). Prior to 2005, Yosemite staff did not maintain consistent patrol records. Therefore, we were unable to calculate return rates for bears based on telemetry data. Instead, we calculated the proportion of bears that returned or did not return to developed areas following transport. We conducted three Fisher's exact tests (all bears, adults, and juveniles; $\alpha = 0.05$) to determine if FC and NFC bears were equally likely to return to developed areas after being transported. In 2011, we classified the fate of transported bears as killed (by wildlife management personnel or harvested), FC, NFC, or unknown.

Results

We identified 95 captures (1992–2011) of 29 bears transported on 60 occasions during 2006–08 (Table 1). Fifty-five percent of transported bears (16 of 29) returned to developed areas by 2011 (Table 2). Human food-conditioned bears were more likely to return to developed areas than NFC bears (Fisher's exact test, $P = 0.003$). Fifteen of 16 (94%) returning bears were FC and only 1 of 9 NFC bears returned to developed areas. FC juveniles (6 of 8) were more likely to return than NFC juveniles (1 of 8 returned; Fisher's exact test, $P = 0.020$), but this was not the case for adults (Fisher's exact test, $P = 0.333$; Table 2). Six of 8 FC adults returned by 2011 and only one NFC adult was transported; this bear did not return (Table 2). Most FC bears (13 of 20; 65%) transported in 2006–08 were euthanized by wildlife management personnel ($n = 10$) or harvested near developed areas ($n = 3$) by 2011 (Table 1). Of the 7 remaining FC bears in 2011, 3 bears were still classified as FC and 4 of these bears (2 being rehabilitated and later released) had unknown fates.

Discussion

Based on black bear capture records from Yosemite, FC bears often return to developed areas

Table 1. American black bear captures and transports in Yosemite National Park, USA, 1992–2011. Foraging class (human food-conditioned, FC; not human food-conditioned, NFC) and age class denotes the initial foraging behavior and age class of bears ($n = 29$) when first captured in 2006–08, respectively. Cubs (cub-of-the-year), yearlings (1-year olds), and subadults (2- and 3-year olds) were considered juveniles in this study. Adults are ≥4 years old. Fate refers to the status of the bear in 2011. Data provided by Yosemite National Park, California, USA.

Bear ID	Foraging class	Age class	Sex	Captures	Transports	Times returned	Fate
3094	FC	cub	F	5	3	2	killed[a]
3061	FC	cub	M	3	2	2	killed[b]
2259	FC	yearling	F	7	6	6	killed[c]
3046	FC	yearling	F	6	4	4	killed[c]
3603	FC	yearling	F	1	1	1	killed[a]
3001	FC	yearling	M	8	4	4	killed[c]
3098	FC	subadult	F	3	1	1	killed[c]
3055	FC	subadult	M	9	5	5	killed[c]
3558	FC	adult	F	9	2	2	killed[c]
3567	FC	adult	F	2	1	1	killed[c]
3566	FC	adult	M	7	4	4	killed[c]
3879	FC	adult	M	3	2	2	killed[c]
3007	FC	adult	M	1	1	1	killed[a]
968	FC	adult	F	6	5	5	FC
3057	FC	adult	F	2	1	0	FC
3602	FC	adult	M	1	1	0	FC
3090	FC	cub	F	5	4	3	unknown
3089	FC	cub	M	1	1	0	unknown
3015	FC	yearling	F	2	1	0	unknown[d]
3013	FC	yearling	M	2	1	0	unknown[d]
3563	NFC	yearling	M	1	1	0	unknown
3009	NFC	yearling	M	1	1	0	unknown
3564	NFC	yearling	F	2	2	1	unknown
2273	NFC	yearling	F	1	1	0	unknown
3010	NFC	yearling	M	1	1	0	unknown
3058	NFC	yearling	M	1	1	0	unknown
3099	NFC	subadult	M	1	1	0	unknown
3606	NFC	subadult	M	3	1	0	unknown
3100	NFC	adult	F	1	1	0	unknown
Total				95	60	44	

[a]Bear harvested in adjacent National Forest.
[b]Bear euthanized by California Fish and Game personnel.
[c]Bear euthanized by Yosemite National Park wildlife management personnel.
[d]Bear sent to a rehabilitation facility as a cub-of-the-year.

after being transported to undeveloped areas. Results from this study are consistent with past studies that investigated the behavior of transported bears. For example, Wasem (1968) showed that 8 of 13 problem black bears (defined as bears involved in repeated incidents; Hopkins et al. 2010) homed to capture areas in Glacier National Park, and 8 of 8 problem black bears traveled an average of 58.6 km (SD = 27.4 km) in 15.1 days (SD = 2.2 days) to return to urban centers in Nevada (Beckman and Lackey 2004). Sauer et al. (1969) and Rogers (1986) concluded that homing declined rapidly when black bears were transported >64 km from capture sites in the Adirondacks, and Harms (1980) suggested that transports have limited success unless black bears are moved ≥80 km. Thompson and McCurdy (1995) suggested that black bear transports failed in Yosemite because 36 km is the greatest distance bears could be moved within park boundaries. This distance does not ensure bears were transported outside their respective home ranges (Graber 1981, Matthews et al. 2003).

Bears that do not return to developed areas are considered management successes in Yosemite. Only 1 NFC bear returned to developed areas by 2011. Although we agree that NFC bears that did not return to developed areas following transport did not likely cause incidents in Yosemite Valley, they may have become FC outside the park or caused incidents in other areas of the park that were not monitored

Table 2. Number of American black bears by age class, status (returned or did not return to developed areas following transport), and foraging class (human food-conditioned, FC; not human food-conditioned, NFC), Yosemite National Park, California, USA, 1992–2011.

Age class	Status	Foraging class		Total
		FC	NFC	
Adult				
(≥4 years old)	returned	6	0	6
	did not return	2	1	3
	total	8	1	9
Juvenile				
(≥3 years old)	returned	9	1	10
	did not return	3	7	10
	total	12	8	20
All bears				
	returned	15	1	16
	did not return	5	8	13
	total	20	9	29

regularly. Considering such transports as management successes may be misleading, as this management method may have a negative effect on the survival of these bears and the social behavior of other bears in the population (Beeman and Pelton 1976). We recommend monitoring translocated bears (bears transported to locations outside their home-ranges; Hopkins et al. 2010) to determine if these bears have lower survival than NFC conspecifics (e.g., Blanchard and Knight 1995) or have negative social interactions with bears near the release site.

Most FC bears monitored in this study were killed by Yosemite wildlife management personnel or legally harvested outside the park near developed areas. In addition, all FC bears recaptured during this study retained their FC foraging behavior and were considered problem bears. Problem bears cause a majority of incidents, property damage, and human injuries in Yosemite each year (C. Lee-Roney, Yosemite National Park, California, USA, personal communication, 2013). For instance, in 2005, 3 problem bears (3821, 3558, 2394) and their 6 FC offspring likely caused most of the 344 incidents and $98,133 in property damage recorded in Yosemite Valley (J. Hopkins, Yosemite National Park, California, USA, personal observation). After a combined total of over 20 years of being classified problem bears, wildlife management personnel killed 3821 and 3558 in 2007 and 2009, respectively (Yosemite National Park, unpublished data). Genetic analysis determined that bear 3821 was the mother of FC bear 2259 (Hopkins 2013). Wildlife management personnel killed this 4-year old problem bear (2259) after being transported out of Yosemite Valley six times. Bear 2394 has been a problem bear for nearly 20 years. She and her offspring caused thousands of dollars in vehicle damage each year at a campground and hotel in Yosemite Valley (Yosemite National Park, unpublished data).

In the early 1980s, wildlife managers at Sequoia and Kings Canyon National Parks (SEKI) concluded that transporting FC black bears was ineffective at reducing the number of incidents and was both monetarily and ecologically costly (D. Gammons, Sequoia and Kings Canyon National Parks, California, USA, personal communication, 2012). Also, past management records from SEKI indicated that most bears returned to developed areas following more than 40 attempts at translocation (NPS, Sequoia and Kings Canyon National Parks, unpublished data). Sequoia and Kings Canyon National Parks personnel transported 23 bears (including females with cubs-of-the-year) in 1995–2008 primarily to provide short-term relief to both visitors and management personnel in areas experiencing high incident-levels and to avoid negative reaction from the public for killing cubs. Management personnel killed 8 bears that were transported; a hunter harvested 1 transported bear in the national forest; 2 transported bears returned to developed areas (1 bear likely died and the other has an unknown foraging behavior); and 12 transported bears had unknown fates. Management personnel killed 3 FC mothers that reared 6 offspring (all cubs-of-the-year) with unknown fates (NPS, Sequoia and Kings Canyon National Parks, unpublished data). Since 2008, transports have been discontinued in SEKI, and currently, their human–bear management program focuses primarily on implementing proactive human–bear management, hazing FC bears, and killing problem bears (D. Gammons, personal communication, 2012).

We suggest that Yosemite consider discontinuing the management practice of transporting FC bears. Although our small sample size limited our ability to make strong inferences related to the effectiveness of this management method in Yosemite, we agree with Thompson and McCurdy (1995) that capturing and transporting bears in Yosemite requires large amounts of time and money and is not likely a viable, long-term solution to reduce bear incidents. Thompson and McCurdy (1995) suggested that Yosemite should develop long-term solutions (e.g., installation of food storage receptacles) that would be more cost-effective.

Our results suggest that in most cases, problem bears are eventually killed in Yosemite. As a result, the Park should also consider euthanizing problem bears, especially females, as they likely transmit FC foraging behavior to their offspring via social mechanisms (Mazur and Seher 2008, Hopkins 2013). Continuing to implement a strong proactive human–bear management program (to prevent naïve bears from becoming human food-conditioned) and removing problems bears from the population will likely further reduce the number of bear incidents in Yosemite. Lastly, we recommend that if Yosemite continues to transport NFC juvenile bears out of Yosemite Valley or other developed areas, they should monitor the movements and activity patterns of these bears. Although our results suggest that these bears do not return to developed areas, it is important to determine their fates in order to direct the future management of these bears.

Management implications

It has become commonplace for Yosemite to scientifically evaluate the methods they use to manage people and bears (e.g., Lackey and Ham 2003, Matthews et al. 2003, Lackey 2004, McCurdy and Martin 2007, Greenleaf et al. 2009, Hopkins et al. 2012). Results from these studies can be used to help direct their human–bear management program. We recommend that Yosemite develop a human–bear management strategy that employs complementary proactive and reactive methods with demonstrated efficacy. Such a management program could help protect people, their property, and bears over the long-term in Yosemite by reducing the number of bear incidents and management-induced bear mortalities.

Acknowledgments

We are grateful to C. Lee-Roney for providing management records; J. Belant, D. Graber, and J. Waller for reviewing this manuscript; D. Gammons for providing details about the human–bear management program at SEKI; and the Yosemite Bear Council for funding this project.

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Received: 26 May 2013
Accepted: 10 July 2013
Associate Editor: J. Waller