Human–Wildlife Interactions 10(1):128–131, Spring 2016

Commentary

Distance-dependent effectiveness of diversionary bear bait sites

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Abstract: We (Stringham and Bryant 2015) previously reported on Bryant's experiment in diversionary baiting of black bears (*Ursus americanus*). This occurred during the historically severe drought of 2007, in the Lake Tahoe Basin at the border of California and Nevada, USA. Effectiveness of baiting was inversely related to each community's distance from the bait site. That has provoked the question whether conflict rates during the period of baiting would have fallen anyway even without baiting. We show here that the general trend during both pre- and post-baiting years (2005–2006 and 2008–2009) was for an increase in conflicts during the same months that conflict rate declined during 2007. We also previously reported that, when data were pooled from all 20 communities, total conflicts in the year after baiting were lower than in the year before baiting; there was no backlash after baiting ended. The question has since arisen about whether pooling data across all communities hid backlash in those communities closest to a 2007 bait site – that post-baiting conflict rate was also inversely related to each community's distance from the nearest bait station. However, our regressions reveal no such relationship between distance versus total annual conflicts in each community during either or both of the 2 years post-baiting (2008–2009).

Key words: black bear, conflict, diversionary baiting, diversionary feeding, feeding bears, human, management, Tahoe Basin, *Ursus americanus*

During May to November of 2007, the Lake Tahoe Basin, at the border of California and Nevada, suffered an historically severe drought. By July, all major tributaries to the Lake had dried up. The only known sources of water available to bears throughout most of the Basin were Lake Tahoe and its sole drainage, the Truckee River. The main mast species in the region are thimbleberry (*Rubus parviflorus*), serviceberry (*Amelanchier pallida*), Manzanita berry (*Arctostaphylos* spp.), huckleberry oak (*Quercus vacciniifolia*), and piñon pine (*Pinus monophylla*). None of these could be found by Bryant's team, and most succulent forage was desiccated by July.

Communities surrounding the Basin suffered an unprecedented level of conflicts with bears, averaging approximately 60/day by August. Millions of dollars in property was damaged by bears, and a few people were injured when they cornered a bear inside a home. These conflicts occurred despite intensive efforts by Bryant and her colleagues in the BEAR League to educate the public about preventive measures. They also escorted bears out of areas where they were not wanted, then applied aversive conditioning to reduce risk of repeat incursions. When that failed to suffice, Bryant experimented with diversionary baiting to lure bears out of communities, and to minimize incursion by new bears. During September – November, the amount and rate that conflicts declined were inversely related to distance between each town and the nearest bait site. In 7 communities approximately 1 km from a bait, conflicts declined 41% after 1 month and 93% after 3 months; mean rate of decline was 1.2% per day. In 3 communities ≥8 km from any bait, declines were delayed ≤2 months before falling at 0.6% per day (18% decline). Considering data from all 20 communities, total conflicts in the year after baiting (n = 346) were 35% lower (n = 533) than in the year before baiting.

Subsequent to publication of that paper, the need arose for more detail on how conflict levels varied over time and among communities. This addendum provides that information.

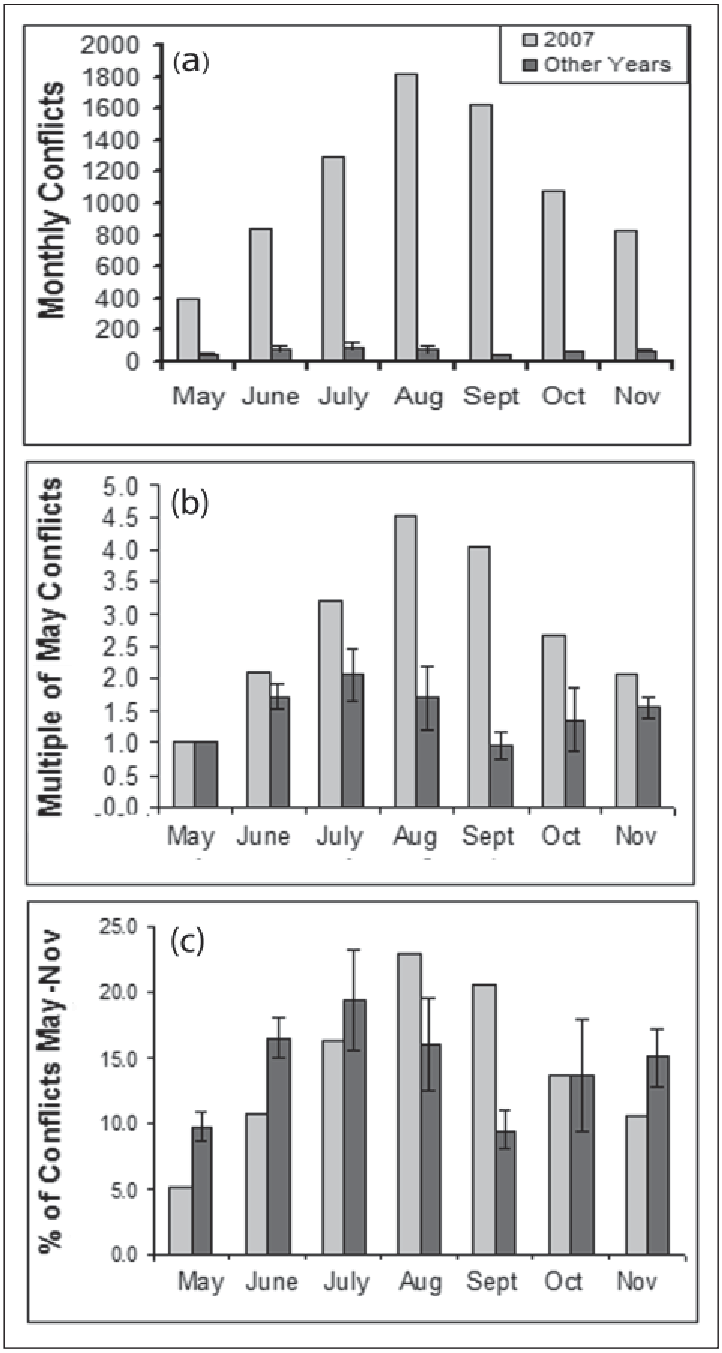

Figure 1. Monthly and annual variation in human–bear (*Ursus americanus*) conflict rates in the Tahoe Basin at the California-Nevada border during 2005–2009. (1a) Absolute numbers of conflicts per month; (1b) number of conflicts as a multiple of the number in May; (1c) % of total conflicts during May to November that occurred each month. Each graph contrasts 2007 versus the mean for the years pre-baiting 2005–2006 and post-baiting 2008–2009. Baiting occurred between the beginning of September and the end of November 2007. Error bars are ±1 SD. The entire May to November pattern of variation in relative conflict rates also differed between 2007 versus pre- and post-baiting years. That held true whether each month's rate is calculated as (1b) a multiple of the May rate (χ^2_6 = 471, P < 0.0001) or as (1c) a percentage of total conflicts during that period (χ^2_6 = 386, P < 0.0001).

Methods

Field methods were described in Stringham and Bryant (2015). For these additional analyses, we employed Chi-square and linear regression software within a QuatroPro 12 spreadsheet.

Results and discussion

Temporal variation in conflict rate

Pre- and Post-Baiting Years — On average, monthly conflict rate doubled between May and July, declined back to approximately the May rate during August to September, then rose again through November, reaching ≤50% above May and September levels (Figure 1a).

2007 — The seasonal ups and downs in conflict rate during the pre- and post-baiting (PPB) years have little relationship with those during the 2007 drought, as can be seen when these 2 periods are compared in any of 3 ways: (a) absolute conflict rates; (b) rate each month as a multiple of the May rate; and (c) percentage of all May to November conflicts that occurred each month.

a. Absolute rates: Conflict rates were not only much higher during 2007, but they rose much faster, doubling by June (month 6), then more than quadrupling by August (Figure 1a).

$$\text{Conflicts} = 470 \times \text{month} - 1{,}968$$
$$(r^2 = 0.99,\ F_{1,2} = 1{,}041,\ P = 0.001)$$

Had conflict rate continued rising at that same rate during September to November, there would have been approximately 3,202 additional conflicts during just November. Instead, relative to 1,819 conflicts in August, conflicts dropped 11% to 1,622 by the end of September and 54% to 834 by the end of November. This November rate was 74% (2,368/3,202) below the projected peak.

b. Monthly rate as a multiple of the May rate differed significantly between 2007 versus the PPB mean: $\chi^2_6 = 471$ ($P \leq 0.0001$; Figure 1b).

c. Monthly conflicts as a percentage of total conflicts during May to November differed significantly between 2007 versus the PPB mean: $\chi^2_6 = 386$ ($P \leq 0.0001$; Figure 1c).

For all 3 ways of looking at these data, the decline in conflicts during September to November 2007 was inversely related to the rise in conflicts during those same 3 months during pre- and post-baiting years. For example, as shown in Figure 1c: % Conflicts $_{2007}$ = –1.78 × % Conflicts $_{PPB}$ + 37.2 ($r^2 \approx 1.0$, $P \leq 0.0001$, $n = 3$).

Although a 54% to 74% decline is much higher than has been achieved at Tahoe with other non-lethal methods of managing conflict bears (e.g., relocation, aversive conditioning), the mean decline might have been even better and variation among communities smaller if there had been a bait station approximately 1 km from each community.

Variation among communities

Given the common observation that conflict levels tend to rise when bears lose access to a source of anthropogenic food (e.g., Gunther et al. 2004), there has been concern that a backlash actually occurred after 2007, but was hidden when we pooled data from all 20 communities to calculate total conflict levels each year. There are 2 ways to address this concern: (a) short of presenting temporal data separately for each of the 20 communities, communities could be divided into subsets; and (b) regression of total conflicts for each year 2008 and 2009 for each community versus its distance from the nearest 2007 bait site.

One correspondent raised the question of whether conflict levels were substantially higher in the 7 communities nearest (approximately 1 km) to a bait station than in the 13 more distant communities. Yes, the ratio of conflict levels between the 7 near communities versus the 13 far communities was 2.51 in 2008 and 2.26 in 2009, mean 2.38 (Figure 2). That contrasts with the 1.23 ratio during the 4 months prior to baiting in 2007, which fell to 0.36 during the 3 months of baiting. Alternately, if one instead bisects data between the 10 communities at 1–2 km versus the 10 communities at 3–20 km, the conflict ratios for near versus far communities drop to 1.81 (2008) and 1.49 (2009). Whether the ratio was also higher for the near-bait communities during 2005–2006 or after 2009 cannot be tested because data from years prior to 2007 did not always identify the location where a conflict

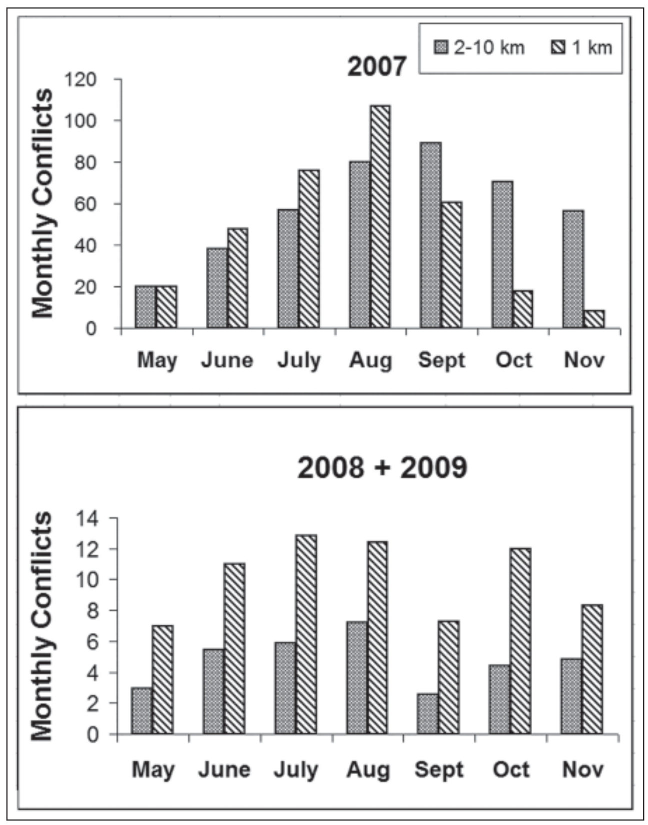

Figure 2. Mean monthly conflicts in communities that were near (approximately 1 km, n = 7) versus far (2–20 km, n = 13) from a bait site during the 2007 baiting experiment. During the 2007 drought in the Lake Tahoe Basin, human–bear conflict rates started out equal in near versus far communities in May 2007, then rose faster and farther in the near communities through August. After baiting began in September, conflict rates fell faster and farther in near communities. During the 2 following years, rates averaged >2-fold higher in the near communities. This should not be misinterpreted as indicating that the near communities suffered a post-baiting backlash. In reality, most of the near-community increase in conflict rates post-2007 occurred in the Tahoe Basin's only large city, South Lake Tahoe, which is not representative of the other 6 near communities, which are much smaller.

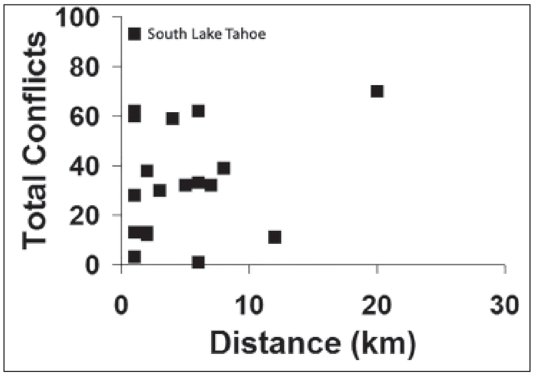

Figure 3. Post-baiting conflicts in each of 20 communities relative to each community's distance (km) from the nearest 2007 bait site. Data pooled from 2008 and 2009 ($r^2 = 0.01$, $F_{1,18} = 0.28$, $P = 0.60$).

occurred; also, newer data have not yet been analyzed.

To the uncritical eye, this might suggest that communities that showed the greatest declines in conflict rate during baiting also had the highest conflict rates after baiting. However, that is an artifact of bisecting the data and to the disproportionate influence by South Lake Tahoe, the Basin's one major city and its major garbage source for bears. South Lake Tahoe was one of the communities approximately 1 km from a bait site and is not representative of smaller communities. When the South Lake Tahoe data are omitted, the ratios for the smaller near versus far communities drop to 1.01 (2008) and 0.92 (2009), demonstrating that no general backlash occurred, much less was hidden when Stringham and Bryant (2015) reported only annual totals. This is confirmed by regressing each of the 20 community's annual total conflicts versus distance from the nearest bait site. There is no correlation (2008: $r^2 = 0.01$, $F_{1,18} = 0.26$, $P = 0.65$; 2009: $r^2 = 0.01$, $F_{1,18} = 0.27$, $P = 0.61$; Figure 3).

Conclusions

These previously unpublished results fully support our original (Stringham and Bryant 2015) conclusions that (a) the effectiveness of baiting was inversely related to distance between each community and the nearest bait site, and that (b) baiting did not generate a post-baiting backlash of increased conflicts.

Acknowledgments

This study was done under the auspices of the Tahoe Basin's BEAR League. Major funding sources included the Jane Dorothy Perlmutter Foundation, the Truckee-Tahoe Community Foundation, Harrah's/Harvey's, and Rick and Ali Van Zee. Richard Hoskins and Lynn Rogers read an early draft of this manuscript and provided valuable insights. The BEAR League's Executive Director Ann Bryant was Principal Investigator. She designed and conducted the experiment, with the aid of numerous volunteers. Consulting biologist Stephen Stringham, Chair of the League's Science Advisory Board, analyzed and interpreted the League's data, then wrote this paper.

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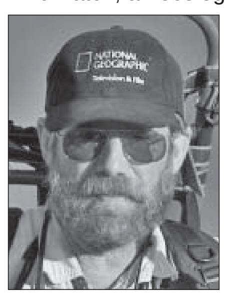

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Ann Bryant is the executive director of the BEAR League, a 1500-member NGO centered in the Tahoe Basin at the border of California and Nevada. She majored in philosophy at Mankato State University in Minnesota. Founded 18 years ago to promote harmonious bear–human coexistence, the League has become a pioneering example of citizen science and wildlife stewardship working in cooperation with municipal, state, and federal agencies, and with a local wildlife rehabilitation center.