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### ATTRACTION OF BIRDS TO HUMAN FOOD IN YOSEMITE NATIONAL PARK, CALIFORNIA

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**ABSTRACT:** We studied the attraction of birds to human food at 50 picnic sites in Yosemite National Park, California, during summer 2009. At each site we made two 10-minute point counts, one in the morning, when human food was never present, and one at midday, when human food was always present. Eight of 26 species fed on human food. We found fewer individuals and species during counts with human food at high-elevation sites and more individuals and species during counts with human food at low-elevation sites. Significantly more Steller's Jays (*Cyanocitta stelleri*) and significantly fewer Mountain Chickadees (*Poecile gambeli*) occurred during counts with human food.

Some species of birds are more sensitive than others to changes in their natural environment. In human-modified patches within larger natural landscapes, such as picnic areas, campgrounds, and ski resorts, populations of sensitive species may increase or decrease in response to human disturbance, presence of human food, habitat changes, or a combination of these factors (e.g., Aitchison 1977, Foin et al. 1977, Guth 1978, Watson 1979, Blakesley and Reese 1988, Piper and Catterall 2006).

Interactions between visitors and animals have been a feature of Yosemite National Park, California, for many decades. The Black Bear (*Ursus americanus*), for example, is notorious for its attraction to human food and becoming habituated to the presence of people (e.g., Madison 2008). Studies of bird and mammal populations in Tuolumne Meadows revealed that the American Robin (*Turdus migratorius*), Brewer's Blackbird (*Euphagus cyanocephalus*), and Brown-headed Cowbird (*Molothrus ater*) were more common and the Dark-eyed Junco (*Junco hyemalis*) was less common within an established campground than in an adjacent area of similar size outside of the campground (Foin et al. 1977, Garton et al. 1977a, b).

Although it is illegal to feed wildlife within Yosemite National Park (Code of Federal Regulations, Title 36, Pt. 2, §2.2), tourists continue to do so. However, the effect of human food on the biology of the species consuming it is poorly known. The long-term feeding of wildlife alters natural behavior patterns and population levels and often results in dependency on human food and habituation to people (Orams 2002). In this study we identify the species of birds attracted to human food and attempt to quantify their attraction to human food within the park.

#### METHODS

From 16 to 19 June and 28 to 30 July 2009 we made fixed-radius point counts (Hutto et al. 1986) of birds at 50 publicly accessible picnic sites in Yosemite National Park. The sites included 19 high-elevation sites (1480–2635 m) along Highway 120, Tioga Road, and Glacier Point Road and 31

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low-elevation sites (870–1280 m) along the Merced River from Arch Rock to Yosemite Valley and at Wawona. Each point count encompassed one or more picnic tables within a radius of 25 m. If not all of the tables within a given picnic area were within the 25-m radius, we divided the picnic area into multiple non-overlapping circles, each with a radius of 25 m. At each count site we counted and attempted to identify all birds detected (seen or heard), except those seen flying through or above the count area, for 10 minutes at two different times of the day: in the morning (07:00–11:24), when nobody was eating at the tables and food was never present, and at midday (10:35–16:17), when people were eating at one or more tables and food was always present. We also recorded which species approached within 2 m of a table with picnickers, fed on human food, or were intentionally fed by people.

We arctan-transformed the raw data for the number of individuals and number of species to meet the assumptions of normality and homogeneity of variances for parametric statistical tests. We used the paired-sample *t* test (*t* statistic; Zar 1999) to compare the numbers of individuals and species during counts with and without human food at low-elevation sites, high-elevation sites, and all sites combined. We used a two-way analysis of variance (ANOVA) to test for differences and an interaction between the categorical variables of food (absent or present) and elevation (low or high) for the numbers of individuals and species of birds.

Because of the large number of zero counts for each species, transformations of the raw data were unable to meet the assumptions of parametric statistical tests. Therefore, for each species observed on ten or more counts, we used the nonparametric Wilcoxon paired-sample test (*T* statistic = smaller sum of positive or negative ranks; Zar 1999) to compare the number of individuals on counts with and without human food for all sites combined. For all statistical tests we used Statistix 9 (Analytical Software, Tallahassee, FL).

## RESULTS

We identified 26 species of birds during the point counts (Table 1). Eight were observed being fed human food (Table 1): Mallard (*Anas platyrhynchos*), Steller's Jay (*Cyanocitta stelleri*), Common Raven (*Corvus corax*), American Robin, Black-headed Grosbeak (*Pheucticus melanocephalus*), Red-winged Blackbird (*Agelaius phoeniceus*), Brewer's Blackbird, and Brown-headed Cowbird. Of these, all but the Common Raven were seen approaching within 2 m of a picnic table at which people were eating.

The remaining 18 species were detected during point counts but were not observed feeding on human food (Table 1): Hairy Woodpecker (*Picoides villosus*), White-headed Woodpecker (*P. albolarvatus*), Northern Flicker (*Colaptes auratus*), Hammond's Flycatcher (*Empidonax hammondii*), Dusky Flycatcher (*E. oberholseri*), Cassin's Vireo (*Vireo cassinii*), Mountain Chickadee (*Poecile gambeli*), Red-breasted Nuthatch (*Sitta canadensis*), Brown Creeper (*Certhia americana*), Yellow Warbler (*Dendroica petechia*), Yellow-rumped Warbler (*D. coronata*), Hermit Warbler (*D. occidentalis*), Wilson's Warbler (*Wilsonia pusilla*), Spotted Towhee (*Pipilo maculatus*), Fox Sparrow (*Passerella iliaca*), Dark-eyed Junco, Western Tanager (*Piranga ludoviciana*), and Pine Grosbeak (*Pinicola enucleator*).

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**Table 1** Number of Individuals per Count on Paired Counts without (Morning) and with (Midday) Human Food at 31 Low- and 19 High-Elevation Picnic Sites in Yosemite National Park, California

Species	Low elevation						High elevation					
	Food absent			Food present			Food absent			Food present		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
Mallard <sup>a,b,c</sup>	0.00	0.00	0	0.29	1.62	0-9	0.00	0.00	0	0.00	0.00	0
Hairy Woodpecker	0.03	0.18	0-1	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0
White-headed Woodpecker	0.06	0.25	0-1	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0
Northern Flicker	0.03	0.18	0-1	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0
Hammond's Flycatcher	0.00	0.00	0	0.00	0.00	0	0.11	0.46	0-2	0.11	0.32	0-1
Dusky Flycatcher	0.00	0.00	0	0.00	0.00	0	0.05	0.23	0-1	0.05	0.23	0-1
Cassin's Vireo	0.00	0.00	0	0.03	0.18	0-1	0.00	0.00	0	0.00	0.00	0
Sieller's Jay <sup>a,b,c</sup>	0.32	0.70	0-2	0.65	0.75	0-3	0.32	0.95	0-4	0.68	1.20	0-4
Common Raven <sup>a,c</sup>	0.29	0.69	0-3	0.42	0.81	0-3	0.00	0.00	0	0.00	0.00	0
Mountain Chickadee	0.13	0.43	0-2	0.03	0.18	0-1	0.42	0.84	0-3	0.05	0.23	0-1
Red-breasted Nuthatch	0.03	0.18	0-1	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0
Brown Creeper	0.10	0.40	0-2	0.00	0.00	0	0.05	0.23	0-1	0.00	0.00	0
American Robin <sup>a,b,c</sup>	0.29	0.53	0-2	0.13	0.34	0-1	0.21	0.92	0-4	0.21	0.92	0-4
Yellow Warbler	0.00	0.00	0	0.06	0.36	0-2	0.00	0.00	0	0.00	0.00	0
Yellow-rumped Warbler	0.00	0.00	0	0.00	0.00	0	0.32	0.95	0-4	0.11	0.46	0-2
Hermit Warbler	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.05	0.23	0-1
Wilson's Warbler	0.00	0.00	0	0.00	0.00	0	0.05	0.23	0-1	0.00	0.00	0
Spotted Towhee	0.00	0.00	0	0.00	0.00	0	0.05	0.23	0-1	0.05	0.23	0-1
Fox Sparrow	0.00	0.00	0	0.00	0.00	0	0.05	0.23	0-1	0.00	0.00	0
Dark-eyed Junco	0.00	0.00	0	0.06	0.36	0-2	0.84	1.38	0-5	0.37	0.60	0-2
Western Tanager	0.10	0.40	0-2	0.06	0.25	0-1	0.11	0.46	0-2	0.00	0.00	0
Black-headed Grosbeak <sup>a,b,c</sup>	0.16	0.45	0-2	0.10	0.30	0-1	0.00	0.00	0	0.00	0.00	0
Red-winged Blackbird <sup>a,b,c</sup>	0.00	0.00	0	0.16	0.64	0-3	0.00	0.00	0	0.00	0.00	0
Brewer's Blackbird <sup>a,b,c</sup>	1.19	2.33	0-9	2.81	8.27	0-35	0.74	1.63	0-6	0.79	1.96	0-7
Brown-headed Cowbird <sup>a,b,c</sup>	0.00	0.00	0	0.06	0.36	0-2	0.00	0.00	0	0.00	0.00	0
Pine Grosbeak	0.00	0.00	0	0.00	0.00	0	0.16	0.50	0-2	0.00	0.00	0
Unidentified species	0.00	0.00	0	0.00	0.00	0	0.11	0.46	0-2	0.00	0.00	0

<sup>a</sup>Observed eating human food.

<sup>b</sup>Approached within 2 m of an occupied picnic table.

<sup>c</sup>Observed being fed by picnickers.

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At low-elevation sites and all sites combined, the number of individuals and number of species per count on counts with human food did not differ significantly from those on counts without human food (Table 2). At high-elevation sites, however, the number of individuals and number of species were both significantly higher for counts without human food (Table 2). A two-way ANOVA testing for differences and an interaction between the categorical variables of human food (absent or present) and elevation (low or high) found that the two variables were not significant for the number of individuals ( $F = 1.40$ ,  $P = 0.24$  for human food;  $F = 0.08$ ,  $P = 0.78$  for elevation), but the interaction between the two variables was significant ( $F = 4.10$ ,  $P = 0.046$ ). The results were similar for the number of species ( $F = 1.16$ ,  $P = 0.28$  for human food;  $F = 0.30$ ,  $P = 0.58$  for elevation), which also had a significant interaction ( $F = 4.49$ ,  $P = 0.037$ ). The significant interactions between human food and elevation indicate that numbers of individuals and species were lower on counts with human food present at high-elevation sites and numbers of individuals and species were higher on counts with human food present at low-elevation sites (Figure 1).

Only six species were recorded on ten or more counts (Table 3); of these, all except the Mountain Chickadee and Dark-eyed Junco were observed eating human food. Significantly more Steller's Jays (a species observed eating human food) and significantly fewer Mountain Chickadees (a species not observed eating human food) were observed during counts with human food than during counts without human food (Table 3). We found no significant differences for the remaining species.

## DISCUSSION

The significant interaction between human food and elevation may explain why we found no significant differences for all sites combined for the number of individuals, number of species, and for all but two species recorded on ten or more counts. Instead of being attracted to food at midday at the lower-

**Table 2** Abundance of Birds per Count on Paired Counts without (Morning) and with (Midday) Human Food at Picnic Sites in Yosemite National Park, California

Sites	Food absent			Food present			$t^a$	$P$
	Mean	SD	Range	Mean	SD	Range		
Low elevation ( $n = 31$ )								
Individuals	2.74	2.92	0–12	4.87	8.75	0–38	-0.81	0.43
Species	1.55	1.23	0–4	1.74	1.24	0–5	-1.02	0.31
High elevation ( $n = 19$ )								
Individuals	3.58	2.80	0–4	2.47	2.99	0–9	2.59	0.02
Species	1.79	1.03	0–4	1.21	1.18	0–3	2.49	0.02
All sites combined ( $n = 50$ )								
Individuals	3.06	2.87	0–12	3.96	7.18	0–38	0.83	0.41
Species	1.64	1.16	0–4	1.54	1.23	0–5	0.68	0.50

<sup>a</sup>Results of paired-sample  $t$  tests.

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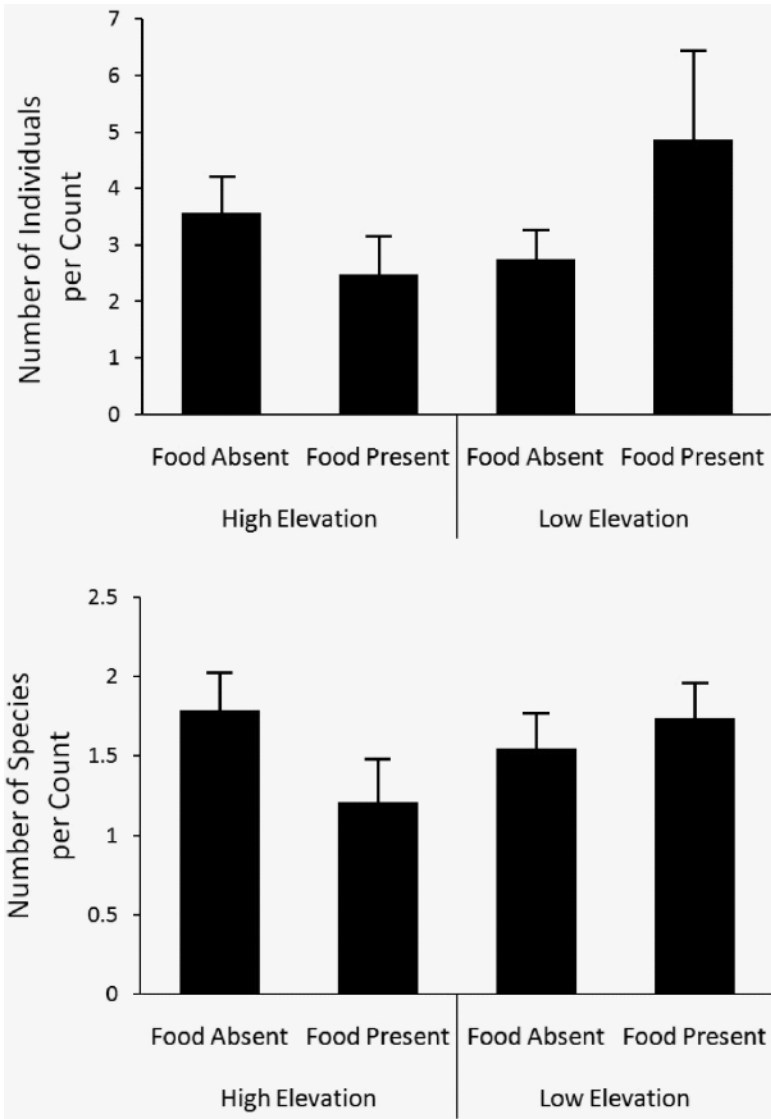


Figure 1. Number of individual birds and species per count on paired counts without human food (morning) and with human food (midday) at 31 low- and 19 high-elevation picnic sites in Yosemite National Park, California. Bar, 1 standard error.

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**Table 3** Abundance of Birds per Count on Paired Counts without (Morning) and with (Midday) Human Food for Species Recorded on  $\geq 10$  Counts at Picnic Sites in Yosemite National Park, California

Species	Food absent			Food present			$T^a$	$P$
	Mean	SD	Range	Mean	SD	Range		
Steller's Jay	0.32	0.79	0-4	0.66	0.94	0-4	30	0.02
Common Raven	0.18	0.56	0-3	0.26	0.66	0-3	25	0.50
American Robin	0.26	0.69	0-4	0.16	0.62	0-4	0	0.10
Mountain Chickadee	0.24	0.62	0-3	0.04	0.20	0-1	0	0.02
Dark-eyed Junco	0.32	0.94	0-5	0.18	0.48	0-2	15	0.22
Brewer's Blackbird	1.02	2.08	0-9	2.04	6.65	0-35	86.5	0.50

<sup>a</sup>Results of Wilcoxon paired-sample tests.

elevation sites, it is possible that birds in dense forests with low morning light levels were simply more active at midday, but activity of most species of birds peaks within the first few hours of dawn in similar habitat in Oregon (Skirvin 1981), as is consistent with our data from high-elevation sites. The apparent stronger attraction of birds to human food at lower elevations (Table 2, Figure 1) may be due to differences in the exposure of birds to human food at different elevations in the park. Unlike high-elevation picnic sites, which are closed during the winter months, low-elevation sites are open to tourists year round, providing a more permanent and predictable source of human food. Birds at high-elevation sites may be less attracted to human food because it is a less dependable resource. The higher numbers of birds detected during counts without human food at high-elevation sites may reflect greater activity of birds during the morning (e.g. Robbins 1981, Skirvin 1981), greater hesitancy of birds to approach human food, repulsion of birds by the presence of picnickers, or a combination of these factors. At high-elevation sites we observed no birds approaching within 2 m of an occupied picnic table (although several birds did approach); in contrast, seven species approached within 2 m during counts at low-elevation sites.

Our data indicate that at least eight species of birds in the park forage on human food; of these, only the Steller's Jay was significantly more abundant on counts with human food. However, some of the birds recorded during the morning counts appeared to have been searching for human food even though no people were eating at the time, for we occasionally saw Steller's Jays and Brewer's Blackbirds searching for leftover food under or on top of picnic tables.

Our list of species attracted to human food is undoubtedly incomplete. Hayes has observed three additional species feeding on human food during previous visits to the park: a Sooty Grouse (*Dendragapus fuliginosus*) with chicks fed by people on 6 August 2006 at Glacier Point (see photo on this issue's back cover), a Bullock's Oriole (*Icterus bullockii*) eating human food on 3 July 2009 at Yosemite Lodge in Yosemite Valley, and a Gray-crowned Rosy-Finch (*Leucosticte tephrocotis*) fed by people on 7 July 1983 on top of Half Dome. Foin et al. (1977:19) reported that in Tuolumne Meadows

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Campground, Mountain Chickadees “frequently darted to the ground to pick up scraps left by campers,” but we never observed such behavior and our data suggest that they departed from picnic areas when people were present.

The effect of human food on the biology of most of these birds is poorly known. Food of human origin is important to the Brown-headed Cowbird in the Sierra Nevada, which is prime habitat for many species that host its parasitic young but apparently marginal habitat with respect to cowbird food (Rothstein et al. 1980, Verner and Ritter 1983, Airola 1986, Rothstein et al. 1987). Its recent population increases may threaten other species that host its young (Rothstein et al. 1980, Verner and Ritter 1983, Airola 1986). We observed Brown-headed Cowbirds only once, when two were fed by people (Table 1).

Despite the prohibition against feeding wildlife in Yosemite National Park, we found that birds are still often fed by tourists. Because the feeding of wildlife has mostly negative but also some positive effects on both wildlife and people (e.g., see review by Orams 2002), more empirical data are needed on the effects of birds feeding on human food.

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