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DAVID S. LEE, *N.C. State Museum of Natural Sciences, P.O. Box 27647, Raleigh, North Carolina 27611;* AND WALTER R. SPOFFORD, *Rancho-Aguila, P.O. Box J, Portal, Arizona 85632.* *Received 11 Dec. 1989, accepted 2 Mar. 1990.*

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Notes on Gray Jay demographics in Colorado.—The social organization and population dynamics of the Gray Jay (*Perisoreus canadensis*) are not well known. Most literature on the Gray Jay is anecdotal, consisting primarily of casual field observations or more detailed observations of one or very few individuals over a period of days or weeks (e.g., Warren 1899; Skinner 1921; Lawrence 1947, 1968; Rutter 1969; Burnell and Tomback 1985). To describe accurately the social and population structure, more long-term studies are required. The value of long-term studies of larger populations of jays has been clearly demonstrated by Woolfenden (1975), Woolfenden and Fitzpatrick (1984) and Brown (1963a, b, 1987). The objective of this paper is to provide an initial report of an ongoing demographic and behavioral study of Gray Jays in the northern Colorado Rocky Mountains. We provide information on survivorship based on mark-resight data, movements, and group size and composition. This report is based on field data obtained over eleven years of sporadic data collection; however, it provides the best information presently available on long-term patterns of Gray Jay social organization.

Materials and methods.—This study was conducted in the Colorado State Forest (CSF), which is 152 km west of Fort Collins on the west slope of the Medicine Bow Mountains, at an altitude of 2500–3800 m. The habitat is open pine forest on west and south-facing dry slopes below 2900 m and closed pine-spruce-fir forest interspersed with grass meadows on north slopes and above 2900 m. Three primary banding sites were established, approximately 3.2 km apart, within a 23-km^2 study area. Site #1 was located at North Michigan Reservoir; Sites #2 and #3 were north and east of the reservoir. Sites #1 and #2, located at

small CSF campgrounds, were established in 1979; Site #3 was more isolated and was established in 1986. All three sites were located at 2700–2800 m elevation. Based on our banding efforts and observations, each site was used concurrently by two to four distinct groups of Gray Jays. Gray Jays were trapped using two-cell Potter traps and a variety of baits. Occasionally, tapes of various Gray Jay vocalizations were used to attract jays to the immediate area of the traps. Each individual was marked with a permanent, numbered U.S. Fish and Wildlife Service aluminum band and a unique combination of plastic, colored, leg bands. These colored bands allowed individual identification of birds at operational distances using binoculars or a spotting scope. Individual Gray Jays were recognized from their colored leg bands during periodic surveys from 1979 to 1989. Positive identification was made whenever possible by re-trapping birds and reading the USFWS aluminum band numbers. These surveys, until recently, were made primarily in the summer and fall months when the study site was readily accessible. Since fall 1986, increased access and personnel have allowed a more intensive effort to band and locate jays during winter and spring months when approximately 1–2-m-deep snow blankets the area.

Gray Jay nesting occurs in late February and March (Brewer 1879, Bradbury 1918, Hurlbutt 1932, Bailey and Niedrach 1932); therefore, minimum longevity calculations were made by assuming that jays banded in adult plumage during summer months were hatched in March of the previous year, while birds in juvenile plumage were assumed to have been born in March of the current year. Jays on our study area cannot be reliably aged after October of their birth year due to their fall molt into adult plumage. Mark-resight survivorship estimates were calculated using the Kaplan-Meier product-limit estimation technique (Kaplan and Meier 1958) and were based on the minimum number of quarters (three month periods, beginning in January) a bird was known to have survived on the study site. Those individuals located in the past year were considered alive (unless death was confirmed) and were classified as "closed" in the Kaplan-Meier calculations. It was assumed that all birds that disappeared had died. Population size was estimated using Jolly-Seber estimators (Nichols et al. 1981), in which relocations were equated with recaptures of individually banded jays. Group size and composition were summarized by number, age class, and season (quarter).

Results and discussion.—Average longevity of a Gray Jay after banding as an adult (N = 86) was 2.8 years (median = 1.7 years). For those banded as juveniles (N = 27), the average longevity after banding was 1.6 years (median = 0.7 years). The maximum longevity, including minimum back-calculation to birth date, is seven years, nine months. The longevity record for Gray Jays is ten years, two months (Clapp et al. 1983); however, we feel that this was based on an incorrect assumption, that Gray Jays retain their juvenile plumage for at least 1.5 years. In the original report, Farner (1947) made no such statement and claims a minimum age of nine years. In our experience with western Gray Jays, juveniles reach full adult measurements in five months (July) and are indistinguishable from adults in color after 1 October. If our assumption of adult plumage after October is correct, then the minimum age of the Farner bird is nine years, five months.

Minimum age survivorship curves for the jays banded as adults (unknown age) and juveniles (known age) are shown in Fig. 1. Survivorship is higher for birds banded as adults, a finding expected but not found in Scrub Jays (Woolfenden and Fitzpatrick 1984). Survivorship of adult and juvenile Gray Jays in Colorado appears to be much lower than Scrub Jay breeders in Florida (Woolfenden and Fitzpatrick 1984). This may be due to higher mortality in Gray Jays or may simply reflect a more transient species or population. We believe, based on the literature and movement and dispersal information described below, that higher mortality due to the relatively harsher sub-alpine environment of the Rockies is the more likely possibility.

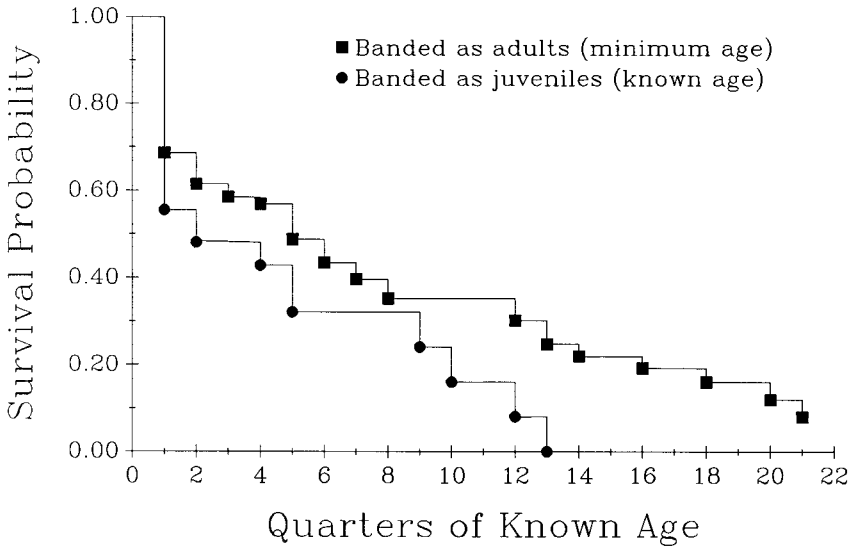

FIG. 1. Kaplan-Meier survivorship curves for Gray Jays in northern Colorado. Birds banded as adults are of unknown age (minimum-age survivorship) while birds banded as juveniles are of known age (known-age survivorship).

Low nesting success and high early mortality of juveniles is indicated by the fact that only 42% of mated pairs had one or more juveniles with them in the July–September quarter (pairs with one juvenile = 27%; two juveniles = 15%). By the October–December quarter, only 19% of pairs still had juveniles (pairs with one juvenile = 17%; two juveniles = 2%). No dispersal of juveniles at these times of year was recorded.

Dispersal movements of Gray Jays appear to be very limited. After 169 person-days of censusing of 116 jays banded in this study area, no band recoveries were made at an appreciable distance from the site at which the jay was banded. Mean maximum distance from banding site for adult jays was 264.6 m (range: 86–858 m; N = 34) and for jays banded as juveniles was 208 m (range: 18–522 m; N = 13). There is no significant difference in these distances ($P > 0.05$, two-way ANOVA). Mean maximum distance was significantly lower at the more isolated Site #3 (mean: 169.99 m vs 298.15 m at two other sites; $P = 0.014$, two-way ANOVA), probably because this site was more heavily forested than the other sites. We hypothesize that there was more usable forest habitat near the capture site at Site #3 and less need to move long distances. This also meant that jays were more difficult to locate and identify at a distance. In summary, birds in this population were relatively stationary, with territorial vacancies into which juveniles can move occurring frequently due to relatively high mortality (Fig. 1).

Overall population size, based on Jolly-Seber estimators for the pooled data from all three banding sites, averaged 27.6 birds from 1982 through 1988 (range: 18.0–50.9). While this initially appears to be a large variation in population size, 80% of this variation between years was explained by a regression against person-days in the field for a given years ($r = 0.89$; $P \leq 0.05$). Mean group sizes for each season and age class (Table 1) are independent of census effort. Group sizes stabilized at approximately 2.3 for the winter months (Jan.–

TABLE 1
AVERAGE GROUP SIZE OF GRAY JAYS, TABULATED BY AGE CLASS AND SEASON

		Jan.–Mar.	Apr.–Jun.	Jul.–Sep.	Oct.–Dec.
Adults	Mean	2.3[a]	2.2	2.3 (2.3)[b]	2.1 (1.7)
	SD	0.9	0.9	0.9 (0.8)	1.1 (0.7)
	N	16	12	48 (20)	40 (8)
	Range	1–4	1–4	1–4 (1–4)	1–7 (1–3)
Juveniles	Mean	—[c]	—	0.6 (1.3)	0.2 (1.0)
	SD			0.7 (0.5)	0.5 (0.0)
	N			48 (20)	40 (8)
	Range			0–2 (1–2)	0–2 (1–1)
Total	Mean	—	—	2.9 (3.7)	2.3 (2.9)
	SD			1.1 (0.9)	1.1 (0.8)
	N			48 (20)	40 (8)
	Range			1–5 (2–5)	1–7 (2–4)
Percentage of single bird groups		0.19	0.08	0.12	0.17

[a] Group size values include repeated sightings of the same groups across, but not within, quarters and years.
[b] In parentheses are values for groups which contained young of the year.
[c] It is impossible to distinguish juveniles from adults during the January through June period.

Mar.). This was generally a mated pair with occasionally a surviving juvenile or an unrelated adult jay ("third bird" of Rutter 1969). Single birds constituted 8–19% (no seasonal difference) of the groups while groups of four or five (a mated pair, one or two juveniles of the year, and another adult jay) occurred in 12% of groups. The unrelated, adult "third birds" were loosely associated with, and subordinate to, all other members of the group. As expected, the number of juveniles in groups which successfully fledged offspring decreased from the third to the fourth quarter of the year (Fig. 1), but interestingly, the number of adults in the group decreased as well (Table 1).

Our preliminary data concur with those of Rutter (1969) that Gray Jays exhibit a monogamous and territorial mating system. Less than one-fifth of mated pairs raise one or two juveniles to independence, and the juveniles remain on the natal territory through winter. Movements of jays are limited, and survivorship on the home range is very low. An interesting aspect of the social organization is the presence of "third birds," adults apparently unrelated to the mated pair which reside on the territory for most of the year. The role of these "third birds" is unclear, but neither Lawrence (1947) nor Rutter (1969) reported nest helpers in Ontario Gray Jays. Intense monitoring of one nesting in our study area indicated no nest helping by a third bird present on the home range of the nesting pair throughout the nesting period (Henry pers. comm.).

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JAMES C. HA AND PHILIP N. LEHNER, *Biology Dept., Colorado State Univ., Ft. Collins, Colorado 80523.* *Received 20 Dec. 1989, accepted 20 Mar. 1990.*

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Nest-site selection by Boat-tailed Grackles.—Female birds that choose nest sites that maximize their reproductive success should have a selective advantage. If females choose nest sites predictably, males may be able to monopolize females in the same sense that predictable resources can be monopolized by an individual (e.g., Brown 1964). It is therefore