

TABLE 3. Results of *F*-tests to compare sample variances for number of feeding trips and mass delivered for the two male age groups.

	Number of feeding trips/hour			Estimated mass delivered/hour		
	<i>F</i> -statistic	df	<i>P</i> -value	<i>F</i> -statistic	df	<i>P</i> -value
1988	1.25	4, 4	0.4170	2.94	4, 4	0.1606
1989	7.56	6, 10	0.0029*	4.66	10, 3	0.1160
1988/1989	4.37	11, 15	0.0048*	3.42	15, 8	0.0423

* Significant at overall type I error rate of $\alpha = 0.05$.

yearling males than older males in 1989 and for combined years. Perhaps younger males are a more risky choice for females in that their behavior is not as consistent as older males.

The *F*-test requires that the data come from populations with normal distributions and is sensitive to deviations from this assumption (Zar 1984). Whether the normality assumption is violated in this case is unknown. Therefore, these results should be tentatively accepted. Nonetheless, the results are interesting in that they indicate an additional hypothesis for mate choice by female American Redstarts.

Dismissing the provisioning hypothesis is premature given the low power of the analyses performed by Omland and Sherry and evidence of differences in variability of the provisioning behavior of the two age groups. Collection of additional data would enhance the power of the analysis and place conclusions regarding this hypothesis on sounder ground.

PARENTAL CARE NOT LIKELY TO EXPLAIN POOR MATING SUCCESS IN YEARLING MALE AMERICAN REDSTARTS

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We welcome Beal's (1995) commentary on our paper (Omland and Sherry 1994) investigating age-specific parental care in American Redstarts (*Setophaga ruticilla*). Her assessment, based on a statistical power analysis, is that additional data are needed before we can conclude confidently that no difference exists in nestling-provisioning behavior by yearling versus older males. Her remarks echo our own caution interpreting our results, in which we stated, "It is possible that our methods and sample sizes were not capable of detecting minor differences in provisioning rates between the two age classes . . ." (p. 611, Omland and Sherry 1994). Her power analysis is useful because it indicates the

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exact level of detectable mean difference in our study. Beal's second finding, that yearling male provisioning behavior was more variable than that of older males in both 1989 and the two years combined, suggests the interesting possibility that yearlings may be relatively risky as potential mates, an idea we discuss below in the context of polygyny. While Beal's analyses aid our understanding of parental care behavior in redstarts, we nonetheless stand by the main conclusion of our study, which was that male contributions to nestling-provisioning are unlikely to be an important factor in females' choice of mate.

First, we argue that the small age-related difference in male nestling-provisioning behavior makes it unlikely to be important in females' choice of mate. Success in mating is dramatically different in the two ages of male American Redstarts in our study area: Unmated older males are nearly impossible to find, whereas about half the yearlings remain unmated on average (Omland and Sherry 1994; and TWS, unpubl. data). Such disparity is unlikely to be explained by differences in parental nestling-provisioning behavior, unless older male nests are provisioned at a consistently higher rate than yearling male nests. We originally expected such a difference in provisioning for the following reasons, (1) Yearlings tend to be in different habitats than older males due to social constraints (Sherry and Holmes 1989, and unpubl. data), which could in turn constrain

yearlings' ability to find food (as could lack of experience); (2) Yearling males might be expected to exhibit restraint in parental care if cuckolded by older males, and cuckoldry results from extra-pair matings in diverse passerine birds including redstarts (R. E. Lemon, pers. comm.); (3) Delayed plumage maturation in species such as American Redstarts is generally interpreted to indicate some disadvantage to yearlings in competition with older males; and (4) Casual observations at Hubbard Brook had suggested that yearlings might not provision nestlings at all in some cases. Contrary to expectation, our study found no dramatic age-specific difference in nestling-provisioning. And we provided ample opportunity for a difference to be detected, if it were pronounced, by considering multiple variables: rate of delivery trips to the nest, food load size per trip, rate of total food load delivered, and food type. Yearling territories could still constrain the ability of birds to provision nestlings in unusual years, e.g., those characterized by low food abundance or poor weather, but this possibility is unlikely to be detected except by long-term study. Any statistical analyses, including power analyses, of data collected in inappropriate years would be misleading. Furthermore, we reported no difference in the quality of yearling versus older male territories in terms of predation risk, based on large sample sizes of nests (Omland and Sherry 1994), and thus we need not assume that yearling male territories are inferior to those of older males in all respects.

Parental provisioning of nestlings is unlikely to explain the poor mating success in yearling male American Redstarts if other male traits have a greater influence on female choice. We mentioned several such factors elsewhere (Omland and Sherry 1994). For example, if females mate with whatever males (regardless of age or plumage) have established territories at the time females begin to breed, they would mate disproportionately with older males because of earlier territory establishment in older males. Age-specific differences in song behavior (e.g., Lemon et al. 1994; C. A. Staicer and V. Ingalls, unpubl. data) or other courtship displays likely influence mate choice. Finally, habitat constraints (territory quality) may act more in spring, when females are selecting mates, than in midsummer when birds are provisioning nestlings. Preliminary data from Hubbard Brook suggest that caterpillar abundance differs more between habitats in May than in June–July (J. Arp and TWS, unpubl. data). Females choosing territories that become suitable earlier in the season (those of older males) could get started nesting earlier and could re-nest more often in the event early nesting attempts failed. Thus, a variety of factors could have a stronger influence on female choice of mates than the potential ability of males to provision nestlings in midsummer.

Parental care of nestlings would be affected by polygyny so as to counteract any relative disadvantage that yearling male redstarts may have with respect to territory quality or lack of experience. Polygyny is not infrequent in redstarts, ranging from about 10–30% of males depending on the year; it occurs overwhelmingly (but not exclusively) in older males; and secondary

females tend to get less provisioning from their mate than primary ones (Secunda and Sherry 1991, TWS unpubl. data). From a female's perspective, older males may be as "risky" parents, due to time they spend at other nest sites, as are yearlings due to habitat constraints. We did not include any cases of known or suspected polygynous males in our analyses (Omland and Sherry 1994). Including these cases would have both decreased the mean nestling-provisioning rate of older males and increased its variance. This would have decreased the difference in feeding behavior between yearling and older males, which complicates interpretation of Beal's suggestion that older males may have less variable nestling-feeding rates than yearling males. Another implication of our data on redstart polygyny and nestling provisioning is that parental care is probably less important in explaining delayed-plumage maturation in this species than are polygyny and other factors that create the shortage of reproductive opportunities for the socially subordinate yearling males.

Further work on food delivery, and other forms of parental care, will help advance our understanding of mating success in species such as redstarts, but provisioning behavior must be integrated with other male characteristics that likely vary with age, such as territory display behavior and polygyny. Our comments above suggest that understanding of redstart mating success will be improved more by examining display behavior and territory characteristics at the time birds arrive in Spring, than by study of parental provisioning behavior later in the breeding season. We believe that our findings, which are the first to be published on provisioning behavior in a passerine with delayed plumage maturation, contribute to our understanding of this phenomenon, as well as reduce the list of factors likely to influence mate choice.

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