

BRIEF OBSERVATIONS ON THE BREEDING BIOLOGY OF THE FLAMMULATED OWL IN COLORADO

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Although the Flammulated Owl (*Otus flammeolus*) is found in western North America from Guatemala to Canada (AOU 1957), Reilly (1968) and Winter (1974) concur that little is known concerning the biology of this small, inconspicuous bird. Henry Henshaw suggested that the paucity of information regarding this small owl of montane forests may be due to its secretive behavior rather than actual rarity (Oberholser 1899). In fact, trained observers have recently discovered it to be locally common in some areas (Winter 1971).

During a study of the impact of pesticides on breeding birds in the Pike National Forest, Colorado, we located three Flammulated Owl nests. The nests were all found in 1971 within 6.4 km of each other, about 13 km north and northwest of Divide, Teller County, Colorado. One nest produced two young birds which were orphaned, removed from the nest and raised in captivity. Each of the other two nests fledged three young. Because they were obtained in research incidental to other work, our data on nesting, growth and development of wild and captive nestlings are not extensive.

STUDY AREA AND METHODS

All three nests were found at 2650 to 2775 m altitude in the upper watershed of West Creek. This watershed of the South Platte River system contains a variety of upper montane stand-types, including Ponderosa Pine (*Pinus ponderosa*) on south-facing slopes and Douglas-fir (*Pseudotsuga menziesii*), covering the steeper north-facing slopes. Ponderosa Pine is dominant on the more open south-facing slopes; however, a dry grassland complex occurs on the lower reaches of these slopes (Marr 1961). Moist bottomlands where the nests were found have complexes of willow (*Salix* spp.), Shrubby Cinquefoil (*Potentilla fruticosa*), open meadows and scattered clumps of Quaking Aspen (*Populus tremuloides*), spruce (*Picea* spp.) and fir (*Abies* sp.).

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Table 1. Characteristics of Flammulated Owl nest trees (Quaking Aspen) in the Pike National Forest, Colorado.

Nest	S. Platte River tributary	Distance to nearest known nest (km)	Height (m)		Exposure of cavity entrance	Trunk diameter at cavity (cm)
			Cavity	Tree		
1	Phantom	6.4	4.1	14.0	West	38
2	Manchester	1.6	2.4	12.0	East	45
3	Manchester	1.6	7.6	10.0	West	16

Table 2. Growth of nestling and captive young Flammulated Owls.

Date	Nestling weight (g)			Observation
	A	B	C	
Nest 1				
10-17 Jun				Adult near or peering from hole (laying or incubating)
30 Jun-14 Jul				Adult tight in nest, not flushed (incubating or brooding young)
16 Jul	44.0	39.3		Sawed inspection hole; adult (66.8g) on nest
21 Jul	45.5	45.5		No adult seen; claw marks, and section knocked out
28 Jul	32.0	29.6		Dead adult below nest; took nestlings into captivity
1 Sep	61.2	64.6		Maximum captive weight
10 Sep	60.2	64.5		Young released into wild
Nest 2				
30 Jun				Adult incubating or brooding young
7 Jul				Adult perched near nest; three nestlings in nest
10 Jul				Same as 7 July
15 Jul	46.5	41.6	47.4	Sawed inspection hole; adult (58.4g) on nest
21-28 Jul				Nestlings fledged
Nest 3				
2 Jul				Adult tight on nest, not flushed (incubating or brooding young)
7 Jul				Adult flushed off eggs; 2 pipping (1 advanced), 1 intact
10 Jul				Two adults taking food to cavity
13 Jul	29.5	44.4	37.1	Sawed inspection hole; adult flushed from nest
20 Jul	36.9	44.0	31.9	Weighed at 1930
21 Jul	46.3	55.6	42.1	Weighed at 0700
28 Jul	50.6	fldgd	47.9	Weighed at 1530
29 Jul	fldgd		58.1	Weighed at 0830

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The nests were found in live aspen by extensive searching and inspecting cavities for potential nesting sites. Hole sizes corresponded to those of the Common Flicker (*Colaptes auratus*) which are apparently favored nesting sites for the species (Bull and Anderson 1978:26-27; Eckert and Karalus 1974:161). The nest cavities are described in Table 1. None of the cavities contained obvious nesting materials other than bits of wood which were presumably left by previous occupants. We found two nests 1.6 km apart along one stream; the third nest was located in a parallel drainage 6.4 km to the west.

Cavities were initially inspected with a viewing tube designed for such use (DeWeese et al. 1975). When the nestlings were about 1 to 2 weeks old, we sawed a section about fist-size at the hole, and periodically photographed and weighed the nestlings. All weighed birds were banded with Fish and Wildlife Service bands. Turnbuckle style window-screen fasteners held the cutout section in its natural position. Cavity alterations were made during daylight hours and, in two instances, when an adult was brooding in the cavity. During the cavity alteration the adult owls were at first sluggish and sleepy when disturbed but offered little resistance, other than some bill snapping. In two nests an adult remained in the cavity, and in the third nest an adult flushed to a nearby perch. All three cavities held young when altered, and the adults did not abandon their nests as a direct result of the cavity alterations. However, we made no attempts to observe discrete behavioral effects.

ACCOUNTS OF NESTS

Weights of nestlings obtained during periodic visits to the three nests are presented in Table 2.

NEST 1

An adult was near or peering out from its cavity on several occasions between 10 and 17 June, but no eggs were observed then. From 30 June to 14 July, we were unable to see the nest contents, because the adult sat tightly within its cavity, refusing to flush. On 16 July we cut into the cavity to band and weigh the brooding adult and its two nestlings. On 21 July we found what appeared to be claw and tooth marks around the hole. Although the sawed section had been knocked out, exposing the two nestlings, both were safe inside and had gained 1 and 6 g during the previous 5 days.

On 28 July a portion of an unbanded adult Flammulated Owl carcass (pelvic girdle with its legs still attached) was found lying at the

base of the cavity tree and the cut-out section of tree was dislodged. Although it was not possible to positively identify the responsible animal, claw marks and other evidence suggested a Bobcat (*Lynx rufus*). However, a Black Bear (*Ursus americanus*) had ripped open a Common Flicker cavity in an aspen tree and depredated the nestlings less than 75 m away only 2 years prior (DeWeese and Pillmore 1972). Our alterations of the cavity hole may have given a predator the advantage necessary to take the adult.

We returned that evening to ascertain whether or not the other adult (banded) was still tending its young. Since both sexes feed young, it was possible that the other adult could raise them. Our concern was well founded because the nestlings had lost 13.5 and 15.9 g (30 to 35%) of their body weight from 21 to 28 July. We observed the nest site and frequently-used perches until 2400 on 28 July without seeing an adult. At that time we fed some moths to both nestlings. Apparently they were not satisfied with our limited supply and their begging calls became more intense. Their additional weight loss overnight and the absence of an attending adult convinced us that they would soon die from starvation; thus, we took the two nestlings into captivity. The banded adult was not seen on subsequent visits to the nest sites.

The two young were about 3 weeks old when captured, based on comparison of their previous weights with the weights of known age nestlings in Nest 3. We fed them mostly live adult grasshoppers (Acrididae), some live moths (Lepidoptera) and an occasional house cricket (Gryllidae). We initially removed the large jumping legs of the grasshoppers, but after a few days the nestlings did so themselves before ingesting them. Food was usually offered in late afternoon, once per day *ad libitum*. No attempt was made to determine the foods of wild Flammulated Owl nestlings in the study area. However, the reported diet is almost exclusively made up of a variety of insects and other arthropods (Jacot 1931, Marshall 1939, Ross 1969). Both birds were first maintained in a large cardboard box, and later moved into a screened garage where they spent much of their captive life. Residence in the garage may have helped them develop hunting and flying skills necessary for survival; the young owls were observed at night capturing insects which were attracted to a light in the garage.

In captivity the young Flammulated Owls apparently derived adequate nutrition for growth from their predominately grasshopper diet. Both birds gained weight and developed full plumage and flight capabilities before release. Pellets of chitinous grasshopper parts were noted in their cage soon after they entered captivity at about 25 days of age. We did not find any pellets in the natural cavities. At this age young in the other two nests were leaving their cavities and may

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have been fed more completely digestible foods. Wild young probably trampled beyond recognition any pellets that they regurgitated in their cavities. Our observations agree with Eckert and Karalus (1974:160) who described the pellets as "poorly formed and made up of bits of chitinous material from insects."

Near the end of captivity, at 50 to 60 days of age, the owls were occasionally released into a large indoor room and fed grasshoppers which were placed on a small low perch. At this age, the owls flew well and easily captured fully active grasshoppers (Figure 1). On several nights we saw the owls fly up to catch small moths resting on the ceiling near overhead lights. The owls captured their prey with their feet while in an upside-down position. They would return to their perch and swallow their catches immediately.

The feet were always used to initially capture, then hold the prey for plucking with the beak, if need be, before swallowing. Moths and similar softbodied insects were usually swallowed intact, but large grasshoppers were usually ripped into pieces before swallowing. Grasshoppers were usually swallowed head first, but sometimes were crushed and softened with the beak before being ingested in either large pieces or sometimes intact.

Drinking water was continually provided the captive owls, but not in large enough quantities for bathing. Soon after release, both owls plunged full-body into a nearby stream and bathed extensively. Apparently we should have given them opportunity to bathe in captivity.

When we released the young owls near their natal area on 10 September, they were about 63 days old and had nearly doubled their body weight during 44 days in captivity. About 10 g of their overall gain, however, was apparently needed to make up the weight loss caused by starvation and dehydration during their orphanage in the wild.

NEST 2

This nest was first found on 30 June, but a tenacious adult in the cavity prevented our seeing the nest contents. On two occasions, 7 and 10 July, we observed three downy nestlings in the cavity and an adult perched nearby. Weights and plumage development were only obtained on 15 July (Table 2). This brood apparently left the nest from 21 to 28 July or about 20 to 27 days after hatching, based on known age and weights of Nest 3 nestlings.

NEST 3

When we found Nest 3 on 2 July, a tenacious adult obstructed our view of the contents. On 7 July we flushed the adult off three eggs in

various stages of hatching. One egg was pipping; another was beginning to pip; and the third showed no sign of hatching. On 10 July we observed the pair bringing food to the cavity, and on 13 July we sawed out a section of the nest tree to band and weigh the three nestlings. Over a 12-hour period during the night of 20 July, the weight changes of these nestlings indicated overnight feeding activity (Table 2). The weights of the nestlings from 1930 to 0700 the following morning increased over 10g each. During a 28 July weighing at 1530, the two remaining nestlings (one had fledged) weighed more than their weighing at 1930 on 20 July by 14g and 16g. At 0830 the following morning, the heavier nestling at the 28 July weighing had fledged, and the remaining nestling had gained again about 10g overnight. It is apparent that weights of nestlings may increase by 20 to 25% overnight from feeding, but an actual 20 to 25% weight increase may require about 1 week. Only weights taken at consistent times before the usual feeding periods may be used for a measure of actual weight gains.

Assuming (1) that the heaviest nestling came from the first egg to hatch, and (2) that the lightest nestling came from the last egg to hatch, then the three nestlings in Nest 3 left the nest in <21 days, 21 days and 20 to 27 days after hatching. This 21- to 27-day nestling period for Flammulated Owls would be shorter than the 30 to 33 days (Sherman 1911), 31 to 35 days (Kelso 1950) and 26 days (Bent 1938) reported for Screech Owls (*Otus asio*).

GROWTH OF NESTLINGS

The only weights of known age nestlings were obtained from nestlings in Nest 3 (Table 2). Periodic weighings of these nestlings indicated that midway into nestling life (about 2 weeks old), individual weights varied as much as 20 to 50%. At this time they had attained about 70% of their eventual fledgling weight. At the time of fledging, their weights averaged about 52g. This weight is well within the range for adult Flammulated Owls reported by Johnson and Russell (1962), Johnson (1965) and Earhart and Johnson (1970).

Exact age of the captive owls from Nest 1 was undetermined; however, weight and development comparisons with Nest 3 provided a rough estimate of their age. In addition, lack of parental care and food probably retarded the growth and development of both captive owls. Nonetheless, we photographed the captive owls when they were approximately 1 and 3 weeks old (Figures 2 and 3). We are not aware of published photographs of this species in juvenal plumage.



Figure 1. A captive Flammulated Owl (*Otus flammolus*), about 6 weeks old, catching a live grasshopper in flight.

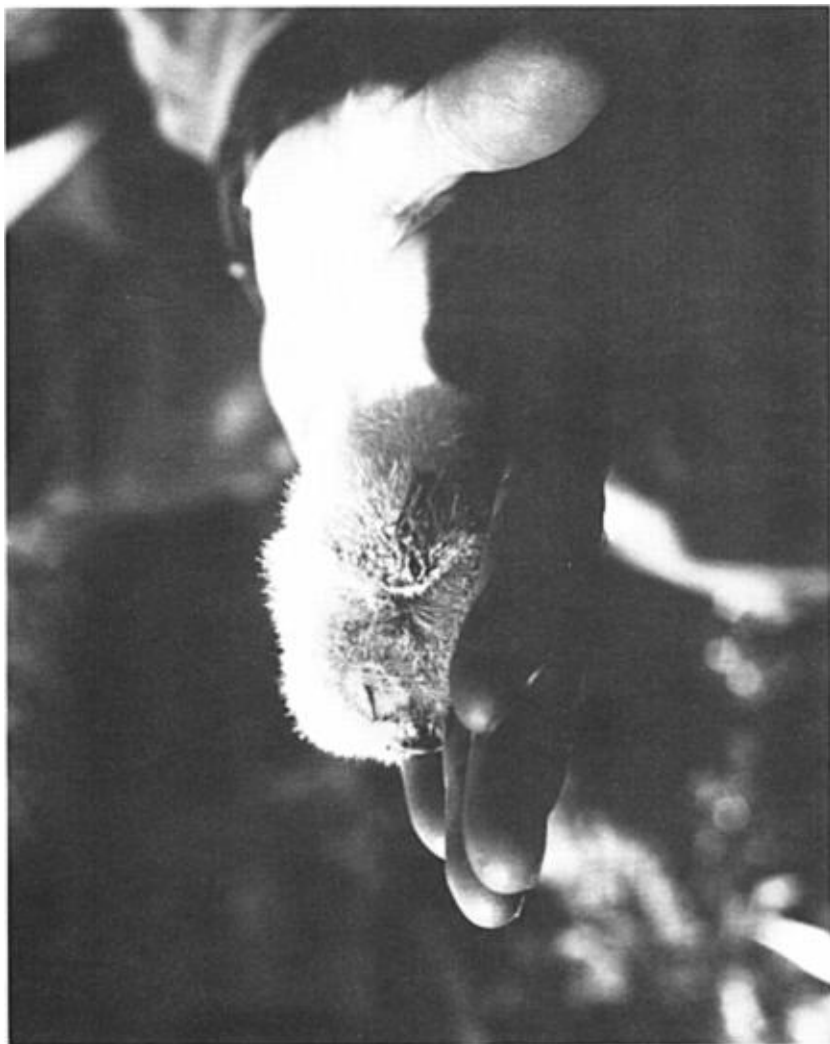


Figure 2 A Flammulated Owl (*Otus flammeolus*) in central Colorado removed briefly from its nest cavity for weighing on 16 July 1971 when about 1 week old

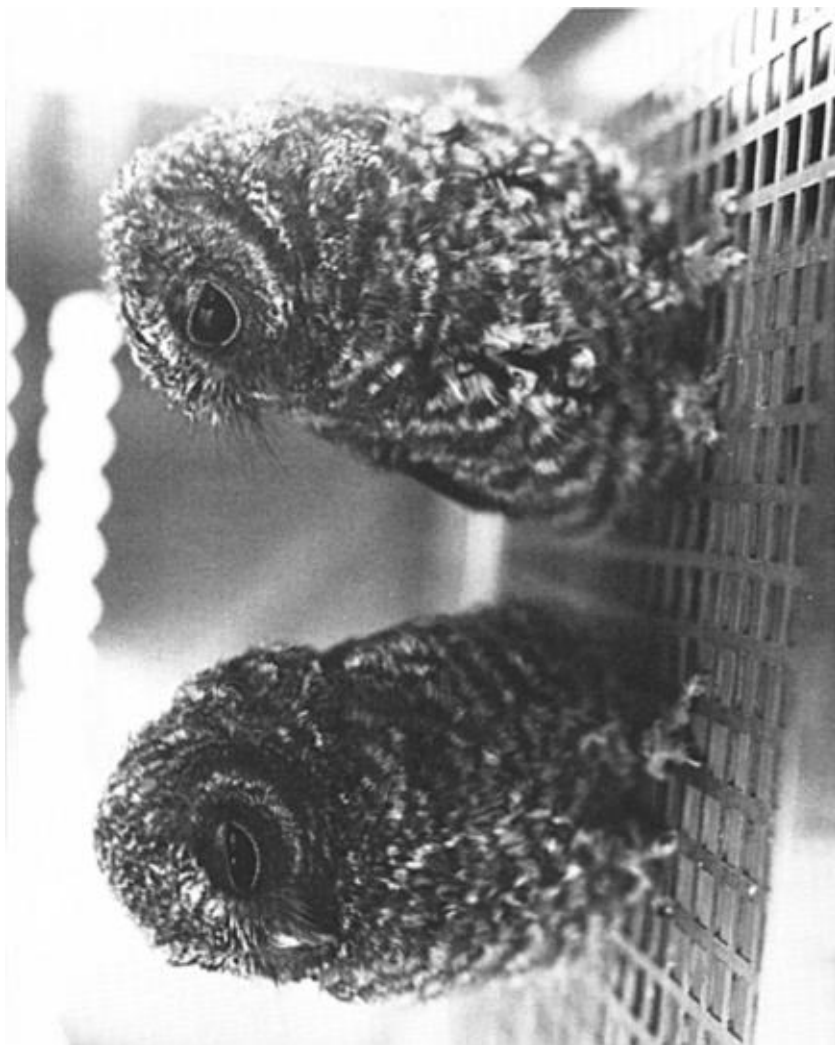


Figure 3. Sibling Flammulated Owls (*Otus flammecolus*) when orphaned and taken captive on 28 July 1971 at the age of about 3 weeks in central Colorado

At about 1 week old, the nestlings were still nearly covered with dense down, all white except for a few darkening primary feathers emerging as blood quills (Figure 2). Tail feathers were not at all evident at this age. At 3 weeks, the owls had noticeably changed to a general gray appearance (Figure 3); the body appeared to be completely covered with juvenal feathers. Also, the breast and belly were predominately barred with alternating transverse markings of dark gray and pale gray. Wing and tail feathers showed considerable development and typical adult barring, but the tail was still quite short. By 6 weeks of age, wing and tail feathers were considerably longer and both captive owls could fly up to 30 m. After 7.5 weeks, both owls were capable of sustained flight of about 50 m, and had attained their maximum weight in captivity (Table 2). At the time of release (about 9 weeks old) the owls had developed a few adultlike, barred feathers on breast, throat, wings and tail; however, the overall plumage was clearly more immature than adult.

DISCUSSION

Physical abilities displayed by the captured owls may indicate the capabilities of wild Flammulated Owls at fledging. At about 25 days, the captive owls, weighing about 40 and 45 g, would fly 0.5 m down from their perch to their cage floor for food. Prior to that age, rather than actually fly, they would either continue to beg for food from their perch or clumsily jump down to it. They were not observed flying upward to a perch or chasing crippled insects until they were about 34 days old. The timing of this behavior, however, was conceivably a little delayed due to their weight loss and possible retarded development of physical strength prior to captivity. Immediately before fledging, the nestlings from Nest 3 weighed about the same as the 25-day old captives. This fact suggests that the fledgling Flammulated Owls from Nest 3 could branch-climb into a bush or low tree and could move around in the forest in short flights from higher to lower perches, although they were certainly incapable of full flight. A 20 m flight made by one captive owl when it was 5 weeks old suggests that the young owls could easily move around in the forest from tree to tree about 2 weeks after fledging. Well-controlled and directed flight was not observed until they were about 53 days old.

Cavities that were occupied in 1971 and other likely cavities in the adjacent area were observed again during the 1972 breeding season, but no Flammulated Owls were found during extensive searching. Whether their apparent absence 1 year later is due to unpredictability of the species or resulted from our disturbances is unknown. Nest 1 was severely disturbed by a predator, and the tree containing Nest 2

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was cut down during the winter of 1971. Our activities, combined with other factors, may have prevented the owls from returning to these specific nesting areas. Future studies should not involve either tampering with or destroying the nesting cavity.

Since this study was completed, other observers have attempted to determine the species' status in Colorado. Winn (1979) found only five active nests and observed 11 owls during intensive searching in the Pike National Forest. She suggested that suitable breeding habitat and nesting sites were probably important in limiting the distribution and abundance of Flammulated Owls in Colorado. Her conclusion was that it is a rare species in Colorado.

SUMMARY

Locations of two Flammulated Owl nests less than 1.6 km apart and a third nest about 6.4 km away suggest that the Flammulated Owl is more numerous in parts of Colorado than previously known. Their obscurity is probably attributable more to behavior than scarcity. Three nests were found in cavities in aspens in the upper montane vegetative type found in moist bottomlands between 2650 and 2775 m elevation about 50 km southwest of Denver. Predation on an adult by a large mammal occurred at one of three nests and may have been encouraged by cutting an enlarged opening into the nesting cavity. Cutting open the cavities was effective for handling adults and nestlings but is discouraged as a routine method for studying these birds. Weight of three nestlings in one nest increased by about 10 g after an overnight feeding, but an actual average weight gain for these 6- to 14-day old nestlings was about 11 g each during 8 days. These wild nestling owls weighed about 50 g before leaving the nest, and two captive nestlings weighed about 60 g when old enough for full flight; two adults weighed 67 g and 58 g. Two captive owls could not fly well for short distances until they were about 7 weeks old. The time from hatching to fledging is estimated to be about 21 days and perhaps up to 27 days.

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