

1–2 min before both geese walked away. Five male Mallards immediately swam to her, continued fighting among themselves, and began copulating with her body. This continued for approximately 7 min with a minimum of three different drakes participating. When the drakes swam approximately 3 m away, a Ring-billed Gull (*Larus delawarensis*) landed beside her and began pecking and tearing at her head and neck, occasionally grabbing her head and shaking it. In approximately 2 min, the five drakes returned, and two of them copulated with her body, but for a shorter duration than the first episode. After approximately 2 min they abandoned her body to the gull which began to tear flesh from her neck and back. The drakes did not return to her.

The proximate cause for this behavior can be explained in terms of the dead hen's lordosis position releasing copulatory behavior in the sexually aroused drakes. Schein and Hale (Anat. Rec. 128:617, 1957) demonstrated that a detached female head in an upright position is sufficient to elicit copulatory attempts in male domestic turkeys (*Meleagris gallopavo*). The adaptive significance of forced copulations in animals has been discussed by Crawford and Galdikas (Can. J. Psych. 27:215–230, 1986), but when it results in Davian behavior, it is difficult to explain in terms of individual fitness since apparently time, energy, and sperm are wasted. Although it was difficult to determine whether ejaculation occurred in all the copulations observed, post-copulatory tail-wagging behavior suggested that some of the drakes had ejaculated (McKinney and Stolen, Anim. Behav. 30:461–474, 1982). However, since this type of behavioral "mistake" apparently occurs infrequently, the fitness cost is too small to be selected against.—PHILIP N. LEHNER, Dept. Biology, Colorado State Univ., Fort Collins, Colorado 80523. Received 29 Sept. 1987, accepted 17 Nov. 1987.

Wilson Bull., 100(2), 1988, pp. 294–296

Nest lining with sheep wool: potential negative effects on Cave Swallows.—Much discussion has centered on the energetic costs and benefits of construction and use of the avian nest. Investigators have discussed the insulative value of roosting (Kendeigh 1960) and nesting (Royama 1966) in cavities and the thermal homeostatic role of domed individual or communal nests (Ricklefs and Hainsworth 1969, White and Kinney 1974, White et al. 1975). Withers (1977), however, found little of this property in mud nests of Cliff Swallows (*Hirundo pyrrhonota*).

Bailey (1928), and later Bent (1968), documented the incorporation of domestic sheep wool into the nests of U.S. birds. Subsequently, van Riper (1977) reported the increasing use of wool in nest construction by six Hawaiian species and indicated that only nest bodies, and not linings, contained this material. In this and a subsequent work (Kern and van Riper 1984), the authors discussed wool's function as a binding, but not insulating, agent. Despite this framework of interest, few studies have attempted to correlate variation in natural nest morphology with concurrent variation in reproductive parameters in the field, although White and Kinney (1974), working under seminatural, relatively uniform environmental conditions, found an inverse relationship between nest insulating value and attentiveness in *Ploceus cucullatus*. Here, as part of our analyses of the influence of man on hirundinids (Martin 1980, Hamilton and Martin 1985), we report the use of wool as a lining material in the nests of Cave Swallows (*Hirundo fulva*), describe its physical contact with eggs deposited upon it, and attempt to relate this phenomenon to length of incubation period, clutch size, hatch, and nestling survival.

Our study sites were nine concrete culverts in Uvalde County, Texas, beneath a 17.7 km stretch of U.S. Hwy. 90 extending from 0.5 km W of the Nueces River to the boundary of

TABLE 1
FREQUENCIES OF OCCURRENCE OF CLUTCHES HAVING VARIOUS INCUBATION PERIODS IN
NESTS OF *H. FULVA* WITH DIFFERENT LINING TYPES

Culvert	N	Incubation period (days)			
		15-16 ^{ab}	16-17	17-18	18-19
Wool culvert	7	0	3	4	0
Other	24	14	6	1	3

^a Incubation of clutch through at least fifteen 24 h periods following clutch completion, possibly part of sixteenth period; longer incubation periods were scored similarly.

^b This is the normal incubation period in *P. fulva* (Martin et al. 1977).

Cline, Texas. The culverts, oriented approximately N-S, are of similar single or multiple passageway construction; passages ranged from 1-14 in individual culverts and from 13.7-25.9 m in length, 1.5-3.1 m in width, and 1.5-2.8 m in height. Nests were open mud cups, built on the upper 15% of culvert walls. By utilizing such relatively uniform, darkened sites in south-central Texas, *H. fulva* recently has expanded its breeding niche, range, and numbers (Martin 1980).

Nests of *H. fulva* in 8 culverts had grass linings that incorporated little or no sheep wool. Culvert #37, in the central portion of this transect, was located near a sheep-shearing enclosure of a nearby ranch; nests in it were lined with considerable quantities of wool. Nests were visited and their contents marked and/or enumerated daily from 10 April to 3 June 1976; this period coincided with the first reproductive cycle for most *H. fulva*. We collected data on length of the incubation period from 31 nests (Table 1). After hatch, four nests were destroyed through human intervention; we arbitrarily excluded these from our subsequent tabulation of distributive statistics (Table 2, $N = 27$ nests). The Mann-Whitney U -test was employed in statistical comparisons; results were considered significant at $P < 0.05$.

In nests lined with wool, eggs tended to become embedded in separate, individual depressions near the bottoms of the nest cups, rather than remaining in tangential, exposed groups as in grass-lined nests. Incubation period was significantly longer in the sample of nests with thick wool linings ($P < 0.025$; see Table 1); these groups did not differ significantly in clutch-size ($P > 0.9$), number of young hatched ($P > 0.5$), and ($P > 0.1$) number of young surviving to 18 days (two days prior to flight potential for this species, Martin et al. 1977).

Within certain physiological limits, incubation periods vary inversely with temperature

TABLE 2
CLUTCH-SIZE, HATCH, SURVIVAL TO 18 DAYS, AND PERCENTAGES OF *H. FULVA* THAT
UTILIZED DIFFERENT NEST-LINING MATERIALS

Culvert	N	Clutch-size		Young hatched		Survived		% Hatched	% Survival
		\bar{x}	SE	\bar{x}	SE	\bar{x}	SE		
Wool culvert	6	4.17	± 0.17	3.67	± 0.33	2.17	± 0.31	88.0	52.0
Other	21	4.14	± 0.14	3.62	± 0.16	2.81	± 0.24	87.4	67.8

(Romanoff 1934, Nice 1954, Skutch 1976). Martin et al. (1977) and Martin (unpubl.) have established the normal incubation period of *H. fulva* eggs at 15–16 days. We have no evidence to indicate that environmental conditions or attentiveness differ in a systematic fashion among culverts included in our study. Our results indicate that because of the compressibility of wool, its use in nest linings by *H. fulva* appears to lengthen the period of incubation rather than to decrease it because of its insulating property (see Kern and van Riper 1984). We hypothesize that partially isolated eggs buried in individual nest-lining depressions may be separated too far for normal incubation patch contact or may be difficult to turn; hatch-synchronizing communication (if it occurs in *H. fulva*) also may be impeded.

Acknowledgments.—We thank Sallie Martin posthumously for her many contributions to and support of the project. Comments by C. van Riper III and C. R. Blem improved the manuscript. Research costs were paid in part by the National Geographic Society and the Texas Memorial Museum of The University of Texas at Austin.

LITERATURE CITED

- BAILEY, F. M. 1928. Birds of New Mexico. New Mex. Dept. Game and Fish. Santa Fe, New Mexico.
- BENT, A. C. 1968. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and their allies. U. S. Natl. Mus. Bull. 237.
- HAMILTON, G. D. AND R. F. MARTIN. 1985. Investigator perturbation and reproduction of the Cliff Swallow. *Auk* 102:167–170.
- KENDEIGH, S. C. 1960. Energy of birds conserved by roosting in cavities. *Wilson Bull.* 73: 140–147.
- KERN, M. D. AND C. VAN RIPER III. 1984. Altitudinal variations in nests of the Hawaiian Honeycreeper *Hemignathus virens virens*. *Condor* 86:443–454.
- MARTIN, R. F. 1980. Analysis of hybridization between the hirundinid genera *Hirundo* and *Petrochelidon* in Texas. *Auk* 97:148–159.
- , G. O. MILLER, M. R. LEWIS, S. R. MARTIN, AND W. R. DAVIS. 1977. Reproduction of the Cave Swallow: a Texas cave population. *Southwestern Nat.* 22:177–186.
- NICE, M. M. 1954. Problems of incubation periods in North American birds. *Condor* 56: 173–197.
- RICKLEFS, R. E. AND F. R. HAINSWORTH. 1969. Temperature regulation in nestling Cactus Wrens: the nest environment. *Condor* 71:32–37.
- ROMANOFF, A. L. 1934. Study of artificial incubation of game birds. *Bull. Cornell Univ. Agr. Sta.* 616:1–39.
- ROYAMA T. 1966. Factors governing feeding rate, food requirement, and brood size of nestling Great Tits *Parus major*. *Ibis* 108:313–347.
- SKUTCH, A. 1976. Parent birds and their young. Univ. Texas Press, Austin, Texas.
- VAN RIPER III, C. 1977. The use of sheep wool in nest construction by Hawaiian birds. *Auk* 94:646–651.
- WHITE, F. N. AND J. L. KINNEY. 1974. Avian incubation. *Science* 186:107–115.
- , G. A. BARTHOLOMEW, AND T. R. HOWELL. 1975. The thermal significance of the nest of the Sociable Weaver *Philetarius socius*: winter observations. *Ibis* 117:171–179.
- WITHERS, P. C. 1977. Energetic aspects of reproduction by the Cliff Swallow. *Auk* 94:718–725.

ROBERT F. MARTIN AND DEAN HECTOR, *Texas Memorial Museum and Dept. Zoology, Univ. Texas at Austin, Austin, Texas 78705. Received 15 Sept. 1987, accepted 24 Nov. 1987.*