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ORIENTATION OF AMERICAN KESTREL NEST CAVITIES AND NEST TREES

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Balgooyen (1976), in his Sierra Nevada study, showed that nest cavities of American Kestrels (*Falco sparverius*) face east significantly more often than expected, and that nest trees are most often located on east-facing slopes. He based his results on comparisons of observed frequency distributions to a uniform distribution. But American Kestrels, typical of most secondary cavity-nesting birds, use abandoned nest cavities excavated by woodpeckers. It is possible, therefore, that the nonrandom orientations of kestrel nest cavities and slope exposure reflect selection by the original nest excavators rather than by the kestrels. Some studies have reported nonrandom orientations of woodpecker nest cavities (Lawrence 1967, Conner 1975, Inouye 1976, Korol and Hutto 1984). If most available cavities or slopes faced east, the apparent preference by kestrels could be random selection of available cavities or trees.

To test this possibility, I compared Balgooyen's (1976) data on nest orientation to an independent sample of 105 nests of the two species whose nests kestrels most often use in California—Northern Flicker (*Colaptes auratus*) and Lewis' Woodpecker (*Melanerpes lewis*; Raphael and White 1984). I collected data from 1975 to 1978 on the same study areas reported by Balgooyen (1976). My null hypotheses were that: (1) no difference existed in orientation of kestrel nest cavities compared to that of available cavities, and (2) slope exposures were equal for kestrel nest trees and available trees. I tested the hypotheses using Watson's U^2 test (Batschelet 1965:35).

Both hypotheses were rejected. Nest cavity orientation differed significantly from expected ($U^2_{105,58} = 0.307$, $P < 0.005$), and slope exposures also differed from expected ($U^2_{93,58} = 0.490$, $P < 0.005$; Table 1). Available cavities were generally oriented in a northerly direction (mean azimuth = 14°; Table 1), whereas most kestrel cavities faced east-northeastward (mean angle = 59°). Angular dispersions, which measure the relative concentration of points around the mean, were similar among nests and available trees for both cavity orientation and slope exposure (Table 1).

Examination of differences between percentages of kestrel and woodpecker nests for each of the eight directions showed the greatest deviation for east-facing cavities and slopes (Table 1), supporting Balgooyen's original observations. Balgooyen (1976) speculated that nest cavities facing eastward might offer thermoregulatory advantages because of warmth of the morning sun and protection from storms and hot afternoon temperatures. These considerations should also apply to the woodpeckers that excavated the nests. If so, most woodpecker nests should have been excavated with east exposures. It is possible that woodpeckers excavated cavities at the place around the trunk where decay conditions were best for nest excavation. In the present study area, however, both Lewis' Woodpeckers and Northern Flickers excavated nests in trees that were decayed throughout (Raphael and White 1984). Therefore, it is unlikely that their nests were oriented in relation to variable decay characteristics of the trees. While these results do not rule out the possibility that kestrels choose cavities to maximize thermal advantages, further study would be necessary before accepting such an explanation. The apparently nonrandom selection of east-facing cavities by kestrels nevertheless cannot be attributed to cavity availability.

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TABLE 1. Nest orientation and slope exposure of nest trees of American Kestrels compared with orientation and exposure of available cavities and cavity trees, Sagehen Creek, California. Values are the percentage within each direction.

		Nest entrance orientation			Slope exposure		
Direction	Midpoint azimuth of group (°)	Kestrel nests[a] (n = 58)	Woodpecker nests[b] (n = 105)	Difference[c]	Kestrel nests[a] (n = 58)	Woodpecker nests[b] (n = 93)	Difference[c]
North	0	14	21	−7	5	15	−10
Northeast	45	19	25	−6	7	15	−8
East	90	34	10	+24	45	18	+27
Southeast	135	7	5	+2	21	24	−3
South	180	0	11	−11	2	13	−11
Southwest	225	12	6	+6	3	6	−3
West	270	5	11	−6	12	0	+12
Northwest	315	9	11	−2	5	9	−4
Mean azimuth[d]		59	14		100	94	
Angular dispersion (°)[d]		66	68		60	65	

[a] Includes 13 nests located during this study plus nests described by Balgooyen (1976).
[b] Includes nests of Northern Flicker and Lewis' Woodpecker.
[c] Percent of kestrel nests minus percent of woodpecker nests.
[d] Calculated following methods of Batschelet (1965:11).

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PESTICIDE CONCENTRATIONS IN SNAIL KITE EGGS AND NESTLINGS IN FLORIDA

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Concentrations of organochlorine pesticides were first reported in the Snail Kite (*Rostrhamus sociabilis*) and its principal prey, the apple snail (*Pomacea paludosa*), by Lamont and Reichel (Auk 87:158–159, 1970), using material from Conservation Area 2A (CA2A) and Loxahatchee National Wildlife Refuge (NWR) in the northeastern part of the Florida Everglades, all collected between 1965 and 1967. Treatment of Surinam rice fields in 1971 with sodium pentachlorophenol (NaPCP) to control populations of freshwater snails (*Pomacea glauca* and *P. lineata*) that resulted in a die-off of Snail Kites was described by Vermeer et al. (Environ. Pollut. 7:217–236, 1974). They found high levels of NaPCP in tissues of 17 kites that they analyzed, and they attributed mortality to NaPCP poisoning. I have found no other published accounts of pesticide residues in this species.

From 1970–1977, unhatched Snail Kite eggs and young that were found dead at nests in Florida were analyzed by gas chromatography for residues of organochlorine pollutants. The 1970 and 1974 material (and Lamont and Reichel's 1967 sample) showed measurable amounts of p,p′-DDE, p,p′-DDD, p,p′-DDT, and dieldrin (Tables 1 and 2). Dieldrin and polychlorinated biphenyl (PCB) residues were less than 0.1 ppm in the eggs and were detected in only one sample of muscle tissue at 0.11 ppm. Concentrations in ppm wet weight of p,p′-DDE, p,p′-DDD, p,p′-DDT, dieldrin, and PCB for two samples of muscle and three of brain tissue (all 1977 material) were not detected at the limit of quantification (0.05 ppm). Other organochlorine compounds that may have been present but were below the detection limit in nestlings were: heptachlor epoxide, oxychlordane, *cis*-chlordane, *trans*-nonachlor, *cis*-nonachlor, endrin, toxaphene, hexachlorobenzene, and mirex.

These residue values were incidental and were considered baseline readings in the environment at that time (no significant accumulation). Problems that might be associated with pesticides have not been detected in the kite population in Florida, where the population has been carefully monitored from 1969 to the present. Large tracts of agricultural land adjoin the principal areas used by kites, and runoff from these areas enters kite habitats through an extensive network of interconnecting canals, without treatment to remove chemical wastes (Sykes, Fla. Field Nat. 11:73–88, 1983; J. Field Ornithol. 54:237–246, 1983; Bull. Fla. State Mus. 29(6):211–264, 1984). Because the kite has a restricted diet and the potential for pesticide problems persists, continued monitoring of the kite population, its prey, and its habitat is needed. While the use of DDT and dieldrin have been prohibited in the United States for about a decade, many other pesticides are applied from aircraft and by tractor in south Florida agriculture. To my knowledge, none of these chemical compounds have been tested to determine the effect on apple snails before their approved use.

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TABLE 1. Pesticide concentrations in Snail Kite eggs from Florida.

Sample[a]	Year collected	Lipid weight (%)	Pesticide concentrations (ppm wet weight)		
			p,p′-DDE	p,p′-DDD	p,p′-DDT
1[b]	1966	4.2	0.33	0.14	0.06
2	1970	3.7	0.05	0.20	ND
3	1970	4.0	0.34	ND[c]	ND
4	1970	4.5	0.17	0.08	ND
5	1970	4.7	0.22	0.10	ND
6	1974	5.1	0.03	ND	ND
7	1974	3.0	0.03	ND	ND
8	1974	5.5	0.03	ND	ND
9	1974	2.9	0.03	ND	ND

[a] Each sample consists of one egg. Five different clutches are represented: No. 1 is from one clutch, Nos. 2 and 3 from a second, Nos. 4 and 5 from a third, Nos. 6, 7, and 8 from a fourth, and No. 9 from a fifth. Sample 1 was collected in Conservation Area 2A (Broward County), 2 and 3 in Conservation Area 2B (Broward County), and 4 through 9 at Loxahatchee NWR (Palm Beach County).
[b] Data from Lamont and Reichel (1970).
[c] Not detected at limit of quantification (0.05 ppm).

TABLE 2. Pesticide concentrations in soft tissue of nestling Snail Kites from Florida.

Sample[a]	Year collected	Tissue	Lipid weight (%)	Pesticide concentrations (ppm wet weight)				
				p,p′-DDE	p,p′-DDD	p,p′-DDT	dieldrin	PCB
1[b]	1967	muscle	—	0.20	0.05	T	T	—[e]
2	1970	muscle	0.84	0.09	T[d]	ND	T	T
3	1977	muscle	0.51	ND[c]	ND	ND	ND	0.11

[a] Sample 1 was collected in Conservation Area 2A (Broward County), 2 at Loxahatchee NWR (Palm Beach County), and 3 at Lake Okeechobee (Glades County).
[b] Data from Lamont and Reichel (1970).
[c] Not detected at limit of quantification (0.05 ppm).
[d] T = <0.05 ppm.
[e] No analysis for PCB in 1967.