TABLE 1
MEASUREMENTS OF TURKEY VULTURE EGGSHELLS

	Sample size (eggs)	Mean shell weight (g)	Mean thickness index[1]	Percent change
California				
Pre-1947	39	7.60 ± .096[2]	2.25 ± .075	
1947+	36	6.72 ± .112	2.00 ± .102	-11*
Florida				
Pre-1947	20	7.28 ± .162	2.09 ± .023	
1947+	22	6.22 ± .197	1.84 ± .043	-12*
Texas				
Pre-1947	16	7.19 ± .187	2.10 ± .043	
1947+	16	5.76 ± .201	1.73 ± .063	-18*

[1] Weight (mg)/length (mm) × breadth (mm).
[2] ± standard error.
* Differences significant at $P < 0.05$; means compared using the t-test.

generally associated with declines in productivity. If the Texas data are representative of Turkey Vultures there, then the reproductive capabilities of that population may be affected. Field studies of the breeding success of the Turkey Vulture in Texas would appear especially appropriate at this time.

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An experimental analysis of the interrelationship between nest density and predation in old-field habitats.—The relationship between nest density and intensity of predation has been found to be positive in most of the studies dealing with species nesting in marsh environments (Tinbergen et al., Behaviour 28:307–321, 1967; Goransson et al., Oikos 26:117–120, 1975). Some authors have presented evidence which suggests that this relationship may also apply to avian communities in upland habitats (Krebs, Ecology 52:2–22, 1971; Fretwell, Populations in a Seasonal Environment, Princeton Univ. Press, Princeton, NJ, 1972). Unfortunately no experimental studies have tested this hypothesis. This study was aimed at answering the question: Does the spatial distribution of nests influence their predation rates in old-field habitats?

Study areas and methods.—The experiment was performed from May through July 1976 at Miami University's field station on the Bachelor Estate approximately 2 km west of Oxford, Butler County, Ohio. A full description of the study area can be found in Gottfried and Thompson (Auk 95:304–312, 1978). Two 4-ha areas were used during the experiment. In Area A the experimental nests were densely distributed (12.7/ha), while in Area B the experimental nests were more dispersed (4.7 nests/ha), simulating normal nest density. Both nonadjacent areas were similar in habitat, number of avian species, and number of predators present.

The experimental design was as follows: I placed abandoned nests of American Robins (*Turdus migratorius*), Cardinals (*Cardinalis cardinalis*), and Field Sparrows (*Spizella pusilla*), each containing 2 eggs of the Japanese Quail (*Coturnix coturnix*), in nest sites that appeared typical of those used by the first 3 aforementioned species. Sixteen such nests (8 in Area A and 8 in Area B) were set out on the Sunday of each of 9 weeks, beginning on 9 May 1976; from these, 8 were selected (4 in each area) by lot to visit daily. I visited these 8 nests in the late afternoon or early evening but did not inspect the remaining 8 nests until Saturday. On that day (day 6 of exposure) I collected and removed any eggs that remained in the 16 nests. On Sunday, I moved all nests to different locations, added fresh quail eggs, and repeated the procedure. Thus, during the 8 weeks I placed the experimental nests at 144 different locations.

Dispersion of the experimental nests was achieved by first establishing a grid of 16 evenly spaced points in each area, then using alternate points for placement of each week's 8 nests. The distance between the points in Area A was 15 m, while in Area B they were 40 m apart. The actual location of each nest in relation to the point was determined by selecting 2 numbers between 0 and 18 from a table of random numbers. These numbers dictated the distance in paces and compass direction from the point (even, north and east; odd, south and west) that each nest was to be placed. The nest was then placed in the nearest site that appeared suitable.

Upon finding an experimental nest with 1 or both eggs missing, I examined the nest and ground below to determine if wind had dumped the contents. If so, the nest was excluded from all analyses.

Predation rates.—The numbers of nests predated in Area A (dense nests) and Area B (non-dense nests) were compared to determine if nest density influences the probability of nest detection by predators (Table 1). Overall, a slightly greater number of nests in Area A were predated (31% of Area A nests, 24% of Area B nests), but these differences are not significantly different ($\chi^2 = 0.59$, $p > 0.05$, 1 d.f.). Monthly comparisons of the nest predation in both areas are also not significantly different (May $\chi^2 = 1.37$, $p > 0.05$; June $\chi^2 = 1.51$, $p > 0.05$; July $\chi^2 = 1.74$, $p > 0.05$).

Daily nest visitation did not increase the predation rate. In Area A (dense nest distribution) 28% of the visited and 34% of the unvisited nests were predated ($\chi^2 = 0.11$, $p > 0.05$, 1 d.f.), while in Area B (non-dense nest distribution) 23% of the visited and 24% of the unvisited nests were predated ($\chi^2 = 0.03$, $p > 0.05$, 1 d.f.).

Nest survival.—The day of nest predation was analyzed for each visited nest to determine if the length of the survival period was influenced by the spatial distribution of nests. Although the predated densely dispersed nests in Area A survived a slightly greater length of time, the differences are not significant (Mann-Whitney $U = 55.5$, $p > 0.05$). Small sample sizes preclude a monthly comparison of nest survival.

Discussion.—These experiments do not support the hypothesis that the spatial distribution of nests in upland old-field habitats influences their probability of being predated. Why should the distribution of nests influence the predation rate of experimental nests in marsh environments and not in upland old-field habitats? There may be at least 2 major reasons for this dichotomy. First, many species (e.g. gulls and terns) nesting in marsh habitats are primarily colonial nesters which have adopted this strategy as a defense against predators. Yet predators are drawn to these areas and do take a large toll on the eggs and young (Patterson, Ibis 107:433–459, 1965). Thus, predators in these habitats could be expected to take a greater advantage of increased nest density, than

TABLE 1

THE OUTCOME OF DENSELY AND NON-DENSELY DISTRIBUTED EXPERIMENTAL NESTS, ACCORDING TO MONTH

	Densely Distributed Nests				Non-Densely Distributed Nests				Destroyed by Weather		
	Pred.*		Succ.**		Pred.		Succ.				
Month	N	%	N	%	N	%	N	%	N	%	Total
May											
Visited nests	8	33	4	17	5	21	6	25	1	4	24
Unvisited nests	8	33	3	13	5	21	5	21	3	13	24
June											
Visited nests	1	4	11	46	3	13	9	37	0	0	24
Unvisited nests	1	4	11	46	3	13	8	33	1	4	24
July											
Visited nests	1	4	11	46	0	0	12	50	0	0	24
Unvisited nests	2	8	7	29	0	0	12	50	3	13	24
Total	21	15	47	33	16	11	52	36	8	5	144

* Predated nests.
** Successful nests = no quail eggs missing.

would their counterparts in old-field habitats, where colonial nesting is rare. The densities of breeding bird populations in these upland habitats are buffered to a greater degree by territorial behavior (Brown, Wilson Bull. 81:293–329, 1969), and thus never reach the densities of marsh dwelling species.

The type of predator may also have some bearing on the hypothesis. There is evidence to suggest that the 2 environments may be affected by different types of predators. In marsh environments where colonial nesters predominate, sight-oriented avian and mammalian predators appear to cause most of the losses (Hammond and Foreward, J. Wildl. Manage. 20:243–247, 1956; Tinbergen et al., op. cit.; Dwernychuk and Boag, J. Wildl. Manage. 36:955–958, 1972; Picozzi, J. Wildl. Manage. 39:151–155, 1975). In old-field habitats, snakes appear to be the major predator, although birds may cause minor losses (Gottfried and Thompson, Auk op. cit.). A visual predator will usually capitalize on the opportunities afforded by a newly found nest by continuing to search in the immediate area for additional nests (Tinbergen et al., op. cit.). A snake, on the other hand, will often return to its burrow and, only after a period of time resume, its hunting activities, thus sacrificing any gains accrued by finding a nest (Goin and Goin, Introduction to Herpetology, W. H. Freeman and Co., San Francisco, 1971).

Fretwell (1972) hypothesized the positive relationship between nest density and predation pressure on the basis of woodland data where the Blue Jay (*Cyanocitta cristata*) is a primary predator of nests. Blue Jays appear to be adept at finding nests by visual cues and would thus be able to exploit a community where nests are densely distributed. It should also be noted that Fretwell's studies were made with nesting birds and thus took into account the presence of parental and nestling activity in and around the nest. It can thus be argued that the use of experimental nests biased the results in the present study. However, Gottfried and Thompson (Auk op. cit.) found that the predation rate of experimental and natural nests were not significantly different (i.e. the presence of parental activity around the nest did not increase the rate of predation). It would thus appear that no sweeping generalizations can be made on the relationship between nest density and predator pressure in upland habitats, as the type of predator may differ from habitat to habitat.

I benefited from discussions with Dr. Charles Thompson. I also wish to thank P. Caprio for supplying the quail eggs.—BRADLEY M. GOTTFRIED, *Dept. of Zoology, Miami Univ., Oxford, OH 45056.* (Present address: *Dept. of Biology, College of St. Catherine, St. Paul, MN 55105*).

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Canada Goose takes over Mallard nest.—Waterfowl are attracted to the park ponds in Allentown, Pennsylvania due to the great amount of artificial food supplied by park visitors. Mallards (*Anas platyrhynchos*) and Canada Geese (*Branta canadensis*) often nest very close to one another in the urban and suburban parks. This tendency may be a response to the limited amount of suitable nesting habitat in the park areas. Frequently I have found nests much closer together and the over-all nesting density greater than that reported by Drewien (Wilson Bull. 82:95–96, 1970). On 1 April 1977, I located a wild Mallard nest with 11 eggs and a wild Canada Goose nest with 6 eggs on a small, 0.15 ha island, in one of the park ponds. The nests were 1.2 m apart and both hens were incubating. Periodic checks of each nest revealed a loss of 4 eggs from the Mallard nest on 13 April, the result of some unknown predator. There was no change in the number of Canada Goose eggs during the period.

On 20 April, during a regular nest check, I observed 1 Canada Goose egg in the Mallard nest and 1 egg missing from the goose nest. Because of the inaccessibility of the pond and island to the public, I concluded that the goose egg rolled from the Canada Goose nest, possibly when the female was turning the eggs, and the nearby Mallard hen retrieved the loose egg. Many ground nesting birds are known to exhibit such egg retrieving behavior. The Mallard hen then continued incubating her 7 original eggs, and the goose egg, while the Canada Goose remained on her own nest, minus 1 egg. The Canada Goose did not lay another egg; she was 18 days into the incubation period.

On 23 April, the female Canada Goose was observed sitting on the Mallard nest that contained its egg, defending it from the Mallard hen, which continually made attempts to get back on her own nest. Later that same day, 5 Mallards hatched from beneath the incubating Canada Goose. The 1 goose egg and 2 Mallard eggs did not hatch. The Mallard hen continued attempting to reclaim her nest, but the female Canada Goose became very defensive, tearing feathers from the duck's breast and neck.

The next day, 24 April, a Mallard hen was observed with a brood of 5 ducklings on the pond, and the female Canada Goose had returned to her original nest, after neglecting it for over 12 h. All 5 remaining goose eggs hatched on 30 April. The 1 goose egg that remained in the Mallard nest did not hatch.