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LARVAL DERMESTID BEETLES FEEDING ON NESTLING SNAIL KITES, WOOD STORKS, AND GREAT BLUE HERONS

NOEL F. R. SNYDER
JOHN C. OGDEN
J. DAVID BITTNER
AND
GERALD A. GRAU

ABSTRACT.—In recent years abdominal lesions attributable to larval dermestid beetles (*Dermestes nidum*) have appeared in nestling Snail (Everglade) Kites (*Rostrhamus sociabilis*), Wood Storks (*Mycteria americana*), and Great Blue Herons (*Ardea herodias*). Although it appears that most nestlings affected have survived, the degree of threat posed by dermestid larvae to various avian species is as yet unclear.

The arthropods associated with bird nests include species that scavenge on litter, species that feed on the tissues of nestling birds, as well as species that exhibit a variety of other trophic patterns (Rothschild and Clay 1952). Judging from the diversity of feeding patterns found within nest-inhabiting *Philornis* flies, tenebrionid beetles, and dermestid beetles, shifts between various diet patterns may occur with some frequency (see Hinton 1945, Dodge 1963, Dodge and Aitken 1968, Kinsella and Winegarner 1974, Crook et al. 1980). In this report we present evidence for recent outbreaks of predation-parasitism in a scavenging dermestid beetle in Florida and Ohio, posing potentially significant problems for at least two threatened avian species.

FINDINGS

During intensive studies of the breeding biology of the Snail Kite (*Rostrhamus sociabilis*), the Wood Stork (*Mycteria americana*), and the Great Blue Heron (*Ardea herodias*), we had many occasions in the late 1970s to measure and band nestlings. While processing young at two kite nests in 1978, we found striking damage to the abdomens of three nestlings. The damage consisted of crater-shaped holes measuring up to 7 mm in diameter at the surface and penetrating as deeply as the body cavity in some cases (Fig. 1a). We had not previously noted such damage, and such damage had not been seen by Roderick Chandler or Paul W. Sykes, Jr., both of whom had handled many dozens of nestling kites in the previous 15 years (pers. comm.). The two nests affected in 1978 represented 3.3% of the kite nests at which young were handled. In 1979 we found nine additional affected nests, representing 10.6% of the nests at which young were handled (Table 1).

Similar abdominal lesions were seen in one Wood Stork out of 43 examined by Scott Clark in a 1977 colony in central Florida (pers. comm.). We saw no affected stork chicks in 1978, but found relatively large numbers in several colonies in 1979—colonies in which we had been handling large numbers of young since 1975 (Fig. 1b and Table 1). The number of nestling storks with wounds in 1979 varied between 0 and 31.8% of the young examined in the various colonies, while the fraction of nests with damaged young reached two-thirds in the most seriously affected colony. In the Wood Stork, as in the Snail Kite, it is doubtful that the lesions might simply have been overlooked in the past (at least the recent past), because the wounds are so easily seen and handling of nestlings has been intensive. On nestling storks that were old enough to stand up in their nests, we found wounds to be conspicuous even when viewed from low-flying aircraft passing over the colonies.

We first noted abdominal lesions in Great Blue Herons in 1975 when we estimated 160 young out of 540 checked in the Elm Island colony of Sandusky Bay, Lake Erie were affected (Fig. 1c). Fewer cases were found at this and other nearby colonies in 1976 and 1977 (Table 1). We did not see any abdominal lesions at the Elm Island colony from 1971 through 1974, although we could have overlooked cases since we did not generally handle chicks in such a way that abdominal lesions would have been obvious during these years.

The similarity in morphology and placement of lesions in Snail Kites, Wood Storks, and Great Blue Herons strongly suggested that

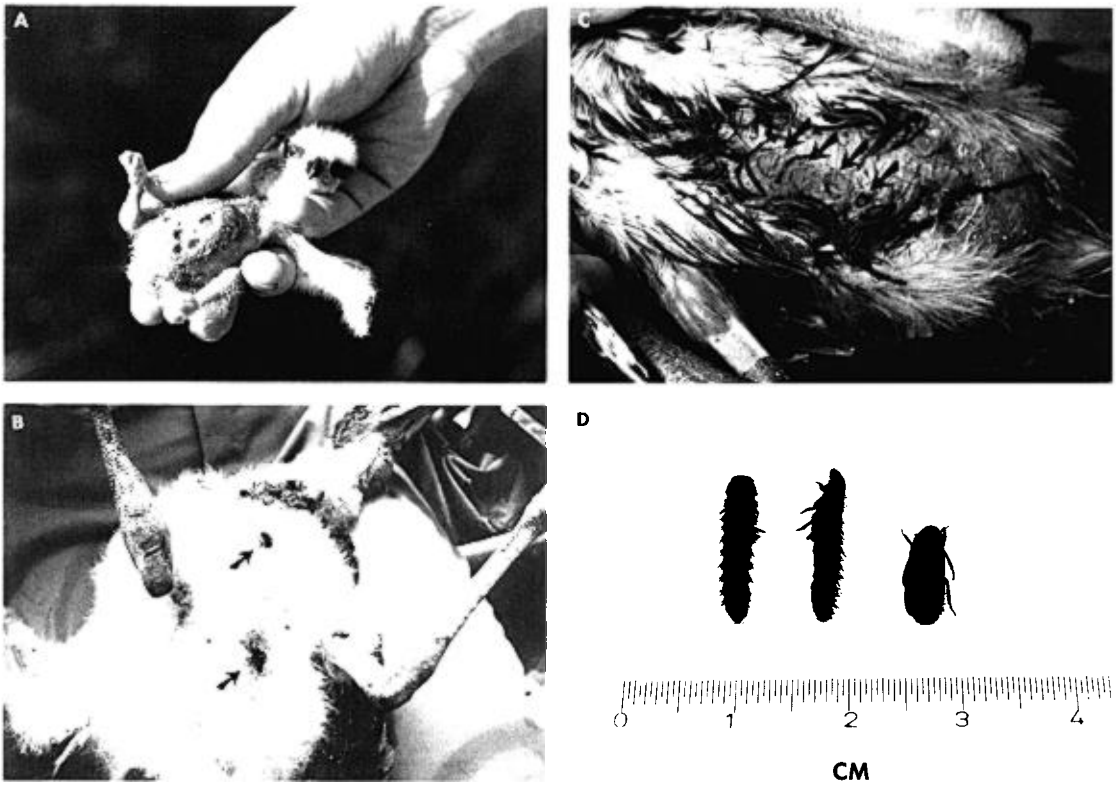

FIGURE 1. Abdominal lesions apparently produced by larval *Dermestes nidum* on nestlings of (A) Snail Kite, (B) Wood Stork, and (C) Great Blue Heron. (D) Larvae and adult of *Dermestes nidum*.

the wounds in all three species might have a common cause. We closely examined the nest contents in all but 3 of the 11 affected kite nests as no obvious culprits were present in the wounds during our visits. Of the eight nests checked, five were sealed in bags and taken to the field station where they were pulled apart twig by twig and all visible animal life was preserved for later identification. Old nests of herons or kites were left as replacements to hold the young in the field. In general, the macroscopic fauna of the nests consisted almost entirely of larval dermestid beetles and spiders. The only creatures identified consistently from all nests examined were dermestid beetles.

Convincing direct evidence of dermestid involvement was obtained by taking one kite nest containing a nestling with fresh lesions to the field station overnight. The nestling sat placidly in the nest until nightfall when it began to give repeated distress calls. With a flashlight we were able to see clearly that larval dermestid beetles were at work in the open wounds. The nestling gave no defensive movements when under attack, yet had it raised its abdomen off the substrate or pecked at the larvae, it presumably might have caused the larvae to desist. This passivity recalls the relative equanimity with which nesting Laysan Albatrosses (*Diomedea immutabilis*) have reacted to Polynesian rats (*Rattus exulans*) chewing on their bodies (see Kepler 1967).

In Wood Storks, as in Snail Kites, we did not see dermestid larvae in the lesions of nestlings during nest checks, but we did find dermestid larvae in both of the affected nests we tore apart. No stork nests with chicks were taken into the laboratory to confirm the agents directly. Dermestid involvement with young Great Blue Herons was immediately apparent, as we commonly saw larvae dropping from lesions of the chicks we handled. All dermestid larvae and adults collected from affected nests of all three bird species were identified as *Dermestes nidum* (Fig. 1d), a species not known previously to feed other than by scavenging (see Barber 1914, Hinton 1945).

In most of the affected kite nests all chicks had lesions. In contrast, over half of the affected stork nests contained both damaged and undamaged chicks, and the frequencies of attack on storks were much greater when calculated on a nest basis than on a chick basis

TABLE 1. Cases of abdominal lesions in Snail Kites, Wood Storks, and Great Blue Herons.

Species	Year	Location	Number young checked	Number nests checked	Number and (%) young affected	Number and (%) nests affected	Inclusive dates of case discovery
Snail Kite	1978	Lake Okeechobee, Glades Co., FL	4	2	0 (0.0)	0 (0.0)	—
		Cons. Area 3A, Dade Co., FL	122	60	3 (2.5)	2 (3.3)	8 April to 17 July
	1979	Lake Okeechobee, Glades Co., FL	39	18	4 (10.3)	2 (11.1)	2 June to 2 July
		Cons. Area 3A, Dade Co., FL	121	67	11 (9.1)	7 (10.4)	13 March to 19 July
Wood Stork	1979	Madeira Rookery, Dade Co., FL	55	20	0 (0.0)	0 (0.0)	—
		Lane River, Monroe Co., FL	45	20	0 (0.0)	0 (0.0)	—
		Pelican Is., Indian River Co., FL	270*	150*	10 (3.7)*	10 (6.6)*	1 June
		El Clair, Hardee Co., FL	21	11	5 (23.8)	4 (36.3)	29 May to 13 June
		Moore Creek, Brevard Co., FL	14	7	3 (21.4)	3 (42.8)	16 May to 30 May
		Bird Is., Brevard Co., FL	22	9	7 (31.8)	6 (66.7)	18 May to 8 June
Great Blue Heron	1975	Elm Is., Ottawa Co., OH	540	379	160 (29.6)*	?	24 May to 8 June
	1976	Elm Is., Ottawa Co., OH	380*	144	1 (0.3)	1 (0.7)	29 May
		Lane Rookery, Ottawa Co., OH	290*	111	7 (2.4)	7 (6.3)	30 May to 6 June
	1977	Mackey Woods, Ottawa Co., OH	700	264	36 (5.1)	36 (13.6)	29 May to 12 June

* Numbers are estimates.

(see Table 1). Similarly, in the Great Blue Heron most of the affected nests contained only a single damaged chick. Because many kite and heron chicks and some stork chicks were checked only once during the nestling period, the incidence figures in Table 1 are presumably underestimates of true incidence. Chicks suffering damage after handling would not have been detected; neither would chicks dying early as a result of damage, nor chicks recovering completely before handling.

In all three species, the number of lesions per chick usually varied between one and six; in the Great Blue Heron in 1975, some chicks had as many as 20 lesions. The age of kite chicks showing damage varied from only a week old to about four weeks old. In storks, most fresh lesions were on either partially or wholly downy chicks. Most of the damaged Great Blue Herons were about two weeks from fledging.

Our data are insufficient to indicate how much of a threat the dermestid attacks may represent. We revisited only two of the undisturbed kite nests containing chicks with fresh lesions, and the wounds had healed completely in all chicks at one of the two nests. At the second nest, the chick was gone and the nest was deserted the day following our discovery of the attacks (Fig. 1a). Because the chick was extremely weak when discovered, we consider it likely that its presumed death was due to the dermestid damage.

In the Wood Stork, we intensively studied a sample of 50 young of which 13 had abdominal lesions. Surprisingly, 77% of the damaged chicks fledged successfully, while only 59% of the undamaged chicks survived until fledging. This comparison does not suggest widespread mortality attributable to dermestid damage. However, one of the damaged chicks that died exhibited swelling and hardening of the abdomen before death, which may have been a direct result of the damage and a principal cause of death. As with the Wood Stork, our impressions with the Great Blue Heron are that mortality due to dermestids has been low, because we did not see moribund chicks with lesions. We did not, however, generally recheck affected heron chicks for survival.

The geographic distribution of dermestid attacks in Florida has been wide, including five counties in central and southern parts of the state. In Ohio we know of cases only from the group of colonies in the Sandusky Bay region reported in Table 1. How many species, other than Snail Kites, Wood Storks, and Great Blue Herons, may have been suffering attacks is unknown. In Florida a 1979–1980 survey of studies of the nesting biology of various birds turned up only one additional case of abdominal lesions—in the Great Egret (*Casmerodius albus*)—see Appendix.

In the Snail Kite, two correlations are worth noting. First, 5 of the 11 affected nests were in melaleuca trees (*Melaleuca quinquenervia*), an exotic species presently spreading rapidly out into the marshlands of Florida. By comparison, only 23 out of 282 nest trees of kites identified for 1978 and 1979 were melaleucas. The difference between these two proportions is highly significant ($\chi^2 = 13.0$, $P < 0.01$), suggesting some sort of facilitation of attack related to nesting in this species. Nests in melaleucas tend to be composed largely of twigs and leaves of melaleuca itself and to be denser than nests in other trees; the precise factors that have led to the high incidence of attacks in melaleucas are uncertain.

Second, the incidence of attack was relatively high for kites nesting in mixed-species colonies, generally involving Anhingas (*Anhinga anhinga*) and various herons. Of the 11 affected kite nests, 8 were in mixed-species colonies, whereas only 138 out of 298 kite nests documented in 1978 and 1979 were in such colonies. These proportions do not differ significantly from one another ($\chi^2 = 2.0$, $0.10 < P < 0.25$), but the difference is close enough to statistical significance to suggest that dermestid attacks are related to nesting in such associations.

DISCUSSION

Conceivably, dermestid involvement in the lesions of these birds might have been secondary—that is, larvae may only have accentuated wounds initiated by other processes. However, because no macroscopic creatures other than dermestid larvae were found consistently in the affected nests, it seems unlikely that biotic agents other than microorganisms could have initiated the wounds. Alternatively, it is possible that wounds could have been initiated by abrasion against twigs in nest bottoms. It seems doubtful, however, that the amount of abrasion experienced by nestlings might have changed enough to explain the recent advent of abdominal lesions in these species.

We know of no published records of dermestid larvae attacking living chicks in North America, yet these insects are commonly present in the nests of a great many species on this continent. Additionally, dermestid attacks on living chicks have been recorded in Europe and Africa (see Kuwert 1871, Taschenberg 1879, Rosenhauer 1882, Noll 1888, Zacher 1924, Hicks 1959, 1962, 1971; Maclean 1973). *Dermestes lardarius* has been seen attacking newly hatched ducklings and chickens as well as boring into the wings of pigeon squabs, sometimes killing them. Similarly, *D. bicolor*, a close relative of *D. nidum*, has been seen attacking pigeon squabs by boring into the undersides of their wings and bodies. Maclean (1973) found dermestid larvae sucking blood from the legs of nestling Sociable Weavers (*Philetairus socius*). We have not noted any damage to the wings of kites, storks, or herons, and have not seen the sort of blood-sucking described by Maclean. The placement of lesions has nevertheless been variable. Although most lesions were located in the abdominal region, we did find a few on chests and legs.

In other species of dermestids and tenebrionids there have been indications that attacks on living chicks might be associated with high populations of larvae (see Rosenhauer 1882, Harding and Bissell 1958). However, this relationship has not held consistently with *D. nidum*. We found many larvae in some of the kite nests containing young with lesions, but very few in other affected kite nests. On the other hand, cases of attack in the Great Blue Heron did seem to be uniformly associated with high larval populations.

Another factor possibly controlling frequency of attacks is the amount of alternative food in nests, in particular, snail or fish scraps falling to the nest bottoms. We have no conclusive way of evaluating this possibility at present, but tend to doubt that the amount of meat scraps in kite and stork nests has changed markedly over the past few years. Both these species generally keep their nests clean of food scraps, and so far as we know, have always done so. In comparison, old (reused) Great Blue Heron nests tend to be well-endowed with organic litter, and most cases of attack were associated with old nests in this species. We note that 1979 was a year of frequent nestling starvation in Wood Storks, but other such years have occurred in recent times without the development of dermestid attacks. We found no signs of nestling starvation at any kite nest either in 1978 of 1979, both of which were banner years for kite reproduction.

Despite the absence of obvious and consistent ecological correlates with cases of attacks, environmental factors of some sort may have been important in eliciting the recent attacks. If so, the attacks may prove to be a transitory phenomenon of no great consequence to the avifauna. Alternatively, the problem could represent a more permanent shift in the biology of *D. nidum* that could continue to become more frequent and widespread. Both the Snail Kite and the Wood Stork are presently listed as endangered in North America (U.S. Fish and Wildlife Service 1976, Pritchard 1978), and it is important that the incidence of dermestid attacks in these species be closely monitored. The Wood Stork, although presently more abundant than the Snail Kite (which numbered about 500 individuals in 1979), has been declining at an average rate of about 4% per year over the last 20 years. Any new mortality factor can only exacerbate the difficulties of this species. Since *D. nidum* has been recorded almost throughout North America, a potential for difficulties exists over a wide geographic area and in a wide range of species.

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U.S. Fish and Wildlife Service, Patuxent Wildlife Research Center, California Field Station, 87 N. Chestnut Street, Ventura, California 93001. Address of second author: National Audubon Society, 87 N. Chestnut Street, Ventura, California 93001. Address of third and fourth authors: Ohio Cooperative Wildlife Research Unit, Ohio State University, Columbus, Ohio 43210. Present address of third author: 1200 Esplanade #207, Redondo Beach, California 90277. Present address of fourth author: U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Jamestown, ND 58401. Received 23 June 1982. Final acceptance 11 August 1983.

APPENDIX. A 1979 survey of avian reproductive biology studies in Florida yielded no cases of abdominal lesions in nestlings of: Brown Pelicans (*Pelecanus occidentalis*), Double-crested Cormorants (*Phalacrocorax auritus*), Reddish Egrets (*Egretta rufescens*), Roseate Spoonbills (*Ajaia ajaja*), Sooty Terns (*Sterna fuscata*), Crested Caracaras (*Polyborus plancus*), Eastern Screech-Owls (*Otus asio*), Northern Flickers (*Colaptes auratus*), Great Crested Flycatchers (*Myiarchus crinitus*), Scrub Jays (*Aphelocoma coerulescens*) Red-whiskered Bulbuls (*Pycnonotus jocosus*), Northern Mockingbirds (*Mimus polyglottos*), and Boat-tailed Grackles (*Quiscalus major*)—R. T. Paul, W. B. Robertson, J. N. Layne, F. E. Lohrer, C. E. Winegarner, S. A. Nesbitt, M. Cummings, G. E. Woolfenden, G. T. Bancroft, and O. T. Owre (pers. comm.). One case of abdominal lesions was reported for the Great Egret (*Casmerodius albus*) in 1980 by B. Patty (pers. comm.).