from the ocean, is puzzling. It is not known whether these nests represent an expansion of the breeding range of *P. a. floridanus*, which nests only in Florida, Louisiana and at a single site in southeastern North Carolina more than 350 km south of the present locality (see American Ornithologists' Union, Check-list of North American Birds, 5th ed., Baltimore, Maryland, 1957; Parnell 1977), or of *P. a auritus*, which nests about 800 km away in Tennessee and Kentucky (Mengel, The Birds of Kentucky, Ornithol. Monogr. 3, 1965) or 650 km northward in New York (Bull, Birds of New York State, Doubleday Nat. Hist. Press, Garden City, New Jersey, 1974). Both *floridanus* and *auritus* occasionally nest in trees with various herons; the latter is particularly prone to do so in the southern part of its range (Bent, U.S. Natl. Mus. Bull. 121, 1922; Bull 1974). Additionally, the nest-site is very near Bailey Creek, the source of severe Kepone pollution, which has plagued the James River and Chesapeake Bay for the past few years. The sediments in this part of the river are known to remain high in levels of this pollutant. As nearly all fish species in this area have been found to contain Kepone levels detrimental to human health, the taking of fish from the James River has been banned since 1975. Kepone is known to have estrogenic activities in birds and may induce eggwhite protein synthesis (Palmiter and Mulvihill, Science 201:356–358, 1978). However, neurological symptoms appear at dosages lower than those producing the estrogenic effect. Since the cormorants forage extensively in the area of Kepone pollution, the future of this colony would indeed seem to be tenuous.

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Corn cob manipulation in Northern Harriers.—Captive and free-ranging raptors, especially juveniles, often playfully manipulate a variety of inanimate objects, including dead prey, twigs, pieces of wood, pine cones, corncobs, clusters of dead leaves, clumps of grass, stones, cow dung, balls of paper, handkerchiefs and feathers (Ficken, Auk 94:573–582, 1977). Because such behavior is common among predatory birds, and because all manipulated objects appear to be within the size range of the raptors' prey, manipulative play behavior has been suggested as a mechanism whereby young raptors acquire skills in prey capture (Fagen, pp. 189–200 *in* Perspectives in Ethology, Vol. 2, Bateson and Klopfer, eds., Plenum, New York, N.Y., 1976; Ficken 1977). Here I compare the sizes of corn cobs manipulated by Northern Harriers (*Circus cyaneus*) with the size of the harriers' principal prey species, the meadow vole (*Microtus pennsylvanicus*).

During the winters of 1973–1974 through 1975–1976, I watched harriers in south central Ohio (Bildstein, unpubl. Masters thesis, The Ohio State Univ., 1976). On 7 occasions during evening pre-roosting, and twice during morning post-roosting periods, I saw harriers pouncing on and carrying, dropping and catching in midair, and apparently "eating" corn cobs. All of the cobs were without kernels; several were caked with mud. On 6 occasions I saw harriers pounce on, and carry, clumps of dirt and grass as well as pull on, and sometimes uproot vegetation. Adult males were seen playing twice, females 8 times and juveniles of unknown sex 14 times. Although harriers frequently snatch vegetation while pouncing on prey and are known to pounce on, and carry, microtine nests (Rolfe, Nidologist 4:39–41, 1897), the behavior I watched was distinctly different from this since it involved extensive repetition of behavioral sequences, more closely resembling a kitten playing with a ball of yarn than a raptor capturing prey (Ficken 1977).

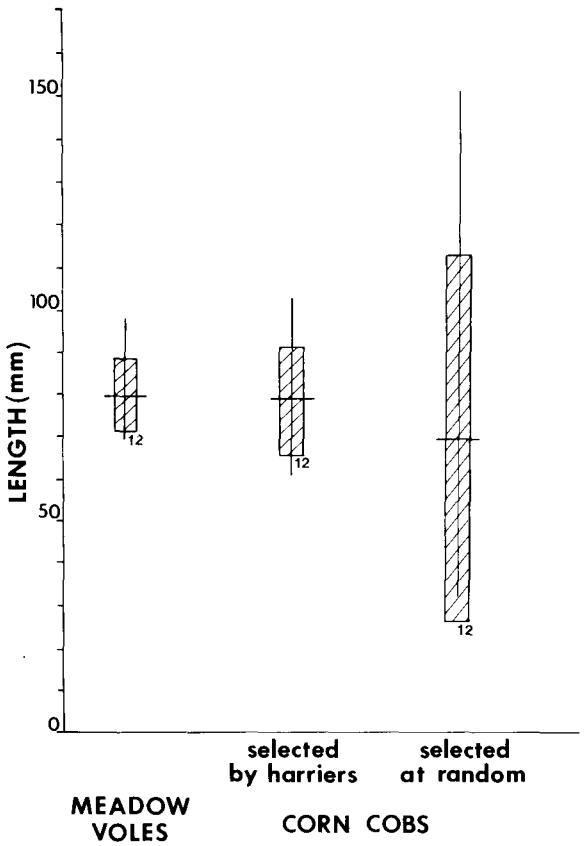

FIG. 1. Lengths of meadow voles, corn cobs selected by harriers and randomly collected corn cobs. Data are presented as the mean ± SD and the range. Sample sizes are shown below the bars.

Harriers were more likely to initiate play if a nearby bird did so, and as many as 3 harriers "played" with corn cobs within 50 m of one another. Whenever possible I noted the location at which a harrier dropped its manipulated object and I attempted to retrieve it. Eighty-five percent (33 of 39) of the objects manipulated were corn cobs, and during the winter of 1975–1976 I was able to collect 12 of them. Three of the retrieved cobs had been manipulated by adult females and 9 by juveniles of unknown sex. All had been carried from an adjacent corn stubble field to the roost field where they were dropped and could be found with certainty. None of the harrier-selected cobs had husks attached. On 11 March 1976, the last day of observation, I used the stick-toss method (Greig-Smith, Quantitative Plant Ecology, Butterworth, London, England, 1964) and randomly collected corn cobs from the same stubble field the harriers had used. As harriers seemed to have selected only huskless cobs, I continued to toss sticks until I had collected 12 cobs without husks. Because it was possible

that harriers had differentially depleted the area, I collected cobs only from the side of the field farthest from the roost where harriers had not been seen taking play objects.

Because voles comprised over 85% of these harriers' diet (Bildstein, unpubl. Ph.D. dissert., The Ohio State Univ., 1978), 12 meadow voles were live-trapped and their body lengths measured from photographs.

Since there was no apparent difference in the variance and mean lengths of cobs manipulated by adult females and juveniles of unknown sex, I grouped the cobs ignoring this variable. The lengths of both harrier-selected corn cobs and meadow voles did not differ significantly from randomly collected cobs (approx. *t*-test, $P > 0.40$, Fig. 1), but variance in the length of the randomly collected cobs was highly significantly different from that of either harrier-selected cobs (F-test, $F = 11.11$, $P < 0.001$) or meadow voles (F-test, $F = 28.70$, $P < 0.001$). Variances in the lengths of harrier-selected corn cobs and meadow voles were not significantly different (F-test, $F = 2.58$, $P > 0.05$). Thus, harriers selected for vole-sized cobs. Harriers did not appear to select corn cobs based on weight. They manipulated both dry, relatively light cobs and completely saturated, relatively heavy cobs.

Although it is possible that physical constraints prevented harriers from manipulating non-vole-sized cobs, this does not appear to be the case. I observed captive harriers manipulate both small fragments of cobs (<10 mm) and full length cobs (>150 mm), as well as vole-sized cobs. While it is possible that size specificity of harrier play objects results from harriers mistaking corn cobs for voles, I believe this to be highly unlikely. Harriers do not hunt for voles in corn stubble fields (Bildstein 1978), nor do they manipulate their prey to the extent that they manipulate corn cobs. Also, harriers engaged in corn cob manipulation, unlike harriers with voles, interrupted their play frequently, either to fly in tandem with another harrier, or to preen. Therefore, I suggest that harriers do not mistake corn cobs for voles, but rather purposefully select vole-sized play objects. This interpretation supports the hypothesis that play behavior is practice or physical training (Groos, The Play of Animals, Appleton, New York, N.Y., 1898; Bekoff, pp. 165–188 *in* Perspectives in Ethology, Vol. 2, Bateson and Klopfer, eds., Plenum, New York, N.Y., 1976; Fagen 1976), which predicts that play sequences should exercise muscles used in prey capture. By selecting vole-sized play objects harriers improve the coordination necessary to subdue prey.

While the data support the practice or physical training hypothesis they do not negate additional functions. Since juvenile raptors appear to manipulate inanimate objects more frequently than adults (Ficken 1977) raptor play may function in acquisition as well as in maintenance of prey catching skills. Also, raptors often attack and manipulate less "appropriate" nonprey items, including butterflies (Peregrine Falcons [*Falco peregrinus*]) and flowers and leaves (Golden Eagles [*Aquila chrysaetos*]) (Temple, pers. comm.). Why they do so remains unclear.

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