with field work. The Ontario Ministry of Natural Resources and the National Capital Commission kindly allowed us to conduct this research on their property. The University of Waterloo provided us accommodation at the Presqu'ile Field Station. L. Best, K. Bildstein, P. Gowaty, A. Horn, L. Kiff, M. Leonard, S. Rothstein, J. Verner, J. Walters, and an anonymous referee reviewed earlier drafts of the manuscript. This work was supported by an NSERC grant to J. P., an NSERC postgraduate scholarship and University of Ottawa scholarship to J.-C. B.-I., and a University of Ottawa summer research scholarship to L.S.

LITERATURE CITED

BELLES-ISLES, J. C. AND J. PICMAN. 1986. House Wren nest-destroying behavior. Condor 88:190–193.

BENT, A. C. 1948. Life histories of North American nuthatches, wrens, thrashers and their allies. U.S. Natl. Mus. Bull. 195.

BOWMAN, R. I. AND A. CARTER. 1971. Egg-pecking behavior in Galapagos Mockingbirds. Living Bird 10:243–270.

PEARSON, G. F. 1936. Birds of America. Garden City, New York.

PICMAN, J. 1977. Destruction of eggs by Long-billed Marsh Wren (*Telmatodytes palustris palustris*). Can. J. Zool. 55:1941–1920.

——— AND A. K. PICMAN. 1980. Destruction of nests by the Short-billed Marsh Wren. Condor 82:176–179.

TEMPLE, S. A. 1978. Endangered birds. Management techniques for preserving threatened species, Univ. Wisconsin Press, Madison, Wisconsin.

VERNER, J. 1975. Interspecific aggression between Yellow-headed Blackbirds and Long-billed Marsh Wrens. Condor 77:329–331.

JEAN-CLAUDE BELLES-ISLES AND JAROSLAV PICMAN. *Dept. Biology, Univ. Ottawa, Ottawa, Ontario K1N 6N5, Canada.* *Received 20 Nov. 1985, accepted 19 Mar. 1986.*

Wilson Bull., 98(4), 1986, pp. 605–607

Fatal antipredator behavior of a Killdeer.—Adult birds often defend their young against predators (Gottfried 1979, Gochfeld 1984). Distraction displays are one form of defense employed by parents, presumably at some risk to the performing bird (Barash 1975, Andersson et al. 1980, Greig-Smith 1980, Walters 1982). Increased intensity of distraction displays, and decreased distance from the potential predator, probably increase the risk to the performing bird (Barash 1975, Andersson et al. 1980). Despite the problem of habituation to intruders after repeated encounters, several studies show a correlation between the intensity of a distraction display and the vulnerability of offspring as indicated by nesting stage (Andersson et al. 1980, Lemmetyinen 1971).

Killdeer (*Charadrius vociferus*) are ground nesting birds that suffer heavy nest and hatching mortality (Nol and Lambert 1984). Killdeer antipredation strategies include cryptically colored eggs and chicks and the use of distraction behavior. Distraction behavior ranges from "false brooding" to "injury-feigning" (Gochfeld 1984). Direct, aggressive antipredator behavior by Killdeer is less common (cf. Deane 1944). Gochfeld (1984) named this type of aggressive behavior the "ungulate display." Birds performing this display move off the nest towards the intruder with their wings held slightly away from the body, and the contour

feathers fluffed. This posture becomes more exaggerated until the wings are held out at a considerable distance from the body, exaggerating the size of the bird. The tail is fanned and the cinnamon rump is exposed. The head is held in a lowered position. While in this crouched posture, the bird lunges towards the intruder in an apparent effort to halt its approach. In this paper I report on the use of a "threat display," which is directed towards predators of both adult Killdeer and their offspring. I also detail the fatality of a threat-displaying bird.

On 3 occasions I observed Killdeer respond to potential predators with a threat display. One case involved a red fox (*Vulpes vulpes*), and the other 2 instances involved humans. Each observation occurred during incubation and when the predator was within 5 m of the incubating bird. In 2 cases the Killdeer was a male and the clutch was within 2 days of hatching. The threat displays observed differed slightly from the ungulate display. The tail was held erect and not fanned. In 2 cases the threat displays were accompanied by a low pitched "growl" call, a call not described by Deane (1944). I was too far away from the bird during the encounter with the red fox to hear whether or not a call was given then.

In the case involving the red fox, the displaying bird was captured and killed by the fox. On 19 May 1985 at 06:30 h, I began observations of an incubating Killdeer from a car parked on a rise approximately 20 m from the nest. Neither adult of the pair had been banded, so I did not know the sex of the incubating bird. At 06:48 h the mate of the incubating bird flew to a feeding area approximately 1 km away. At 07:10 h a red fox approached the area of the nest from behind the incubating bird. When the fox was 2 m from the nest, the incubating bird showed signs of detecting the fox. The initial response of the bird was to run 0.25 m towards the fox in a threat posture. The Killdeer then quickly turned away and began injury-feigning, at which time it was pounced on and killed by the fox. The entire sequence of events lasted <30 sec.

I continued watching the nest for several hours after the attack, but, although there were Killdeer in the area, no bird returned to the nest. On returning later in the afternoon, I found that the clutch had been destroyed (shell fragments were found nearby).

To my knowledge this is the first documented case of a bird attempting to distract a predator and being captured and killed by that predator. Gochfeld (1984) suggests that individuals may minimize the risk involved in distracting a potential predator by keeping a safe distance from the predator. In order to remain at a safe distance an individual must be aware of the predator. When a predator is able to get very close to the nest without detection it seems likely that the nest will be discovered and predated. Therefore the "cost" to the surprised bird is high. In my observation the incubating bird was surprised by the predator. The initial response of the bird was to threaten the predator. My observation supports the assumption in the literature that distraction behaviors are performed at some risk of injury or death to the performer.

Acknowledgments.—G. Bourne, B. Gottfried, C. Ristau, R. W. Storer, M. W. Tome, and J. Walters provided helpful comments on the manuscript. This study was supported in part by a grant from Sigma Xi and a Rackham Dissertation Grant from the University of Michigan.

LITERATURE CITED

ANDERSSON, M., C. G. WIKLUND, AND H. RUNDGREN. 1980. Parental defense of offspring: a model and an example. Anim. Behav. 28:536–542.

BARASH, D. P. 1975. Evolutionary aspects of parental behavior: distraction behavior of the Alpine Accentor. Wilson Bull. 87:367–373.

DEANE, C. D. 1944. The broken-wing behavior of the Killdeer. Auk 61:243–247.

GOCHFELD, M. 1984. Antipredator behavior: aggressive and distraction displays of shorebirds. Pp. 289–377 *in* Behavior of marine animals. Vol. 5 (J. Burger and B. L. Olla, eds.). Plenum Press, New York, New York.

GOTTFRIED, B. M. 1979. Anti-predator aggression in birds nesting in old field habitats: an experimental analysis. Condor 81:251–257.

GREIG-SMITH, P. W. 1980. Parental investment in nest defense by Stonechats (*Saxicola torquata*). Anim. Behav. 28:604–619.

LEMMETYINEN, R. 1971. Nest defense behaviour of the Common and Arctic terns and its effects on the success achieved by predators. Ornis Fenn. 48:13–24.

NOL, E. AND A. LAMBERT. 1984. Comparison of Killdeer, *Charadrius vociferus,* breeding in mainland and peninsula sites in southern Ontario. Can. Field-Nat. 98:7–11.

WALTERS, J. R. 1982. Parental behavior in Lapwings (Charadriidae) and its relationships with clutch sizes and mating systems. Evolution 36:1030–1040.

DIANNE H. BRUNTON, *School of Natural Resources, Univ. Michigan, Ann Arbor, Michigan 48109.* *Received 12 Nov. 1985, accepted 3 May 1986.*

Wilson Bull., 98(4), 1986, pp. 607–608

Plunge-diving by Olivaceous Cormorants in Chile.—Seabirds employ a variety of foraging methods, but only surface-diving has been reported for cormorants (Phalacrocoracidae) (Ashmole 1971). We report here on plunge-diving by Olivaceous Cormorants (*Phalacrocorax olivaceus*) at Chiloé, Chile.

During 12–13 November 1985, in a sheltered, sand-pebble bay at Punta Puñihuil, at the south end of Mar Brava beach, on the west coast of Chiloé Island (41°55′30″S, 74°02′W), we observed 1–5 Olivaceous Cormorants foraging in water less than 2 m in depth. Three of the birds foraged by surface-diving, but 2 flew at maximum heights of 0.5 m above the water for 5–50 m before making low, oblique plunges into or in front of breaking waves of approximately 0.25–0.5 m high or into calm water 0.5–1.0 m depth. Birds plunged head first with their wings folded against their bodies, rather than folded behind the body as in gannets *Morus* spp. (Nelson 1978). Oblique plunges had a mean duration of 1.7 ± 0.6 sec [SD] (N = 20). Fish were caught during at least 2 plunges; additional fish may have been swallowed while the birds were underwater.

At the same time, Olivaceous Cormorants foraging by surface-diving in the same area remained underwater for 15.2 ± 4.4 sec, N = 12, similar to dive-durations in water <2 m deep in Peru (12.3 ± 4.5 sec, N = 36) (Duffy 1983), and in Texas, (16.0 sec) (Morrison et al. 1978). We saw 2 cormorants switch from surface-diving to plunge-diving and one switch back again.

Plunge- and surface-diving were used almost interchangeably, suggesting that both were effective methods of prey capture. The Olivaceous Cormorant is one of the most wide-ranging cormorant species (Blake 1977). The very unusual use of plunge-diving by a cormorant, in addition to normal pursuit-diving, may enable the bird to exploit food not normally available to cormorants.

Acknowledgments.—This paper is based on part of the FitzPatrick Institute's 25th Anniversary Expedition to Chile. We are grateful for assistance, logistic support, and permission to work on Chiloé from the Corporación Nacional Forestal de Chile. We thank R. Navarro for assistance in the field.