

CARE AND BEHAVIOR OF PENNED DOUBLE-CRESTED CORMORANTS

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A study on the effects of insecticides in fish-eating birds was initiated at South Dakota State University (SDSU) during the summer of 1969. We chose the Double-crested Cormorant (*Phalacrocorax auritus*) for the following reasons: (1) Local cormorants, pelicans, and their eggs were monitored for insecticide levels in 1967 and 1968. Cormorants were found to have average levels of organochlorine insecticides of 4.9 ppm and 165 ppm for muscle and fat respectively. These relatively high levels warranted further investigation of possible adverse effects on the species. (2) The feeding habits of local cormorants were studied by Trautman (1951), who found that their diet consisted mainly of black bullheads (*Ictalurus melas*) that could be readily obtained from a local commercial fisherman for feeding the penned birds. (3) Young birds were plentiful and could be collected from a nesting colony on Dry Lake, 30 miles northwest of the university.

The purpose of this paper is to report our experiences in the care and the feeding of *P. auritus* and to provide a baseline for interpreting the effects of insecticides on its behavior.

In preparation for the study, cages (Figure 1) were erected in the SDSU Wildlife Research Area. These enclosures were built in two complexes of three units each (8' × 8' × 6'). A concrete floor sloped three degrees to the front of each unit where a walkway gutter ran the length of the complex and emptied into a drain. This design facilitated washing the cages. Partitions between individual units were of ¾-inch plywood. Galvanized metal 16 inches wide was embedded in the concrete around the inside base of each cage to prevent intercage contamination and to guard against possible rodent intrusion. Heavy screening embedded in the concrete completed the front and back of the cages. Several large rocks, a low bench along one wall, and a large tree limb in the center of each cage provided perches. Water tanks for each unit were made by cutting 55-gallon oil drums lengthwise and welding legs to the bottom to prevent tipping. These were sprayed with a nontoxic plastic to prevent corrosion, and a split plastic hose covering the rim protected the feet of perching birds.

In June 1969 we visited the Dry Lake rookery to determine both the number of young and the accessibility of nests. The rookery was in a stand of large willows and cottonwoods in a swamp on the northeast side of the lake. Its 55 nests contained an average of 3.2 eggs per nest,



Figure 1. Cormorant cages at South Dakota State University.

about one egg more than the figure Trautman (1951) reported. The nests were 1–2 feet in diameter and weighed from 5 to 20 pounds. On 18 June 1969 we collected 52 young birds with some of their nests and placed them in three cages. We hoped that the presence of the nests would decrease the possibility of shock after capture. Four birds died during their first night in captivity, so we suspended 250-watt heat lamps 2½ feet above the birds to minimize the effects of exposure.

During the first 4 days of captivity all birds had to be force-fed. This was done by grasping the maxilla with the left hand, depressing the lower mandible with the right hand, and pushing the fish down the bird's throat with the right forefinger. Approximately 2,000 fathead minnows (*Pimephales promelas*), obtained from a local bait farm, were fed each day in four feedings per day for the first week. By the end of the week all were taking four 8-inch bullheads daily unassisted. After the first week we used bullheads exclusively as feed. When frozen fish were fed, they were thawed completely and the diet was supplemented with B-complex vitamins to prevent vitamin deficiency and consequent loss of appetite (Flieg, pers. comm.).

Trautman (1951) noted that the cormorant does not lay a single clutch of eggs all at once, but typically has young of various ages in the nest. Because of this age difference the birds when captured weighed

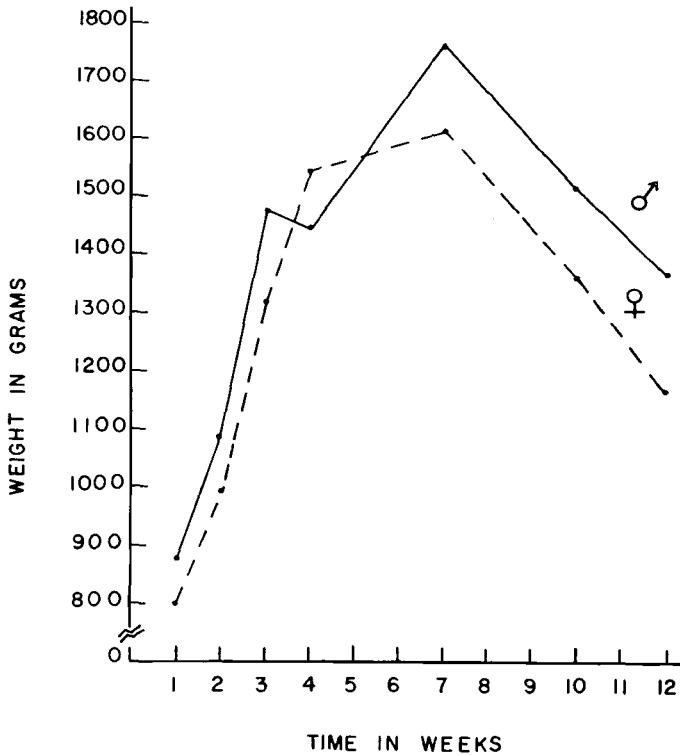


Figure 2. Growth curves of male and female Double-crested Cormorants.

from 450 to 1350 g. Throughout our study all birds were weighed weekly to determine possible significant weight differences between male and female groups. Analysis by curvilinear regression showed males to be significantly heavier than females ($P < 0.01$; d.f. = 71). Both males and females reached their growth peak at 6–7 weeks of age, as shown in Figure 2.

During the period of adjustment to captivity, one bird refused fish for 6 days and had to be force-fed. This bird showed little vocal or physical activity and appeared to be ignored by the other birds. After 5 days the bird's movement became feeble, breathing was labored, and it died. A necropsy by the university's Animal Disease Research and Diagnostic Laboratory revealed lesions of aspergillosis; *Aspergillus fumigatus* was isolated from the lungs and air sacs, and one primary bronchus was obstructed by a caseous plug. The following week two more birds died and were also found to be infected with *A. fumigatus*. Necropsy of other young wild birds showed them frequently infected by the fungus.

Treatment consisted of spraying the birds with 50 ml of 0.1 mg/ml Amphotericin-B (Fungizone, Squibb Co., New Brunswick, New Jersey) plus 0.13 mg/ml Terramycin (Pfizer Co., Terre Haute, Indiana) for 15 minutes (Halliwell, pers. comm.). Three to four birds were placed in a 20-gallon plastic container covered with glass so we could watch them during the fogging. The treatment was repeated three times during the first week and once a week for the next 2 weeks. After these treatments only one other bird died from the fungus. D. V. Hunter (pers. comm.) suggested the nesting material might have been the source of the fungus, and we subsequently isolated *A. fumigatus* from the nesting material. All nests were then removed and the cages were thoroughly scrubbed and disinfected with Environ (Vestal Laboratories, St. Louis, Missouri). During the rest of the study all cages were cleaned and disinfected twice weekly. All birds were killed at the end of the summer. Of the 46 birds necropsied, 4 were found to have lesions typical of *A. fumigatus* (Bicknell et al., 1971). The kidney tissues showed no gross or histopathological signs.

From about the third day of captivity, the birds gathered around the keeper during feeding with heads elevated and necks extended while emitting high-pitched squeaks and peeps. Plessis (1957) also reported this response. An empty hand held over the birds elicited the same response.

In captivity the smaller birds were noted to worry the larger birds by bobbing and weaving in front of them. This often continued for several minutes until the larger bird raised its head and walked away. If the smaller bird persisted, the larger bird usually opened its mouth and the other placed its entire head into the gular pouch of the larger bird as if to feed. Mendall (1936) reported this feeding behavior in wild cormorants.

While the fish were being prepared, the birds in the cage gathered excitedly around the door screeching, flapping their wings, and climbing the screen with the aid of their claws and hooked beaks. Typically after feeding, the birds jumped into the water tank, swam around ruffling their feathers, and then stood in the sun to stretch and flap their wings until dry.

At this time the birds appeared to associate food more with objects used for its preparation than with the person feeding. For example, in the initial phase of the study the birds went immediately to the person feeding. Later the birds tended more to gather near the table where the fish had been prepared. When I (G. G. D.) stood some distance from the table the birds made no orienting response to me, but if just one bird started toward me while I simulated feeding, all the birds rushed to me.

Late in June one bird suffered a compound fracture of the radius. The bird was taken to the laboratory where a 3-cm incision was made at the site of the fracture. Bone splinters were removed and the wing was splinted and taped to the bird's body in the rest position. The injured bird appeared to lapse into shock but recovered within an hour. It was kept under a brooder lamp for the next week and then placed in a separate pen. Recovery appeared complete until the second week in July when a severe staphylococcus infection appeared in the broken wing. The bird was given a 1.5 cc intramuscular injection of procaine penicillin and within several days the infection was considerably reduced. Though recovery was complete, the bird regained only partial use of the wing.

The penned birds became very docile with no excessive pecking or excitability when approached. When released from the cages during cleaning, the birds stayed in the immediate vicinity investigating objects such as cans, brooms, sticks, and nails. They remained in groups much like ducks, and could be herded back into their cages with little difficulty.

Within a month after capture a pecking order appeared well-established within each group. A small bird typically went from bird to bird gesturing as though begging to be fed, only to be pecked by the bird it approached. If the small bird persisted in begging from one particular bird and was finally driven off, every other bird it passed pecked it lightly on the head until it reached its perch. A large bird in one cage was the first to perch in the tree limb in his cage. When other birds started perching in the same tree the large bird retained the top position. If another bird tried to perch in his spot, the large bird immediately drove the other off by pecking and pushing. The bird was the apparent mediator of squabbles and never was openly challenged by any of the other birds in the cage. If two birds began pecking each other, the dominant bird came between the two and pecked each bird in turn until they retired and sat quietly. In contrast, when a bird was dying the other birds in the group ignored it and never directly attacked it.

The birds appeared to make little discrimination between what was edible or inedible until an object was in the bird's mouth, and occasionally not even then. For example, while lunging for a fish on the ground one bird hit a small stone and promptly swallowed it.

In late July we saw one bird pick up a small piece of wood 2-3 cm long and spit it out. This it repeated twice, when another bird took the piece of wood and passed it to another bird, who passed it to yet another, after which the stick was discarded. This behavior has also

been reported in the wild (Mendall, 1936). When released from the cages during cage cleaning or feeding, the birds often picked up sticks varying from 4 cm to 40 cm in length and ran about with their heads elevated and extended. Two or three birds then chased the stick-bearing bird until they caught the stick. An avian tug-of-war ensued until one bird wrestled the stick away from the first. The routine usually continued until the stick was discarded or swallowed. Swallowing sticks caused the death of three birds. When necropsied one was found to have three sticks 30, 17, and 14 cm long lodged in his throat and stomach, a large blood clot in the abdominal cavity, and a ruptured esophagus and stomach. Lewis (1929) also reported that several captive birds died after swallowing sticks.

P. auritus has proved to be an excellent laboratory bird. Its adaptability to captivity was excellent, and no special attention was necessary other than periodic treatment for aspergillosis. A survival rate of 87 percent was obtained for birds taken at approximately 2 weeks of age. When we repeated the study the next year, we collected 50 birds approximately 4 weeks old and treated them for aspergillosis throughout the entire study. Survival in this group was 100 percent.

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SUMMARY

Describes the care and behavior of Double-crested Cormorants studied in South Dakota during the summers of 1969 and 1970. Young birds were collected from a rookery at Lake Poinsett and penned at South Dakota State University. During the first week of captivity birds were force-fed fathead minnows; they then accepted 8-inch black bullheads supplemented with B-complex vitamins until the end of the study. Both males and females reached their growth peak at 6 to 7 weeks of age and males were significantly heavier than females ($P < 0.01$; d.f. = 71). Pecking orders were rapidly established in each cage with the largest male usually the dominant bird. Both wild and penned birds were found to be infected with the fungus, *Aspergillus fumigatus*, and caged birds were treated with Amphotericin-B. Three birds died after swallowing sticks. The overall survival rate for 52 penned birds in 1969 was 87 percent, and 100 percent for 50 birds penned in 1970.

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