THE AUK
A QUARTERLY JOURNAL OF
ORNITHOLOGY

VOL. 92 OCTOBER 1975 NO. 4

PREY CAPTURE BY THE BROWN PELICAN

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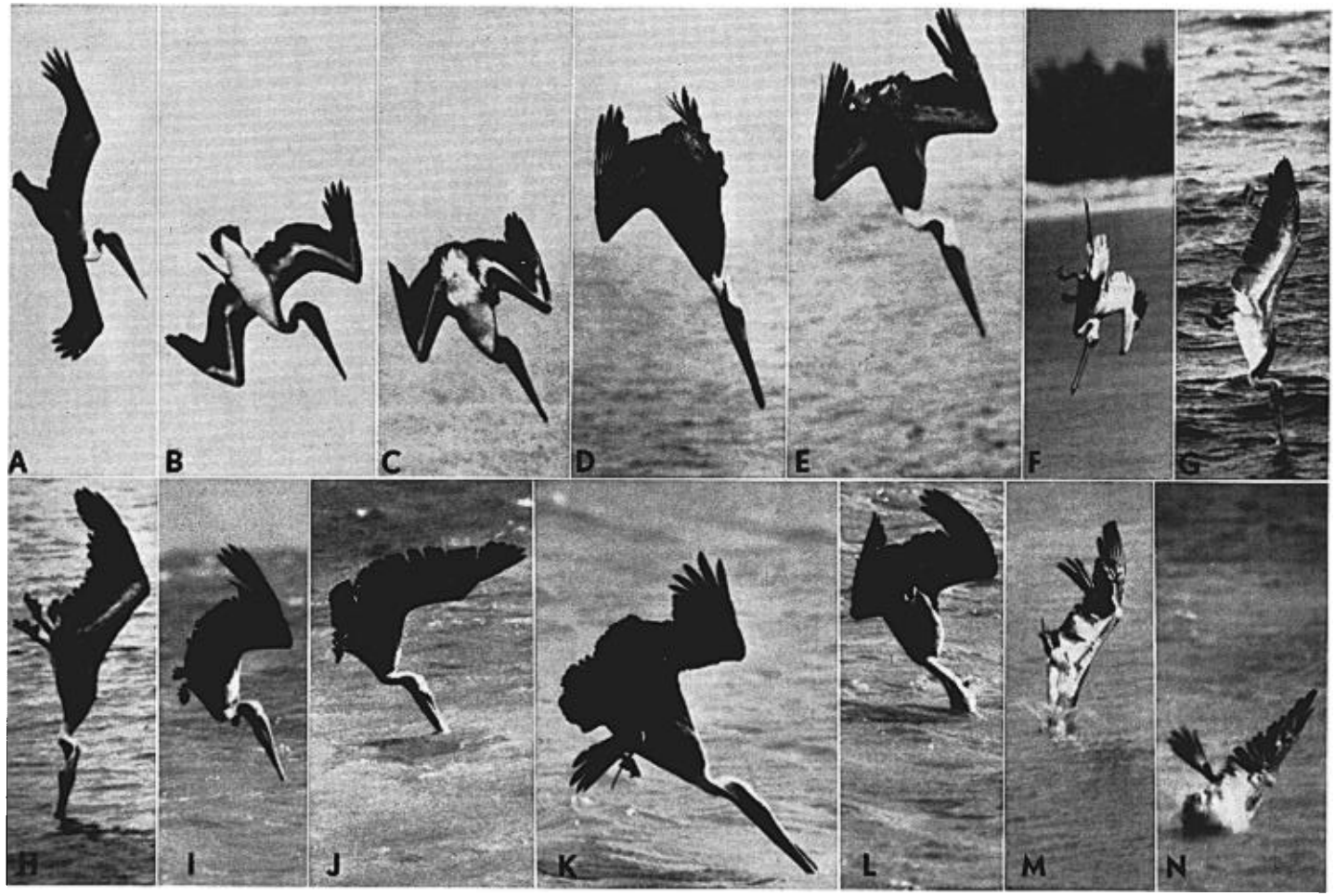
METHODS of prey capture are of considerable interest to biologists. Fish-eating birds have been studied extensively (cf. Ashmole 1971) and, among seabirds, the order Pelecaniformes provides a diverse assemblage of capture methods. Owre (1967) describes in detail the structural adaptations for swimming underwater and impaling and seizing fish by the Anhingidae and Phalacrocoracidae respectively. The Fregatidae grasp their prey from very near the surface without entering the water (Wetmore 1965). The Sulidae and Phaethontidae plunge into the water and pursue fish and squid, probably to some depth. The white pelicans of the subgenera *Pelecanus* and *Cyrtopelicanus* seize their prey while swimming on the water surface, often fishing communally. The Brown Pelicans (*Pelecanus occidentalis*) however surface plunge for fish. The long bill and exaggerated gular pouch of pelicans have elicited speculation from biologists and laymen alike as to their actual movement underwater (Allen 1923, Coues 1927, Peterson 1963, Abbott 1966, Gardiner 1973). For the first time we are able to describe the use of the bill and pouch during prey capture by diving Brown Pelicans.

Fig. 1 is a composite made from 35-mm color slides of pelicans diving in various situations in Florida. Figs. 2 and 3 are selected composites of slides obtained with a motorized Nikon held approximately 2 feet underwater while baiting the nearby pelicans with frozen fish in front of the camera. While these photographs were obtained under somewhat unnatural conditions at a marina in the Florida keys, we believe they accurately represent the technique Brown Pelicans use when diving to catch live fish.

Considerable variation exists in the aerial diving process, probably accountable through interactions of several factors: individual experience of the birds; the species, size, depth, speed of movement, and schooling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characteristics of the prey; wind conditions, affecting both the bird and the water surface; intensity and angle of the light; depth and clarity of the water; and perhaps the hunger of the individual bird.

The basic pattern of a usual pelican dive (Fig. 1) consists first of sighting and selecting the prey. We believe that a pelican dives for an individual fish, even if it is in a school. During the dive the head is withdrawn over the shoulders, the legs are brought forward (Fig. 1, see A–D), and the wings are bent so that a triangular surface of the back and wings is formed (C–E). The diving bird keeps the head stable to allow sighting down the bill at its selected target. Bending the wings astern increases the diving speed. If the bird finds itself pointing too high or too low, it corrects its aim by moving the wing tips up or down; they function exactly as an airplane's elevators. A bird has nothing resembling an airplane rudder, and normally changes course in level flight by a banked turn. To correct to right or left in a fast dive, the pelican rotates its body, but not its head, by raising one wing tip and lowering the other. The extreme rotations noted, to approximately 180° (Fig. 1, note D especially, note also E, H, L) probably result from the need for further correction after a 90° rotation is passed. This is more quickly accomplished by rotating toward 180° than by returning to the normal attitude. The bill enters the water at various angles, both to the water and to the body of the bird (G–L). Upon bill contact with the water the legs and wings are thrust backwards (G, H, M) thus accelerating the movement of the bill at the moment of surrounding the prey.

The bill enters the water with the gular pouch remaining contracted between the flexible mandibular rami (Fig. 2 A–B) and at an angle so that the fish becomes positioned between the upper and lower mandibles. Once the prey is thus positioned, both the upper mandible and the rami of the lower mandible move to surround it. Little water pressure is exerted against the relatively small and streamlined surface of the upper mandible, and it moves rapidly. We believe its primary functions are to chase the fish into the water space formed by the enlarging gular pouch, and then to close the trap. Movement of the gular pouch underwater is probably impossible. The opening formed by the bowing lower mandibles is approximately 500 cm^2, and the pouch can be expanded to hold approximately 10,000 cc of water (based on filling the pouches of four fresh-dead specimens from the west coast of Florida, two adult males and two adult females). The average weight of 41 Florida Brown Peli-

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Fig. 1. Aerial maneuvers of the Brown Pelican while diving for fish.

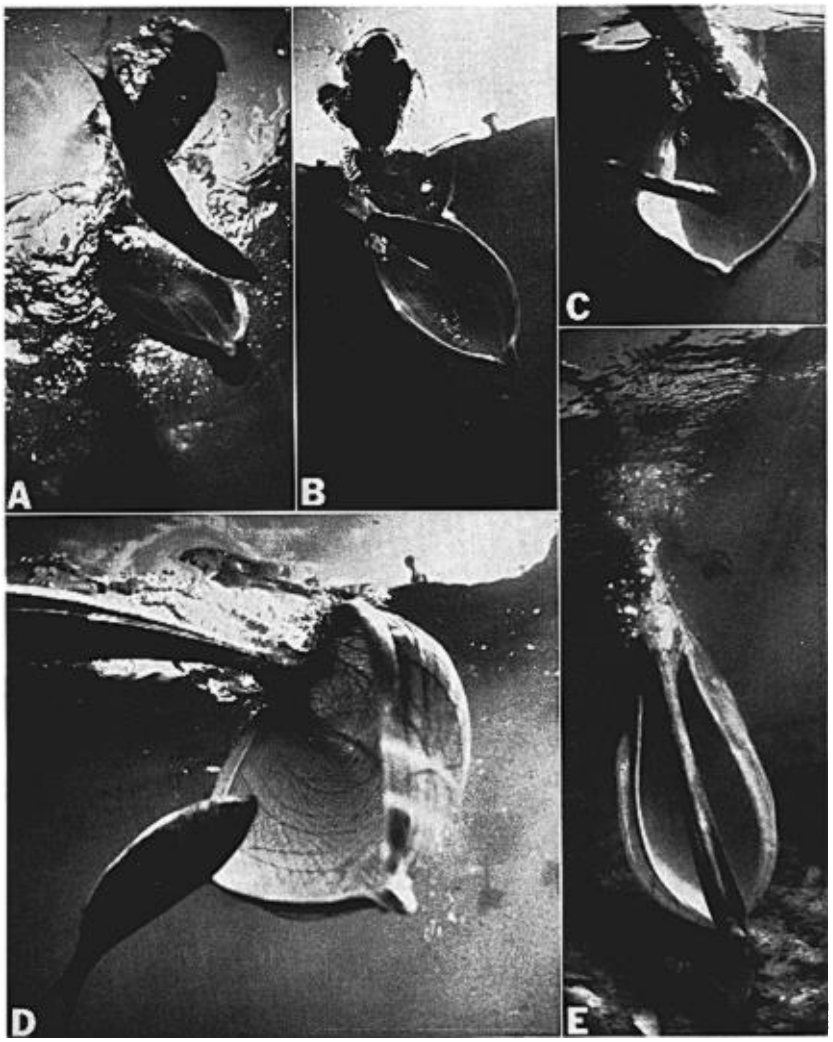

Fig. 2. Initial stages of underwater movement of the bill and pouch of Brown Pelican while catching fish.

cans is 2.9 kg, and of the water in the pouch about 5–8 kg at fullest expansion under water. We suspect it is impossible for a pelican to move this volume and weight of water at all, and certainly not rapidly enough to trap a fish attempting to avoid capture.

The mandibular rami alone can move because of the elasticity of the pouch and as they do the pouch fills with water. The trap is closed as

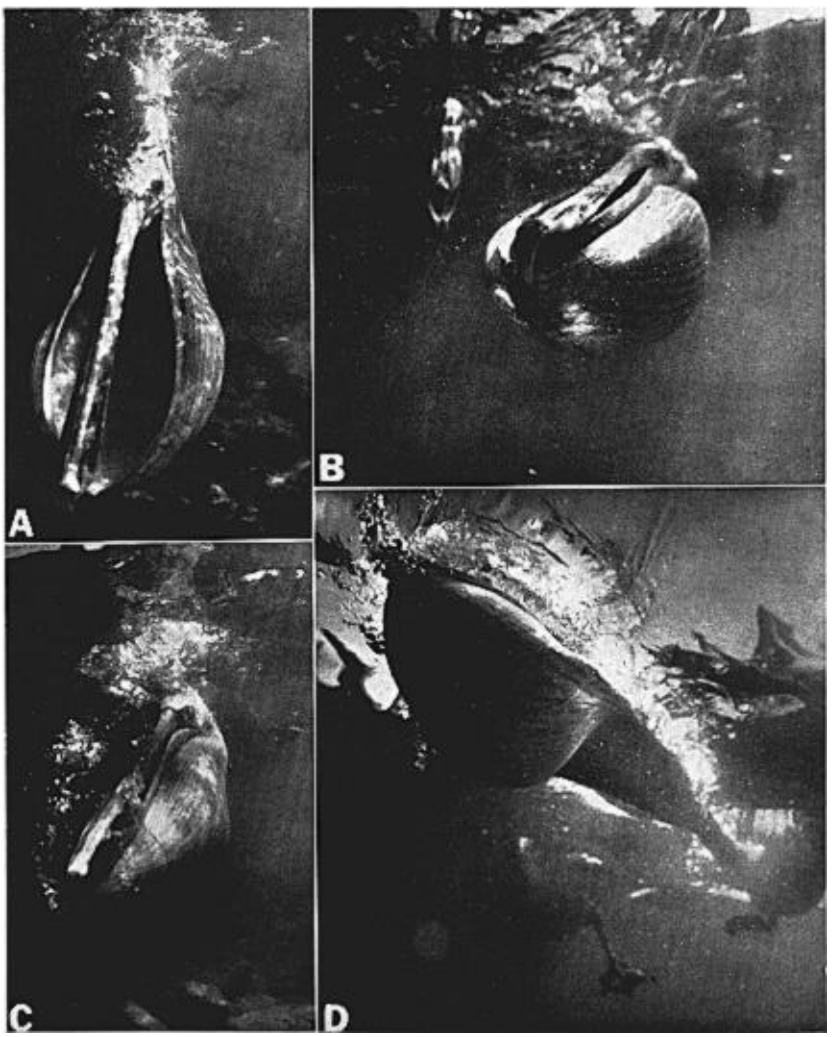

Fig. 3. Terminal stages of underwater movement of the bill and pouch of the Brown Pelican while catching fish.

the rami return to their normal unbowed position and meet the upper mandible (Fig. 3 B–C), and the highly expandable pouch remains filled with water. If the dive is successful, the prey is also inside the pouch. The mandibles are closed tightly enough so the fish cannot escape, but the bird must empty the water from the pouch before it can swallow the prey. As noted above, a pelican is unable to move this water. Instead,

as the head is raised vertically the water begins to flow by gravity out of the still submerged bill, leaving the fish inside. Once the water has flowed out, the pelican is able to lift its bill entirely out of the water and swallow the fish with a toss of the head. Less than 2 sec elapse between touching the water and encircling the fish. Often up to a minute is needed to drain the pouch and swallow the fish. If no catch is made, the head and bill rapidly return to the normal position. This enables observers to measure the success of diving pelicans by carefully noting their postplunging behavior (Orians 1969, Anderson and Schreiber MS).

ACKNOWLEDGMENTS

We sincerely thank The Frank M. Chapman Fund of the American Museum of Natural History, The International Council of Bird Preservation, the National Audubon Society, and especially Mrs. Mary G. Smith and the National Geographic Society for preparing the photographs. D. B. O. Savile's clarification of the aerodynamic aspects of the dive is appreciated. Portions of this description appear in Schreiber (1975).

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