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Lower jaw action during prey capture by pelicans.—Schreiber et al. (1975) gave a detailed account of the technique of prey capture by the Brown Pelican (*Pelecanus occidentalis*) based on photography of individuals diving into a marina. Their excellent illustrations show clearly the remarkable extent to which the rami of the lower jaw bow outwards during the capture of a fish. Although they do not comment on the mechanics involved in mandible bowing, Schreiber (in litt.) has suggested interaction with the water as the means by which this is brought about. Obviously, this possibility must be considered carefully.

Forces acting on the lower jaw under water can be considered under two heads: those acting directly on the jaw, and those acting via the gular pouch. As the lower jaw moves forward during the bird's entry into the water, pressure against the water will inevitably exert some backwardly directed force upon it. This would tend to compress the jaw along its long axis, and thus to bow the rami outward. However the force can be only a small one, as the lower jaw presents a very small area to the water from its anterior aspect; moreover, as the jaws bowed outwards, continuing motion in the same direction would increasingly produce forces acting against the lateral surface of the rami, and tending to counteract bowing. It seems unlikely, therefore, that direct interaction between lower jaw and water would produce the bowing effect.

Mandible bowing could be produced by the gular pouch only while it is relaxed and distended. In this condition, as the photographs show, it assumes a rounded cross section as it is filled by water, bulging out either side of the lower jaw rami to which it is attached. In this condition an outward force component would act on each ramus; with a contained weight of water of 5–8 kg, this force component may be of substantial magnitude. However this does not explain how it is possible for the rami to bow while the pouch is contracted, as shown clearly in Figures 2A and 2B of Schreiber et al. (1975). Contraction of muscles in the pouch (presumably M. mylohyoideus anterior though this has not been checked by dissection) would inevitably exert a medially directed force on the rami, tending to pull them together. Moreover, as the photographs show (Figs. 3B, 3C) the rami can move together again while the pouch is fully distended.

It seems, therefore, that interactions between jaw and water are insufficient to explain how bowing is brought about. Confirming this view, some photographs of pelicans show considerable mandible bowing out of water, e.g. those of *P. onocrotalus* (Nicolai 1974: 132). Extensive bowing out of water is also shown during the Bill Throw performance of *P. occidentalis* (Schreiber 1977, Fig. 6).

An alternative mechanism is that provided by M. pterygoideus, the large and complex jaw muscle linking the lower jaw with the palatine and pterygoid. Part of this muscle (M. pterygoideus ventralis medialis) originates on the ventral surface of the palatine and inserts on the internal process of the lower jaw. When the internal process is pulled forward, the lower jaw ramus is pivoted on its articulation with the quadrate, swinging its lateral surface outwards. This action, which can be modified by means of the other jaw muscles, has been fully described and discussed in various other groups of birds, (notably the Charadriiformes and Procellariiformes) by Judin (1961), Zusi (1962), and Burton (1974). Pending further research, I would suggest that this is also the main mechanism of mandible bowing in *Pelecanus*. An illustrated description of M. pterygoideus in *Pelecanus* is given by Hofer (1950), and further dissection of this genus and other Pelecaniformes may shed more light on the structural basis of this action. Nevertheless it is clear that M. pterygoideus ventralis medialis is indeed well developed in pelicans, with its area of origin enlarged by means of a deep ventral keel along the midline between the ankylosed right and left palatines. It is interesting to see from the photographs of Schreiber et al. that the upper jaw is able to perform extensive movements independently of the lower, even while the latter is fully bowed. Schreiber (in litt.) has pointed out that during the Bill Throw, throwing the head high stretches the pouch taut, producing forces that will tend to cause bowing. The precise contributions of the pouch and pterygoideus musculature in this situation are impossible to assess without experiments involving stimulation of surgically isolated muscles; but it may be noted that the photographs of *P. onocrotalus* in Nicolai (1974) show birds bowing the mandibles in a roughly horizontal position, when the pouch would be making no contribution to the action.

Obviously the jaw movements of *Pelecanus* have reached a high degree of refinement and versatility, and further investigation may contribute substantially to our understanding of jaw mechanics in birds as a whole. The amenability of pelicans to captive conditions may prove useful in pursuing such studies.

ACKNOWLEDGMENTS

I am extremely grateful to Ralph W. Schreiber for the interest he has shown in this paper, and for his helpful comments on a draft version.

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A 36-year laying record of a Wattled Crane at the New York Zoological Park.—Few data are available on the reproductive history of individual cranes over long periods. The laying history of a female Wattled Crane (*Bugeranus carunculatus*) acquired as an adult by the New York Zoological Society on 6 May 1940 and still living at the Bronx Zoo offers useful insights into this species' reproductive potential.

During 14 of the past 36 years, this bird (NYZP-I.D. #400210) was unmated and reproductively quiescent. A mate was available from 1940 to early 1949, and zoological garden records show that she produced chicks each year from 1944 through 1947. After the male died on 12 March 1949, no other mate was acquired until 3 April 1963, when the St. Louis Zoological Park provided a bird it had acquired as an adult on 28 September 1951.

Although the female had not laid in many years, perhaps not since her original mate had died but certainly not since 1957, she promptly bred with the new male and produced a clutch of two fertile eggs in November 1963. Since then, a record has been maintained of each egg deposited. Although fertility has been extremely low (only seven of the eggs discussed below are known to have been fertile) the laying record is of interest in itself.

From 4 November 1963 through 30 July 1976, #400210 deposited 58 eggs in 41 clutches; 17 clutches were of 2 eggs and 24 of 1 egg. The bird's reproductive year apparently begins in October and ends in June. No eggs have been deposited in July, August, or September. Peak laying periods during the 13 years from 1963 through 1975 were April (11 eggs), March (10), February (9), January (8), and November (8). The breeding pair has been maintained with a New York City photoperiod, largely outside but often indoors with some heat under a skylight in winter.

In eight 2-egg clutches, the second egg was laid on the 4th day following the first; in 6 clutches, the laying interval was 3 days. The shortest period between 1-egg clutches was 15 days and the shortest period between 2-egg clutches was 14 days. The most productive year (1969) produced 8 eggs: one on 5 February, a 2-egg clutch beginning 21 days later, a 2-egg clutch beginning on 17 March 15 days after the second egg of the second clutch, a 2-egg clutch on 3 April started 14 days after the completion of the third clutch, and a final 1-egg clutch on 20 April only 13 days after completion of the fourth. From 1974 through 1975 only 1-egg clutches were deposited and only 2 eggs have been laid in each of the last 2 years. She has laid no eggs thus far in 1976.