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SPREAD-WING POSTURES AND THEIR POSSIBLE FUNCTIONS IN THE CICONIIDAE

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IN two recent papers Clark (1969) and Curry-Lindahl (1970) have reported spread-wing postures in storks and other birds and discussed some of the functions that they may serve.

During recent field studies (1959–69) of all 17 species of storks, I have had opportunities to observe spread-wing postures in a number of species and under different environmental conditions (Table 1). The contexts in which these postures occur shed some light on their possible functions.

TYPES OF SPREAD-WING POSTURES

Varying degrees of wing spreading are shown by at least 13 species of storks under different conditions. In some storks (e.g. *Ciconia nigra*, *Euxenura galeata*, *Ephippiorhynchus senegalensis*, and *Jabiru mycteria*) I observed no spread-wing postures and have found no reference to them in the literature. In the White Stork (*Ciconia ciconia*) I observed only a wing-drooping posture—with the wings held a short distance away from the sides and the primaries fanned downward—in migrant birds wetted by a heavy rain at Ngorongoro Crater, Tanzania. Other species often opened the wings only part way, in a delta-wing posture (Frontispiece), in which the forearms are opened but the primaries remain folded so that their tips cross in front of or below the tail. In some species (e.g. *Ibis leucocephalus*) this was the most commonly observed spread-wing posture. All those species listed in Table 1, with the exception of *C. ciconia*, at times adopted a full-spread posture (Figures 1, 2, 3), similar to those referred to by Clark (1969) and Curry-Lindahl (1970) in several groups of water birds.

POSSIBLE FUNCTIONS

Three possible functions for spread-wing postures were given by Clark (1969) and were further elaborated by Curry-Lindahl (1970).

PAINTED STORK *(Ibis leucocephalus)* facing the early morning sun in the delta-wing posture. Bharatpur, India, October 1967.

(From a Kodachrome by M. P. Kahl)

TABLE 1

TYPES AND USAGES OF SPREAD-WING POSTURES NOTED IN STORK SPECIES

Species[1]	Type of posture[2]	Wet plumage	Dry plumage	Shading nest contents	Social display
Mycteria americana	2, 3	X	X	X	X
Ibis ibis	2, 3	X		X	X
Ibis leucocephalus	2, 3	X	X	X	X
Ibis cinereus	3	X			X
Anastomus oscitans	2, 3		X	X	
Anastomus lamelligerus	2, 3	X	X		
Sphenorhynchus abdimii	1, 2, 3	X	X		X
Dissoura episcopus	3		(X)[3]		X
Ciconia ciconia	1	X			
Xenorhynchus asiaticus	3				X
Leptoptilos dubius	3		(X)		X
Leptoptilos crumeniferus	3		X	X	X
Leptoptilos javanicus	3		X		X

[1] Nomenclature follows Peters (1931).

[2] 1 = wing-droop, 2 = delta-wing, 3 = full-spread.

[3] Parentheses indicate observation in captives only.

Other functions have been discussed by Goodwin (1967) and Kennedy (1968). Based on my observations of spread-wing postures in storks, I suggest extending the list of possible functions as follows: 1) wing-drying; 2) thermoregulation, a) cooling, b) warming; 3) feather treatment; 4) shading nest contents (eggs or young); 5) balancing; and 6) social displays.

I believe that each of these functions is involved—at one time or another—in the various spread-wing postures shown by the Ciconiidae. In some cases two or more functions may coincide during a single spread-wing posture.

Wing-drying.—Full-spread postures (Figure 1) are common in many species of storks when their plumage is wet, such as immediately after a rain or when the bird has just bathed. Typically the bird holds its wings open, flaps them vigorously from time to time, and faces into the wind. A striking example of this function was once given by a captive juvenile *Ibis ibis,* which adopted a full-spread posture just after bathing, in spite of the fact that the air temperature was only 22°C, the sun was obscured by clouds, and the bird was shivering with cold. Those species (e.g. *C. ciconia*) in which full-spread postures are apparently absent or rare usually adopt wing-drooping postures when wet.

Figure 1. American Wood Stork (*Mycteria americana*) drying its wings in the full-spread posture after bathing in a pond. Note the wet feathers on breast, abdomen, and under wings. Bartow, Florida, USA, May 1960.

Figure 2. Asian Openbill Stork (*Anastomus oscitans*) sunning in the full-spread position. Bharatpur, India, October 1966.

Figure 3. A female Marabou Stork (*Leptoptilos crumeniferus*) shading two nestlings (16 and 18 days old). Adult bird is standing so that head and neck are in shadow of body and wings. Kitale, Kenya, December 1964.

Wing-drying postures are apparently more common among the Ciconiidae than among the Ardeidae or Threskiornithidae. To my knowledge, no investigations have been conducted to determine whether the plumage of storks is more wettable than that of the other ciconiiform families. A highly wettable plumage has been demonstrated in the Phalacrocoracidae (Rijke, 1968), a group well-known for spread-wing postures.

Thermoregulation.—During warm weather storks often stand for extended periods with their wings spread. The opening of the wings seems to be especially stimulated by a sudden change in wind speed or the appearance of the sun after a cloudy period. The behavior is quite contagious and often radiates quickly throughout the flock or nesting colony. Undoubtedly such spreading of the wings helps to reduce hyperthermia by exposing the thinly feathered areas under the wings and allowing the loss of body heat by convection and radiation, when the air temperature is lower than body temperature. Usually such cooling postures are accompanied by panting, erection of the upper-back feathers, and urohidrosis (excreting on the legs as a thermoregulatory mechanism; see Kahl, 1963). Generally the bird faces away from the sun, keeping the inside of the wings and the axillary region in the shade, and often bends forward so that its head and neck are in the shadow created by the body and the open wings (Figure 3).

At other times storks adopt full-spread or delta-wing postures in early morning or late afternoon, when the air temperature is low. In these situations, the birds generally face toward the sun (Frontispiece and Figure 2) and appear to "enjoy" the warmth of the radiation received. It is, however, difficult to determine from uncontrolled observations whether the birds are actually sunning in order to warm themselves or whether they are merely drying their plumage, which may have become dampened by the high relative humidity at low ambient temperatures. Sunning as a means of raising body temperature has been hypothesized in the Cathartidae by Heath (1962), Curry-Lindahl (1970), and J. McGahan (pers. comm.).

Feather treatment.—In addition to the warming and drying effects in the sunning postures discussed above, the sun's radiation may also have other beneficial effects on the plumage itself. As suggested by Hou (reviewed by Kennedy, 1968) irradiation by the sun of preen-gland oil on the feathers may produce vitamin D, which is then ingested by the bird during preening. In the sunning postures of the Marabou Stork (*Leptoptilos crumeniferus*), the birds often altered their postures, depending on the time of day, so that the wings were held in a position that was approximately perpendicular to the rays of the sun—as if the birds were attempting to absorb a maximum amount of radiant energy (Schneider, 1952: 241; Kahl, 1966: 85).

It has also been suggested (Thomson, 1964: 282) that the warmth of the sun on the spread plumage may cause ectoparasites to become more active and, thus, easier for the birds to catch and remove during preening.

Shading nest contents.—Most storks at times stood in the nest so that the shadow cast by their body protected the eggs or small young from the direct rays of the sun. Shading was observed with enough regularity that I feel it is unlikely that it occurred accidentally. Such behavior was observed even in some species in which spread-wing postures have not been observed. It has been reported and illustrated in the White Stork (*C. ciconia*) by Haverschmidt (1949: 44) and Siewert (1932: 166) and in the Black Stork (*C. nigra*) by Siewert (1932: 87).

In those storks showing spread-wing postures, some, such as the wood-storks (*Mycteria* and *Ibis*) and openbills (*Anastomus*), generally shaded their nests in the delta-wing posture. Others, such as the marabous (*Leptoptilos*), generally shaded their nests in the full-spread posture (Figure 3).

It is probable that the function of shading the contents of the nest is often combined with *self*-thermoregulation (see above) in birds adopt-

Figure 4. Pair of Abdim's Storks (*Sphenorhynchus abdimii*) giving a mutual greeting display at the nest. The male (foreground) holds wings fully open while clattering bill vertically upward. Lake Shala, Ethiopia, April 1967.

ing spread-wing postures over eggs or young during hot weather. Although the parent usually positioned itself so that the nestlings were shaded, it sometimes did this inaccurately or failed to shift its position to compensate for movement of the sun. In such cases, young more than a few days old crawled into the shadow of the parent when they became overheated.

Balancing.—Austin (1961: 44) noted the suggestion that spread-wing postures in cormorants might be related to balance. In storks, balancing seems to be an obvious cause of certain short-term spreading of the wings. Immediately after landing, when standing or walking on unstable branches, or when perched in gusty winds, storks often hold their wings temporarily open for balance. Balancing movements differ from those described above in that they are generally of shorter duration, are often related to locomotion (landing or walking), and usually alternate or coincide with other postures related to the maintenance of bodily equilibrium.

Social displays.—During courtship and pair-formation, several species of storks show ritualized displays at the nest that incorporate spread-wing postures. I described (Kahl 1966: 92) one such display—termed the Balancing Posture because of its apparent derivation from a balancing movement—in the Marabou (*Leptoptilos crumeniferus*), and I have recorded other spread-wing social displays in storks of the genera *Mycteria, Ibis, Sphenorhynchus* (Figure 4), *Dissoura,* and *Xenorhynchus* (Kahl, MS). The form and context of most spread-wing social displays in storks suggest an evolutionary derivation from balancing or flight intention movements.

Discussion

Clark (1969) commented on the occurrence of spread-wing postures in the Pelecanidae, Phalacrocoracidae, Anhingidae, Ciconiidae, and Cathartidae, and on the possible phylogenetic implications of this behavior pattern in these families. Relationships between certain members of these groups have been suggested previously by Jollie (1953), Cottam (1957), and Ligon (1967).

It is of interest that another thermoregulatory mechanism—that of excreting on the legs when overheated—has been observed in most species of storks by Kahl (1963, and MS); in several species of New World vultures by Hatch (1970) and J. McGahan (pers. comm.); and in a cormorant (*Phalacrocorax carbo*) by E. K. Urban (pers. comm.).

As Clark (1969) has rightly noted, the spread-wing posture is, apparently, a "rather simple behavioral trait" and might have evolved independently several times. However, urohidrosis (excreting on the legs) is probably a more complex trait—involving both behavioral and physiological adaptations—and is less likely to have evolved independently. If excreting on the legs is homologous in these groups, perhaps they are more closely related to each other than has generally been realized.

What is most needed now are experiments designed to reveal the behavioral and physiological pathways operating in spread-wing postures and in urohidrosis in the different groups. Such studies would help to determine whether the apparent similarities in these behavior patterns actually reflect structural similarities and would assist in evaluating the probabilities of common descent.

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