

RITUALISED DISPLAYS AND DISPLAY FREQUENCIES OF ANDEAN FLAMINGOS *PHOENICOPARRUS ANDINUS*

CORY JOHN LINDGREN¹ & S P C PICKERING²

¹Oak Hammond Marsh, Box 1160, Stonewall, Manitoba, ROC 270, Canada

²The Wildfowl & Wetlands Trust, Slimbridge, Glos. GL2 7BT, UK

Little information is available on the ritualised display behaviour of Andean Flamingos. Observations were made on a captive flock of 51 Andean Flamingos from 28 March to 6 May 1989 at The Wildfowl & Wetlands Trust, Slimbridge, Gloucestershire. A total of 14 ritualised displays were observed and described. The frequencies of these displays, display sequences, and their temporal variation within the day were examined. Many of these displays have not been described previously for Andean Flamingos. The Wing Flap Salute was the most common ritualised display observed followed by Wing Leg Tail Stretches, Attempted Flights, Neck Swaying and Inverted Wing Salutes. Andean Flamingos were found to display throughout the entire day with bimodal activity peaks at 10:00 h and 16:00 h. Thirteen display sequences were observed with the Wing Flap Salute initiating the majority of display sequences. The two most common display sequences observed were a Wing Flap Salute followed by a Wing Leg Tail Stretch and a Wing Flap Salute followed by an Inverted Wing Salute. In general, Andean Flamingo ritualised displays were found to be similar to those of other flamingos, but some distinct differences were observed.

Keywords: Andean Flamingo, Ritualised Displays, Display Sequences

Flamingos are highly social birds. They are among the few animals that perform massed, mixed-sex, group displays in which all individuals behave in the same ritualised manner. Flamingos display throughout the year although there may be a peak in frequency and intensity prior to the breeding season (Studer-Thiersch 1974, Kahl 1975, Espino-Barros & Baldassarre 1986). The function of these displays is not understood fully although they are thought to play a role in ensuring synchronous nesting and/or in facilitating pair formation (Allen 1956, Brown 1958, Studer-Thiersch 1974, Ogilvie & Ogilvie 1986).

Flamingo display and behaviour have been described by numerous researchers. Behavioural inventories have been constructed for Greater Flamingos *Phoenicopterus ruber roseus* (Allen 1956, Brown 1958, 1966, Studer-Thiersch 1974), Caribbean Flamingos *Phoenicopterus ruber ruber* (Rooth 1965, Studer-Thiersch 1974), Chilean Flamingos *Phoenicopterus chilensis*

(Studer-Thiersch 1974) and Lesser Flamingos *Phoeniconaias minor* (Brown & Root 1971). However, there is no comparable behavioural inventory for Andean Flamingos *Phoenicoparrus andinus* or James' Flamingos *Phoenicoparrus jamesi*. In this paper we describe the ritualised display behaviour of Andean Flamingos and make some comparative analyses to the published display descriptions for the other species of flamingo.

A review of the literature dealing with flamingo behaviour revealed that only Studer-Thiersch (1974, 1975) has looked at the relative frequencies of ritualised behaviour by *Phoenicopterus*. Studer-Thiersch (1974) examined differences in displays of Greater, Caribbean, and Chilean Flamingos and concluded that the display of the Caribbean was the most primitive. Studer-Thiersch (1974) further concluded that only slight differences exist in group display between Caribbean and Greater Flamingos. The second objective of this paper was to examine relative frequencies and

temporal variation in ritualised displays of Andean Flamingos.

Methods

Study Area

Observations were made at The Wildfowl & Wetlands Trust, Slimbridge, Gloucestershire, UK. (51° 44'N 02° 24'W). A flock of 51 Andean Flamingos was held in a fenced enclosure with access to indoor accommodation in poor weather. The fenced enclosure is approximately 1000 m² of which about 30% is water. The flamingos had access to two circular nesting islands, one approximately 2 m² in diameter and a second 3 m² in diameter. Prior to this study, mud was added to the nest sites and 36 mud nest bases (0.2 m high and 0.4 m in diameter) were constructed. Each bird had a plastic darvic ring above the tibia-tarsus joint for individual identification. The flock first bred in 1969 and, since then, some birds have bred during 14 seasons and reared 19 chicks.

Observations

Observations were made throughout daylight hours for minimum periods of 30 minutes. Forty-six hours of observation were collected between 28 March and 6 May 1989. During observation periods the different displays were recorded and photographed. A behavioural check sheet was developed to record ritualised displays and the frequency at which each behaviour was performed. In order to investigate temporal variation within a day, each data collection day was divided into three observation periods: morning (06:00-12:00 h), afternoon (12:01-16:30 h) and evening (16:31-21:00 h). During 22 of the 92 observation periods, two observers were present. The identity of each bird performing the ritualised display was recorded.

Results

A description of each ritualised behaviour observed during this study is given below. Each behaviour has been named after similar behaviour descriptions documented by other authors

(Studer-Thiersch 1974, Kahl 1975). Andean Flamingo displays were divided into four general categories: (1) Ritualised Head Displays, (2) Ritualised Wing Displays, (3) Locomotory Behaviour and (4) Aggressive Behaviour.

The display behaviours of Andean Flamingos did not seem to be directed at other flock members. Instead, displaying individuals orientated themselves so that they were facing directly into the wind.

(1) Ritualised Head Displays

Head Flagging: Head Flagging was observed to occur while Andean Flamingos were taking part in Marching displays (see below). The neck of the bird was outstretched vertically, and the head and bill of the bird were held at an angle of 45° from the horizontal. The head was turned in a jerky fashion, from one side of the body to middle, and then to the other side of the body. The head and bill were moved in an arc of approximately 40°. This behaviour was often accompanied by a whistling vocalisation.

Head Shake Preen: The head and neck of the flamingo were held vertical and high, the head was then shaken several times from side to side, followed by a preen either between the wings along the back of the body or to one side of the body.

Twist Preen: The head was shaken from side to side and then twisted over the back to preen between the wings. The flamingo false preens underneath one wing, exposing the black primary feathers. The Twist Preen was observed to occur mainly during Marching displays (see below). Head shaking was much less exaggerated than in the Head Flagging display.

Broken Neck: This behaviour was observed to occur mainly during Marching displays. The birds head was suddenly snapped down, to form an angle of 45° above the horizontal, so that the bill touched the feathers on the middle of the foreneck.

Alert: The neck was stretched vertically and the head and bill held at a 45° from the horizontal.

(2) Ritualised Wing Displays

Wing Flap Salute: The bird stands erect, with the

neck stretched vertically and the head and bill held at an angle of 45° from the horizontal. The wings were opened to the side of the body, and held open for one to two seconds. The wings were then slowly flapped forwards and backwards, on average 8.1 times (S.D.=2.9 range 5-17 $n=84$), with the speed of wing-flapping increasing with each flap. If the tail was cocked higher than the body after a Wing Flap Salute, the flamingo would follow this display with a second display to form a sequence.

Inverted Wing Salute: The head and neck were stretched slowly forward and down until they were horizontal and in-line with the body, while the tail was cocked up above the line of the body. The wings were then slowly opened so that the underside of the wings faced backwards. A low vocalisation sometimes accompanied this behaviour.

Wing Leg Tail Stretch: One leg and one wing, on the same side of the body, were stretched slowly behind the flamingo. The tail of the displaying bird was also turned to the same side of the body to which the leg and wing were stretched. There was no significant preference for Wing Leg Stretches to the right side of the birds' body vs the left side (left hand side $n=607$, right hand side $n=567$, Chi-squared=1.3, $df=1$, N.S.). A low vocalisation sometimes accompanied the Wing Leg Tail Stretch.

(3) Locomotory Displays

Marching: Defined as when three or more flamingos gathered together walking forward in a tight group often touching one another. The group would typically March in one direction and turn and then March in the opposite direction. Speed changes were frequent and Marching birds were observed to perform Head Flagging, Broken Neck, Twist Preen and False Feeding displays while Marching. Flamingos on the perimeter of the Marching birds were observed to perform Wing Flap Salutes. Marching only occurred in water. During this study, a total of 11 Marching displays was observed, in five cases the entire flock of 51 Andean Flamingos was observed Marching. The average size of the Marching groups was 33 birds (S.D.=18.6, range 10-51).

Parading: Occurred both in the water and on the land. The flamingos walked in a single line while continually moving about the enclosure. No speed changes were observed with the average speed being much slower than a normal walking pace. Andean Flamingos were observed to form groups of 10 to 15 individuals while Parading.

Attempted Flights: A bird would run into the wind, with wings flapping, while attempting to take flight. Individuals were pinioned and therefore not able to fly. After an Attempted Flight, flamingos would sometimes follow with a Wing Flap Salute. A flamingo performing an Attempted Flight was often observed to walk slowly to the other end of the enclosure and repeat an Attempted Flight. It was not uncommon to observe the entire flock performing this display simultaneously.

False Feeding: Single birds or pairs would walk along with their head down and bills just above or in the water often moving their head from side to side as if feeding but no movement of the bill or pumping action could be detected to suggest that actual feeding was taking place.

(4) Aggressive Displays

Neck Swaying: A bird would stretch its neck horizontally out from its body towards another bird, then sway its neck from side to side. This display was typically performed while a flamingo was standing, although birds sitting on a nest mound were also observed Neck Swaying. Some birds were also seen to raise their tail coverts while Neck Swaying. Neck Swaying may be a threat or aggressive display used by one individual flamingo or a pair of flamingos to fend off an approaching pair or single flamingo.

Bumping: Bumping was observed to be an aggressive behaviour that involved direct contact between two flamingos. The aggressor would Bump another flamingo with its chest, usually targeting the flank or rear of the other flamingo. The flamingo that was Bumped was usually observed to leave the immediate area without any aggressive retaliation.

Display Sequences: For the purposes of this study, a display sequence was defined as the occurrence of two or more displays, with one

Table 1. Number of two-display sequences observed performed by Andean Flamingos. Figures in brackets are expected values. (*=Chi-squared $P < 0.05$; ***=Chi-Squared $P < 0.001$).

First Ritualised Display	Second Ritualised Display		
	Wing Flap Salute	Inverted Wing Salute	Wing Leg Tail Stretch
Wing Flap Salute	144 (200)	273* (226)	291 (283)
Inverted Wing Salute	4 (3)	2 (26)	5 (4)
Wing Leg Tail Stretch	9 (23)	7 (25)	66*** (33)

display following another by less than 10 seconds. Thirteen different display sequences were observed over the course of this study (eight two-display sequences, four three-display sequences and one four-display sequence). The majority of display sequences observed were initiated with a Wing Flap Salute. The two most common display sequences performed by Andean Flamingos were a Wing Flap Salute followed by an Inverted Wing Salute (referred to as sequence #1) and a Wing Flap Salute followed by a Wing Leg Tail Stretch (referred to as sequence #2).

A Chi-squared matrix was constructed to investigate whether any two-display sequences occurred more frequently than expected. In order to reduce the number of cells that contained zeros, the axis was reduced to three displays. Two sequences occurred more frequently than expected. The Wing Flap Salute followed by an Inverted Wing Salute and a Wing Leg Tail Stretch followed by a second Wing Leg Tail Stretch (Table 1).

Frequency of Display Behaviours

Figure 1 illustrates the total number of the most common ritualised displays observed in this study (displays observed with a total frequency of less than ten were not included in Figure 1). Data analysis indicated a statistically significant difference ($F = 38.53$, $df = 8,810$, $P < 0.01$) between frequencies of performed

displays. Overall the most common displays observed over this study were the Wing Flap Salute (representing 41% of all ritualised displays observed) followed by the Wing Leg Tail Stretch (20%), and Attempted Flights (14%).

Overall, the Wing Flap Salute was observed to be the most frequent ritualised behaviour performed by Andean Flamingos. The Tukey post hoc test indicated that the Wing Flap Salute, Wing Leg Tail Stretch, and Attempted Flights occurred with frequencies significantly different ($t = 3.127$, $P < 0.05$) from all other displays.

Display Variation between Individual Flamingos

Every flamingo in the flock was observed to perform a Wing Flap Salute at least once. However, two birds did not perform a Wing Leg Tail Stretch and 17 were never observed giving an Inverted Wing Salute. There were no significant differences between the mean frequencies of male and female flamingo display rates (Table 2), unlike studies by Rooth (1965) who reported males being more active than females.

Display Frequencies within Days

We compared the average frequencies with which ritualised displays occurred over the morning, afternoon and evening observation periods (Figure 2). Observation period means

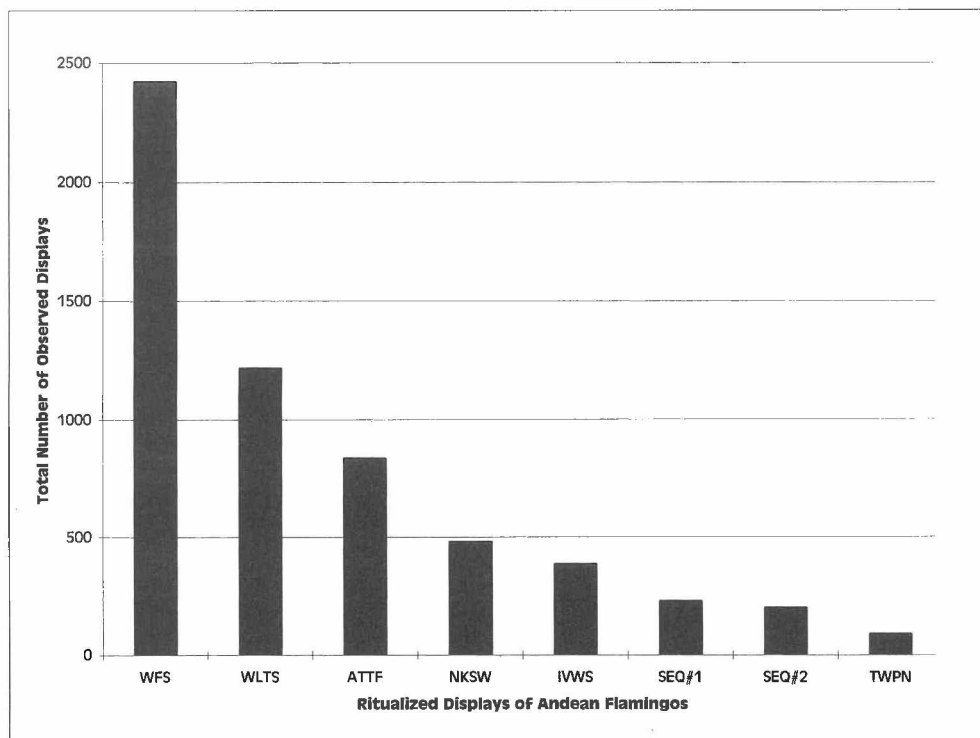


Figure 1. Total number of each display observed performed by Andean Flamingos. WFS - Wing Flap Salute; WLTS-Wing Leg Tail Stretch; ATTF-Attempted Flight; NKSX-Neck Swaying; IVWS - Inverted Wing Salute; SEQ#1 (WFS followed by a IVWS); SEQ#2-(WFS followed by a WLTS); TWPN-Twist Preen. Displays observed with total frequencies <10 were not included in figure.

were calculated from Wing Flap Salutes, Attempted Flights, Wing Leg Tail Stretches and Inverted Wing Salutes. Andean Flamingo displays, in general, occurred throughout the day, with bimodal peaks of display activity at 10:00 h and then again at 16:00 h, with a smaller activity peak at 12:00 h. There was no significant difference in the frequency with which each individual display was performed between morning, afternoon and evening observation periods (Table 3). However, two display sequences, sequence #1 and sequence #2, were found to occur at significantly higher frequencies during evening observation periods (see Table 3).

Discussion

The repertoire of Andean Flamingo behaviour

appears to be similar to that described for other flamingos (for pictorial descriptions of display behaviours in other flamingos the reader is referred to Rooth (1965), Brown (1958), and Studer-Thiersch (1975)). A total of 14 ritualised displays was observed and described during this study of Andean Flamingo ritualised display behaviour. Only the Wing Flap Salute and Alert Posture have been described previously for Andean Flamingos (Kahl 1975).

The Wing Flap Salute was the most common ritualised behaviour performed by Andean Flamingos in this study, followed by Wing Leg Tail Stretches, Attempted Flights, Neck Swaying and Inverted Wing Salutes. In *Phoenicopterus* flamingos, the Twist Preen was the most common display followed by the Wing Salute, with Inverted Wing Salutes and Wing Leg Tail Stretches being the least frequent (Studer-

Table 2. Mean frequencies of most common display behaviours performed by male and female Andean Flamingos.

Behaviour	Sex	Mean	S.D.
Wing Flap Salute	Male	1.80	0.58
	Female	1.55	0.61
Wing Leg Tail Stretch	Male	0.91	0.51
	Female	0.71	0.39
Inverted Wing Salute	Male	0.09	0.10
	Female	0.11	0.11
Attempted Flight	Male	0.31	0.11
	Female	0.50	0.14

**Figure 2. Temporal variation in Andean Flamingo ritualised displays within days.**

Thiersch 1974). The Wing Flap Salute as performed by Andean Flamingos is similar to descriptions of Wing Salutes performed by other flamingo species. Kahl (1975:144) reported that "the Wing Salute in Andean Flamingos has been seen only a few occasions and at long distances". The description of a

Wing Salute by Kahl (1975) is similar to our description except that we found an increase in the speed with which the wings are opened and closed (or flapped). Wing Salutes performed by Greater and Caribbean Flamingos held at Slimbridge (personal observations) were characterised by the wings held outstretched

Table 3. Mean display rates of Andean Flamingos during morning, afternoon and evening observation periods.

Display	Morning		Afternoon		Evening	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
WFS	24.09	37.64	24.86	35.2	33.25	21.55
IVWS	5.96	15.6	2.58	3.01	4.28	2.92
WLTS	11.93	8.78	13.96	7.98	15.36	9.3
ATTF	8.4	17.17	8.41	13.69	11.57	16.67
NKSW	5.47	4.37	5.41	5.76	5.32	4.28
Sequences:						
SEQ#1	2.68	3.06	1.51	1.8	3.53	2.21
SEQ#2	2.03	2.05	0.97	1.41	3.85	2.99

to the sides of the body, but not flapped. Chilean Flamingos first opened the wings, flapped them forward and then held them at 40° in front of the body before closure (Studer-Thiersch 1974). In Andean Flamingos, we have described the behaviour as a Wing Flap Salute, to recognise the opening and closing of the wings, and to differentiate this from Wing Salutes of other flamingo forms.

The Wing Leg Tail Stretch was observed to have the second highest rate of occurrence in Andean Flamingos. Kahl (1975) reported that the Wing Leg Stretch occurs repeatedly during display bouts and is contagious among flock members. The Wing Leg Tail Stretch has been documented to occur in all three forms of *Phoenicopterus*, but not in Andean Flamingos. This behaviour has been described as a Wing Leg Stretch in *Phoenicopterus* (Caribbean, Chilean, and Greater Flamingos) by Studer-Thiersch (1974). We observed Andean Flamingos to stretch/move their tail to the same body side as the leg and wing were stretched/moved. For this reason, we have called this behaviour a Wing Leg Tail Stretch, in order to recognize the involvement of the tail. The results of this study revealed that Wing Leg Tail Stretches occurred with equal frequencies to both the right and left sides of the Andean Flamingo's body. Unlike the Chilean Flamingo

(Studer-Thiersch 1974), Andean Flamingos did not seem to orientate Wing Leg Tail Stretches towards any flock members.

Kahl (1975) and Ogilvie & Ogilvie (1986) both reported that Andean Flamingos have not been observed to perform Inverted Wing Salutes. We observed Slimbridge Andean Flamingos performing Inverted Wing Salutes. The Inverted Wing Salute is similar to the description for Greater, Caribbean and Lesser Flamingos (Studer-Thiersch 1974, Kahl 1975) in that the head and neck are extended straight out (horizontally) and in line with the body. This differs from Chilean Flamingos, where the neck and head is coiled in front of the body (Kahl 1975).

Attempted Flights are normal preparation for flight in the wild (Allen 1956, Rooth 1956, Brown 1958, Studer-Thiersch 1972). Attempted Flights were observed to have the third highest rate of occurrence in the Andean Flamingos studied, and were observed to initiate six different display sequences. Rooth (1965) also reported that Attempted Flights are part of behavioural sequences in Caribbean Flamingos. Rooth (1965:86) reported that after a few minutes of flight the same sequence of display was repeated, noting that the "sight of circling flamingos may be interpreted as the increase in display activity, since flamingos do not, in

general, fly very often or extensively". Hence, in captivity where the Andean Flamingos are pinioned, Attempted Flights may have replaced the circling behaviour observed by Rooth (1965).

The Alert and Broken Neck displays observed in Andean Flamingos seemed to be the same as in other flamingo species. The Head Flapping performed by Andean Flamingos appears to be most similar to the Caribbean (Studer-Thiersch 1974) and Lesser Flamingo (Brown & Rooth 1958) in that the neck is held almost vertically unlike the Greater and Chilean where the neck is slightly curved (Studer-Thiersch 1974).

There were no differences between the mean frequencies of ritualised display activity during the morning, afternoon and evening. Other authors have provided observations upon temporal variation of flamingo display but lacked quantitative data. Allen (1956) reported that display occurred at a minimum around 12:00 h. Brown (1958) stated that there was no particular time when displaying did not occur but reported an increase in display behaviour in the early hours of the morning peaking at midday then decreasing with the increasing heat of the day. Rooth (1965) reported that the Caribbean Flamingo had activity peaks at 10:00 h, marking the end of the feeding period and beginning of the resting period and then peaking again at 16:00 h, with the beginning of drinking, preening and bathing. In general, the Andean Flamingos displayed at maximum rates at 10:00 h, and then again at 16:00 h, with a smaller activity peak at 12:00 h (see **Figure 2**). These display peaks are similar to those reported by Rooth (1965).

The fact that distinct display differences were observed in Andean Flamingos in this study, comparable to the other flamingo forms, supports the taxonomic status given to *Phoenicoparrus*. Further research may focus on display activity prior to and during the nesting period. A comparative study between ritualised displays of Andean and James' Flamingos is also required.

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