

Evidence of directed interactions between individuals in captive flamingo flocks

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Abstract

Information on social behaviour traits can be inferred from observed associations or measured as the frequency of direct interactions between individuals. For some species, information on interactions between individuals, and the form that these interactions take, is limited. This paper describes three social interactions (affiliative, mate-guarding and directed aggression) seen in captive flamingos (*Phoenicoparrus* sp. and *Phoenicopterus* sp.) that could be of help to those studying flamingo social behaviour, by adding explanation of direct interactions to the overall flamingo ethogram. Information on how flamingos organise their social structure appears infrequently in the literature, and what (if any) specific social interactions are performed from one bird to another can be lacking in description and definition. The behaviours explained in this paper provide an insight into the social lives of flamingos that can give support to further, deeper, studies into social hierarchy and social affiliation.

Key words: behavioural observation, ethogram, Phoenicopteridae, social behaviour.

The social nature of flamingo (genus: Phoenicopteridae) flocks has been measured mainly on their levels of gregariousness and on their grouping together for feeding and for courtship displays (Kahl 1975; Studer-Thiersch 1975a,b; Henriksen *et al.* 2015). Much less is known about the long-term bonds that exist between individuals within a group. Whilst it is evident that persistent pair bonds seem to exist between birds (Shannon 2000; Rose *et al.* 2014) and also that individual flamingos can assort preferentially with chosen conspecifics from

either sex and across ages (Williams & Anderson 2012; McCully *et al.* 2014; Hughes 2015), there are no published records of flamingo behaviour that demonstrate a direct interactive social behaviour from one bird to another, such as the mutual grooming or allopreening seen in other highly social species. Field scientists recognise the potential importance of pair bonds in flamingo species (Diawara *et al.* 2014), through work undertaken on birds in zoological establishments. For instance, the potential impact on partner choice of flock

courtship display and nest site choice (*i.e.* initiation and termination of display, and occupation of favoured nesting areas) has been recognised for some time (Swift 1960; Studer-Thiersch 1975b; Studer-Thiersch 2000), indicating that pair bonds and a defined social structure may determine how successful flamingos are at breeding. Behavioural interactions between members of a pair have received relatively little attention in flamingo species, however, and the extent to which individuals interact directly with birds other than their mates is also poorly understood.

Studies to date have shown that individual proximity (measured as birds that are within one-neck of each other) can be used to determine preferential associations between flamingos (Studer-Thiersch 1975a; Rose & Croft 2015). Individual birds allow preferred partners into this zone of tolerance more readily than individuals with which they are less familiar or less comfortable (Rose & Croft 2015). Interactions between birds of a mated pair are much more subtle and much less obvious than the associations between flamingos involved in mass courtship display. Monogamy has been noted in flamingos, with strong pair bonds seeming apparent, but whilst there are rituals between male and female birds these are very inconspicuous (del Hoyo 1992). Moreover, there is a tendency for flamingos in wild flocks to change mates from one year to the next (Cézilly & Johnson 1995), whilst in captive flocks the pair bonds can be much more stable. Several authors have noted that pairing may be determined simply by birds following each other away from the main courtship group once they have selected

each other for breeding, and remaining close together thereafter (Shannon 2000; Johnson & Cézilly, 2009). Same-sex pairs and mixed/same-sex trios may also occur within a flock (King 2006), and the social bonds between these birds may be equally as important to an individual's welfare and position within a flock hierarchy, as to an individual within a male-female pair. Therefore, interesting research questions around the benefit of social bonds need not be focussed on enhanced reproductive potential in these species.

Hinde (1976) defines social organisation as the “content, quality and patterning of associations”, with said associations having a defining role in an organism's social structure. The two ways of describing relationships between individuals in a group are based on either interactions or associations. Whilst associations infer a relationship based on proximity between individuals, a direct measure of sociality can come from the range of interactions that are performed from one animal to another (Croft *et al.* 2008, 2009, 2011; Voelkl *et al.* 2011). Ideally, evaluating social relationships comes from observation of interactions between individuals; however, when these are difficult to observe, association patterns are a useful substitute for determining social preferences (Whitehead 2008). It is important to note that the majority of interactions take place between associated individuals (Whitehead 1997, 2009) and therefore can aid in identifying relationships with particular fitness benefits.

Previous research has documented the benefits of long-term pair bonds in many other avian species (Black 1996), specifically regarding access to resources and breeding

success. Flamingos, with their highly gregarious nature and highly organised, stylised courtship display, may be one of those species whose social biology is important not only to pairs but to small affiliative groups as well as to the cohesion of the large flocks. Some authorities suggest that seasonal monogamy in (wild) flamingos is a by-product of nest site fidelity (Cézilly & Johnson 1995), yet the birds may also display more refined and more constant aspects of sociality than are evident from the behaviours directed to specific individuals within a flock (Shannon 2000; Diawara *et al.* 2014). Therefore, studying interactions that clearly deliver a specific social message from one bird to another could determine the importance of sociality to the flamingo flock overall (Rose *et al.* 2014), and also provide insight on how the behaviour patterns of captive flamingos may differ from the observed social systems of free-living birds.

Adding to the description of bird-to-bird interactions updates and expands the literature on flamingo social structure to generate further research questions. As such, in this paper we therefore describe three different behaviours, which each occurred in at least two flamingo species, and which may constitute either a directed interaction indicating social preference or a social hierarchy between individuals. Most of these behaviours, described below, were noted during observations made for a larger study on the social behaviour of captive flamingos, during which the birds' activities were recorded by continuous event sampling over a fixed time period and the total frequency of performance was recorded (Martin & Bateson 2007). The

exception was the affiliative interaction (*i.e.* Interaction 1) seen at Zoo Berlin, which was timed (in minutes) in its complete performance and included as part of a daily activity budget (Martin & Bateson 2007).

Interaction 1: Affiliative interactions between individual *Phoenicoparrus* flamingos

This behaviour was observed between two captive James' Flamingos *Phoenicoparrus jamesi* and two captive Andean Flamingos *Phoenicoparrus andinus* at Zoo Berlin and the WWT Slimbridge Wetland Centre, respectively. The animals involved in these interactions were a pair of wild-caught, adult James' Flamingos of breeding age and two female, wild-caught, adult Andean Flamingos of breeding age. Occurrences of this behaviour were noted in late spring, early summer and mid-summer on warm, sunny days. However, timing of the behaviour varied, with observations noted in the morning, at midday and also in the afternoon. All observations were made during regular zoo opening times (between 09:00 and 18:00 h).

During the affiliative interactions the birds stood next to each other and rubbed their heads backwards and forwards over each other. In the case of the Andean Flamingos, the behaviour occurred between two female birds, with one bird being sat down asleep. The standing bird rubbed its head over that of the other bird, and also down the side of its wings (Fig. 1). In the James' Flamingos, this behaviour was observed between a male and female paired to each other, with both members of the pair actively engaging in this behaviour (Fig. 2).

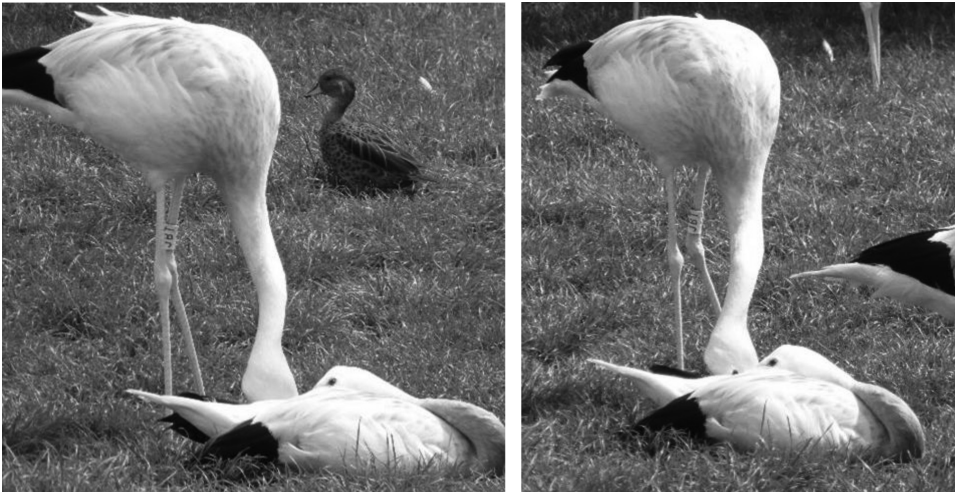


Figure 1. A female Andean Flamingo wipes her head over the head, back and wings of a resting bird, who makes no move to stop this behaviour from occurring.

Head-flagging, the common courtship display of flamingos (*e.g.* del Hoyo 1992), seems poorly developed in the James' Flamingo and observations of its performance are sketchy. The head flagging display of the James' Flamingo is described by Kahl (1975) who reported several birds standing in a circle, facing each other waving their heads from side to side. No direct contact was noted, and the described behaviour occurred in a flock, rather than between a pair. Moreover, in Kahl's observations the birds uttered several single-note calls during head-flagging, whereas the behaviour pictured above was performed in silence. It is thus possible that this pair-bonding display is an altered, less obvious version of the head-flagging display used by the James' Flamingo to form partnerships initially. Another suggestion could be that it is a form of false-feeding behaviour (*i.e.* birds going through the pattern of collecting

food as if they were filtering water), which has been reported for Greater Flamingo *Phoenicopterus roseus* pairs that appear to be highly bonded (Studer-Thiersch 1975a). The function of a false-feeding action may be to cement the pair bond and ensure stability in a relationship; Studer-Thiersch's definition would certainly seem apt in the case of these James' Flamingos.

This characterisation (false-feeding) may also fit well with the behaviour observed in the two Andean Flamingos, because the bird actively engaged in the interaction with the resting bird moved its head over the other bird in a rhythmic and stylised manner. As the resting bird did not move away or displace the bird that was interacting with it, one could assume that, as its preferred associate, it was allowing this behaviour to continue. These two flamingos are not parent-offspring, nor otherwise related as far as it is known, but have been in the same flock since the 1960s.

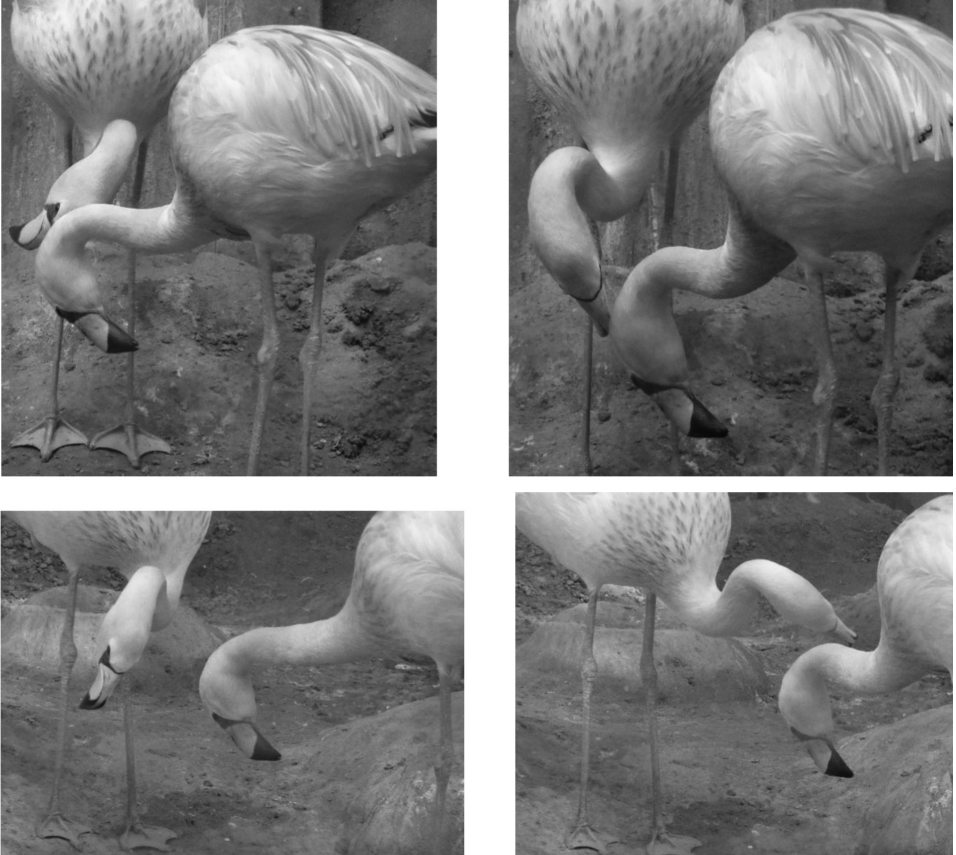


Figure 2. A pair of James' Flamingos (male left, female right) move their heads over one another in unison. Each bird sways its head from side-to-side, and brushes the top of its head over that of its partner. After completing the behaviour, the female walks off, followed by the male.

Interaction 2: Mate-guarding in *Phoenicopterus* sp.

This behaviour was noted in spring, before nest building had occurred and during communal courtship display. Johnson and Cézilly (2009) have previously reported a mate-guarding type behaviour in wild Greater Flamingos in the Camargue, in which the male remained in close proximity to the female, and we likewise found that

when members of a Greater Flamingo pair are in close proximity to each other, the male may position himself to stand protectively over the female (Fig. 3), in a manner that prevents other birds from coming within the range of his neck (Fig. 4).

We have also observed this behaviour in the American Flamingo *Phoenicopterus ruber* (Fig. 5). Mate-guarding may be highly pronounced in these two species because of



Figure 3. A male Greater Flamingo (right) stands over his mate (centre) to displace two males (left) that are approaching the female.



Figure 4. The male Greater Flamingo in the pairing stretches his neck to full length as a deterrent to two marauding males. The female remains resting, apparently confident in her mate's ability to ward off rivals.



Figure 5. A male Caribbean Flamingo watches over his mate (left), when another male intervenes and attempts a copulation (centre). The original male fends off the rival and re-joins his mate.

the comparatively large size difference between the male and the female, which enables the male flamingo to form a protective stance over his mate and thus deter rivals more effectively.

It would be interesting to see if these mate-defence behaviours have been observed in the *Phoenicoparrus* and *Phoeniconaias* flamingo species, and also in the Chilean Flamingo *Phoenicopterus chilensis*. The context of such behaviour in the wild would help to elucidate factors affecting mate choice and selection processes between birds that in turn determine long-term patterns of monogamy in flamingos.

Interaction 3: “Bumping”

This is a behaviour that we have noticed in all six species of flamingo, and is an interaction that may have negative connotations to the individual that is “bumped” but a potential positive effect for the bird performing the “bumping”. One flamingo will deliberately walk into and “bump” or push another bird out of its way (Fig. 6).

The bird that is pushed is normally sleeping, resting or preening, or not engaged with the “bumping” bird in any manner. Moreover, this “bumping” behaviour does not appear to be indiscriminate as observations suggest that a flamingo will walk around some individuals in the flock but deliberately push into others (see Table 1), suggesting that it may have an underlying association with hierarchy or flock structure. The hypothesis that “bumping” is non-random however requires testing with quantitative data on marked individuals. Preliminary observations made of the “bumping” interaction within different small subgroups of foraging and preening Greater Flamingos (Table 1) found that not all adult birds received this interaction, nor did all perform this behaviour. Similarly the behaviour was not directed to just one age category or gender. On each occasion when “bumping” was observed, the displaced individual offered little retaliation and soon resumed the behaviour that it was performing before it was interrupted, only in a new location away from the bird that pushed

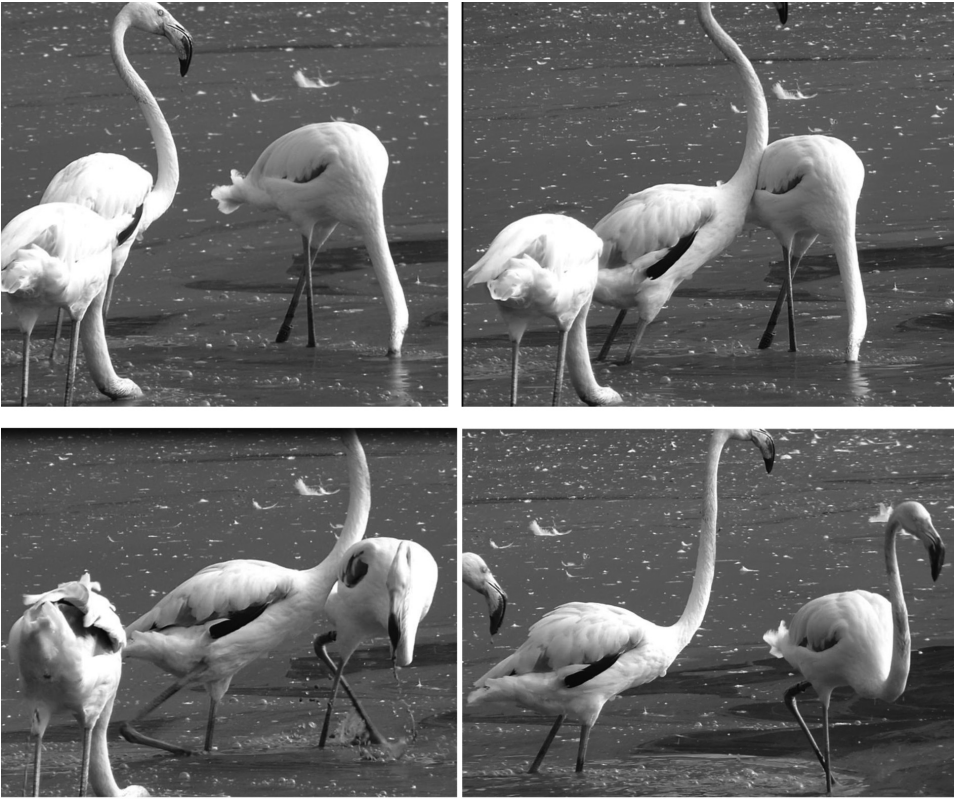


Figure 6. Three foraging Greater Flamingos. One male bird (back left) moves towards another male (right) and deliberately walks into this birds, pushing the bird out of the way. The bird that is pushed gives no resistance and does not retaliate. There is no follow-up antagonism from the male that has performing the pushing. Likewise, another male flamingo that is feeding (front left) is ignored.

into it. Schmitz & Baldassarre (1992) have previously documented three separate types of aggressive behaviour in flamingos, involving direct bill contact, feather spreading and posturing. These all appear to be absent in “bumping” behaviour, where there is no feather spreading, pre-warning or attempt to engage the target bird in a display of aggression. Occurrences of “bumping” therefore are worthy of further study, for instance to identify whether one sex performs

them more frequently and how birds use such behaviour to organise their position in flock relative to other flamingos. It would also be interesting to determine whether initiation and the reason for this behaviour differs (or not) between the six species.

Whilst there are several papers on flamingo aggression, these seem to focus on instances of agonistic behaviour around resources (for example feeding or nesting) or that caused by different environmental

Table 1. An example of “bumping” activity from three observations of mixed sex and age groups of Greater Flamingos.

Date/Time/Behaviour/ No. of birds involved	ID	Age	Gender	Bumped?	Bumps?
27.05.2015/PM/foraging/ six birds	PAB	Juvenile	Male	No	No
	BBJ	Adult	Female	Yes	No
	BBF	Adult	Female	No	No
	GJV	Adult	Male	No	Yes
	PCL	Adult	Male	Yes	No
	PCV	Juvenile	Male	No	No
21.03.2014/PM/foraging/ four birds	HLT	Adult	Female	No	No
	NAS	Adult	Male	No	Yes
	Ring not visible	Adult	Female	Yes	No
	ABN	Adult	Female	No	No
12.05.2014/PM/preening/ three birds	Ring not visible	Adult	Female	No	No
	DZD	Adult	Male	Yes	No
	GVY	Adult	Female	No	Yes

variables (Bildstein *et al.* 1991; Perdue *et al.* 2011; Hinton *et al.* 2013; Peluso *et al.* 2013). In these studies, aggression is documented as pecking and fighting, and other forms of contact aggression are not defined. Hughes & Driscoll (2014) noted the occurrence of a non-random dominance hierarchy in a group of American Flamingos, suggesting that unresolved encounters (and the context that these encounters occur in) alongside the number of connections one individual bird has to all others can affect the individual's place in a flock's dominance structure. However, this flock had a very strongly skewed sex ratio and it would be interesting to determine how hierarchy develops in

large flocks with a more equal balance of males to females. Hughes *et al.* (2013) and Hughes & Driscoll (2014) note that stable dominance relationships are more likely to form around relatively permanent resources (*e.g.* nesting areas), in comparison with feeding locations, as these are more likely to be patchy in distribution and hence birds may struggle to perceive the respective status of each individual. The development of an individual's rank within a group can be based upon the number of antagonist interactions that it initiates with conspecifics (Noble 1939). Indeed, the same authors go on to state that birds with an “inherent aggressive disposition” are more likely to

climb a social hierarchy more quickly. The pushing/“bumping” behaviour described could fit this scenario, and lead to an empirical study on the underlying reasons for its performance in flamingos.

Conclusions

Although this paper is simply a description of interesting interactions that have been noted, the behaviours described appear indicative of preferential and chosen relationships between birds, as well as showing ways that birds can cement their place in the social order of the flock. Such associations (positive or negative) are reinforced by a direct or directed interaction between individuals, or towards another individual challenging a relationship. As indicated in earlier studies, flamingos may exist in a more complex social system of long-lasting and preferential relationships rather than loosely-connected gregarious flocks. Further studies should indicate whether such behaviour commonly occurs between flamingos in their natural habitats, the range of flamingo species in which such behaviours occur, and the extent of such directed interactions occurring between individuals in male-female, or same sex, pairings. We feel that more focussed study into interaction rates between individual flamingos, in both a wild and captive setting, could explain the the occurrence and meaning of these behaviours, and shed light on the context behind their performance.

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Photograph: Andean Flamingos and a single James' Flamingo at WWT Slimbridge, UK, by Paul Rose.