



# **Communication Observation of an Attempted Forced Copulation within a Captive Flock of Greater Flamingos (***Phoenicopterus roseus***)**

Paul Rose <sup>1,2</sup>



<sup>2</sup> WWT, Slimbridge Wetland Centre, Slimbridge GL2 7BT, UK

**Simple Summary:** Observation of animal behaviour is an essential tool for gathering new information on species' ecology, evolution, and responses to the environment. Even for familiar species, new information on their activity patterns can be obtained from chance or prescribed observation of behaviour. This paper describes an attempted forced reproductive encounter between a male and female Greater Flamingo, illustrating the defensive behaviour of the female bird and the male's efforts to secure a mating. This paper provides information on the complex world of reproductive relationships within such a highly gregarious, colonial species, and recommends new avenues for future research to help understand the mechanism and function of different mating tactics in a specific focal species, the flamingos.

Abstract: Flamingos (Phoenicopteriformes) are obligate colonial species that nest in large colonies, with monogamous pairs rearing a single chick following a synchronised group courtship display. Within this relatively simplistic behavioural description, deviations from these social and reproductive norms are apparent. Same sex pairings, multi-bird relationships and extra pair copulations are documented in the literature. Flamingos display highly sexually selected characteristics of plumage colour, carotenoid accumulation and diversity of display movements that underpin mate choice decisions. The brightest birds in best body condition are more successful at breeding. Therefore, documented mate guarding of female birds by male partners, is a relevant response to maximise investment in a pair bond. Limited information that describes the action of forced copulation by the male flamingo and the response of the female bird is available in the literature. This paper describes an occurrence of an attempted forced copulation by an older male Greater Flamingo to a younger female bird. Such behaviour may be an artefact of the captive environment, and limited mate choice when compared to the sizes of wild flocks, or it could be regularly apparent in the wild and therefore worthy of more scrutiny and empirical study.

**Keywords:** reproductive behaviour; extra pair copulation; mate choice; flamingo; social behaviour; behavioural observation

## 1. Introduction

The likelihood of extra pair copulations for some species of bird may be associated with a species' life history and parental care strategies [1,2]. Species that attain a high longevity and where both parents raise young are more likely to be "genetically monogamous" [3] compared to species that display limited parental care and reproduce more quickly across an overall shorter adult lifespan [4]. However, the highly social environment of a breeding colony provides multiple opportunities for potential mates to interact and therefore extra pair copulations could be promoted as a means of increasing reproductive output [5]. Forced extra pair copulations, or sexual coercion of a female bird from a male in an attempt to increase the chance of her being available for mating is rare in most avian species but common in wildfowl (Anseriformes) [6–8]. In the latter taxon, forced extra pair copulations



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**Copyright:** © 2022 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https:// creativecommons.org/licenses/by/ 4.0/). have been documented in 55 duck (Anatidae) species [7]. The reproductive anatomy of the male bird [9] together with the morphology of the female's reproductive system (to reduce the success of unwanted mating) may have created an "arms race" that focuses efforts on extra pair copulations [10]. Reproductive anatomy, together with the social environment such species live in and the degree of competition for mates within a brief period of courtship display may have all combined to cause the evolution of such forced copulatory mating strategy [8].

In the wild, flamingos (Phoenicopteriformes) are likely seasonally monogamous, choosing a new partnership after a complex and diverse courtship display for each breeding opportunity [11]. Captive flamingos can display a mixture of long-term social partner or be more flexible in their selection of mate between breeding seasons [12,13]. The diverse nature of captive flamingo social relationships documented by Shannon [13], including inter- and intra-specific pairs, trios (both multi-male and multi-female) and quartets, may reflect both the flamingo's flexibility in its social choices and also the constraints of the captive environment on what social and reproductive activities the flamingo would like to perform. This diverse array of social relationships includes behaviours performed to guard a mate from rivals, and extra pair copulatory behaviours that flamingos use to extend their reproductive influence within the flock [14]. Whilst discussion of mate choice, aggression between males and females around breeding, and the occurrence of extra pair copulations is noted in the literature, there is little information on how female flamingos respond to the unwanted advances of a male bird nor any description of the social interaction that occurs.

Greater Flamingos (*Phoenicopterus roseus*) are the largest and most widespread species of flamingo [15], inhabiting saline lagoons, coastal wetlands and salt flats across Mediterranean Europe, into the Middle East, India and Sub-Saharan Africa [14]. This species is sexually dimorphic with the male flamingo being taller and heavier than the female [16]. Greater Flamingos use carotenoid pigments from their diet to stain their plumage a pale pink, which is an honest signal indicative of individual quality, foraging effort and attractiveness as a breeding partner [17].

This note provides details of an interaction between a male and female Greater Flamingo housed in a large captive flock (158 birds, 40% male, 55% female and remainder of unknown sex) and describes the advances of the male bird in an attempt at a forced copulation and the reaction and defensive behaviour of the female bird.

#### 2. Study Area

The observation took place at WWT Slimbridge Wetland Centre, UK on 18 July 2022 from 15:27 to 15:30 BST in the captive flock of Greater Flamingos. WWT Slimbridge is open to visitors from 09:30 to 17:30 daily. Flamingo husbandry occurs in the morning before public opening, with birds being fed on specialist flamingo pellet at approximately 08:30. An afternoon feed (approximately 15:00) occurs depending on bird needs. The two birds involved both wore Darvic (plastic) leg rings and were therefore identifiable to the observer. The female bird (PJL) was captive hatched at WWT Slimbridge (exact date unknown) but was at least 13 years old at the time of observation. The male flamingo (GJJ) was also captive bred, being hatched in 1987 (35 years old at the time of observation). Both birds displayed mature adult nuptial plumage (pastel pink bill and legs, blush pink head and neck, pale white body, and coral pink covert wing feathers). The Greater Flamingos lived in an expansive enclosure (approximately 2400 m<sup>2</sup>) furnished with a large sanded island (approximately 280 m<sup>2</sup>) for nesting and loafing, a pool with various shallow and deeper sections for wading, swimming and filtering feeding, a large indoor house (that birds did not have access to at the time of the observation) and grassed areas around the pool that allowed the birds to leave the water. Public viewing of the enclosure was from a sunken hide that shades the visitors and reduces disturbance to the flamingos. Approximately 50% of the flock were engaged in nesting behaviour during the observation and were situated in a back right section of the main nesting island. Around 20–25 nest mounds where completed or partially completed. Records of eggs laid on specific nest mounds by

ringed individuals would be recorded during a nesting event. All flamingos were flight restrained to prevent escape. Figure 1 shows the overall scope of the Greater Flamingo enclosure at WWT Slimbridge.



**Figure 1.** The Greater Flamingo enclosure at WWT Slimbridge. **Top**, the left-hand side showing the feeding area; **Bottom**, the centre and right-hand side showing the main pool and sanded island. The roof of the public viewing hide can be seen top right. Photo credit: P. Vaughan.

#### 3. Observation of Behaviour

A chance observation occurred at 15:27 on 18 July 2022 when the Greater Flamingo flock were being observed for their response(s) to the uncharacteristic heatwave that was creating temperatures of up to 37 °C in the late afternoon in the South West of the UK. Any reaction of these nesting flamingos was being filmed to provide information on the welfare state of the birds that may be useful to other animal keepers and zoological collections in the future. The observer was located in the exhibit's public viewing hide; no visitors were present in the hide at the time and no animal care staff were in or around the flamingo enclosure. The complete sequence of behaviour was captured on film and can be viewed at the following links: https://doi.org/10.6084/m9.figshare.21517002.v3 (accessed on 11 August 2022) (first appearance of these two birds and the aggression of the female to the male) and https://doi.org/10.6084/m9.figshare.21517011.v1 (accessed on 11 August 2022)

(close-up recording of the male's attempts to mount the female and her defensive behaviour and evasion).

The unusual behaviour of two birds, running whilst flapping out of the feeding area (situated to the left of the observer's position), behind the main nesting colony at the back of the island, and then coming to a stop on the right hand side of the nesting birds caught the observer's attention (Figure 2). The speed of their running and apparent panic suggested the presence of a predator, e.g., a large gull (*Larus* sp.) yet all other flamingos remained undisturbed and continued their routine behaviours.



**Figure 2.** Screenshot from the first video recording (taken at 00:01). The two birds in question are highlighted in the red circle and they first appear on the left-hand side of the shot. The female (shorter bird) is in front of the male (larger bird). All other flamingos are unperturbed.

The female flamingo ran around the back of the colony until she reached its far edge; she then turned to the male bird (Figure 3) and commenced agonistic behaviours to repel his advances. This activity was ignored by all other flamingos in the flock.



**Figure 3.** After being chased from the feeding area to the far right-hand side of the nesting colony, the female flamingo turns on the male bird who is chasing her and aggressively jabs at his neck and breast. The birds are highlighted in the red circle. Screenshot from first video recording (taken at 00:04).

The male flamingo repeatedly attempted to walk behind the female and push his body over her wings and back, in a manner associated with the prelude to copulation [14] (Figure 4). The female bird repelled this by either grappling his bill with hers, jabbing at his neck and breast, or grabbing and holding on to his feathers whilst attempting to push him

away (Figure 5). After her original run into the colony (Figure 2), the female flamingo did not attempt to fly away from her attacker, nor enter the water to evade him. Her responses were directed back at the male bird to drive him away, rather than flee.



**Figure 4.** The male flamingo (taller bird) attempts to turn the female bird into the position for copulation. Her response is aggressive and defensive. Screenshots taken from second video recording (00:17 to 00:22).



**Figure 5.** The female flamingo's (shorter bird) responses to the male's attempts at copulation. This involved direct contact (grabbing and pulling at the male bird's feathers and bill) and vocalisation and posturing/jousting with her bill aimed at his. Screenshots take from second video footage from 00:30 onwards.

The male flamingo attempted one mount of the female bird, flapping his wings and jumping with both legs in the normal manner for copulation of the male up onto the back of the female (whilst she would usually form a platform with her spread wings) [14].



However, in this instance, it was to the side of the female bird who had grabbed on to the male's neck and therefore he landed back in the same location on the sand (Figure 6).

**Figure 6.** Attempted (unsuccessful) copulation of the female flamingo by the male flamingo. The male flamingo is flapping his wings and jumping onto the female. Screenshot from second video recording from 00:47.

The encounter ended when the female bird moved away into the middle of the nesting flamingos that were sat on their mounds, and the male bird commenced preening rather than pursuing her further or moving away to return to an existing partner (Figure 7). This behaviour of the male flamingo at the end of this encounter (commencing preening and remaining in the location from where the female exited) may suggest that he was an unpaired bird as he made no attempt to find his nesting partner in the group or move towards a female partner elsewhere in the flock. This would provide a further interesting area of study, to categorise the behaviour of a male flamingo after such an opportunistic mating attempt to determine whether he returns (or not) to his already established partnership.



**Figure 7.** The end of the encounter with the male bird preening (circled red) and the female (now out of view) disappearing into the main nesting group. The behaviour of the male flamingo suggested he was unpaired and that this was an opportunistic attempt at a copulation as this male bird did not attempt to seek out any partner once the forced copulation encounter had ended. Screenshot from second video footage at 01:24.

### 4. Discussion

This paper describes the interaction between a captive male and female Greater Flamingo involved in a forced copulation attempt of the female bird by the male. The female flamingo resisted the advances of the male flamingo in an aggressive manner, using physical and vocal aggressive behaviours to reduce his chances of a successful forced mating. The male flamingo consistently attempted to manoeuvre the female flamingo into a position for copulation, by pushing her body and standing to the side or immediately behind her. The aggressive response of the female bird was successful in resisting the advances of the male flamingo and the strength of her reaction and the physical display of aggression suggested that this female bird was not being mate guarded by another male flamingo and was therefore unpaired.

In published work on captive Caribbean Flamingo (*P. ruber*) behaviour an absence of forced copulations of male to female birds is noted [13], yet in research on captive Chilean Flamingos (*P. chilensis*) when extra pair copulations occur they could be cooperative [18]. Differences in flock size, and time of observation (e.g., courtship periods, or during nesting) may account for different descriptions of flamingo reproductive interactions. This contrasts with some explanations of female aggression towards males who had attempted copulation when the female was partnered or nesting [13]. Both wild [14] and captive [19] flamingos will display mate guarding behaviour. The male flamingo positions himself close to hthe female and remains nearby to reduce the opportunity that other males may have of copulatory attempts [14]. In the wild (and in captivity) female flamingos may benefit from the protection of their selected breeding partner during the first stages of pair bonding (post courtship and pre-nesting). As copulation intensity builds before the first eggs are laid [20], mate guarding is likely to be more important to protect female flamingos from the unwanted advances of un-paired male flamingos that are seeking a last chance copulation before birds are settled on nests.

From observation of wild flamingos, Johnson and Cézilly [14] noted that female Greater Flamingos were particularly susceptible to unwanted mating attempts from a non-partner male when in the position for copulation. However, in the case of this captive female bird, there was no male partner in attendance who attempted to help rebuff the advances of the intruding bird, as has been documented in bonded flamingo pairs [19]. As the female bird entered the nesting island from the left-hand side of the pool that contained the feeding area, it may have been that whilst she was distracted by foraging the male bird attempted to gain a copulation. Pushing and displacement of a distracted bird by a neighbouring individual is documented [19] and therefore an original chance encounter in a foraging patch may have initiated this more complex social interaction between these two birds. The male flamingo did not move away to a partner after the encounter had finished and remained preening for around 10 min. If this had been an attempt at an extra pair copulation, the bird would likely have made some attempt to relocate and reunite with his current mate.

In other species of bird, females may solicit extra pair copulations to increase fertility and therefore reproductive output [21], however no documented evidence currently exists of female Greater Flamingos (wild or captive) actively seeking copulations outside of their breeding pair [14]. The behaviour documented in this occurrence indicates that this female flamingo had not initiated and was not interested in the advances of the male bird. As has been noted in other waterbirds (e.g., ducks) [7], female flamingos can display elaborate anti-forced-copulation tactics and, when combined with direct aggression, may be used to defend the pair bond with the female's original partner [14]. However, further study and documentation of extra pair copulation and occurrences of potential or actual forced copulation is required in flamingos to fully understand the mechanisms behind such interactions.

Unwanted copulation attempts may occur frequently in flamingo flocks (wild and captive) across different species. The size of flocks and the complexity of relationships within them (including the diverse array of flamingo social interactions [13]) may make

systematic recording of such copulation attempts difficult. A further observation of a copulation attempt of a male Chilean Flamingo to a sitting female flamingo (in the same zoological collection but different enclosure) also suggested a forced attempt at mating by a male bird to a female that is not interested. This encounter was also partially video recorded and can be viewed here: https://doi.org/10.6084/m9.figshare.21517020.v1 (accessed on 11 August 2022). Similar occurrences of a male Greater Flamingo attempting to initiate a copulation with a sitting female (with an approach from the rear and front of the female bird) have also been anecdotally observed by flamingo care staff (P. Vaughan, personal observation). Forced copulation in captive flamingo flocks may be an artefact of smaller flock sizes than would not be found in the wild and therefore limited opportunities for pair formation and breeding and thus is worthy of further investigation.

The density of wild flamingo breeding colonies can be a challenge to observation of individual bird of dyadic behaviour [22]. Therefore, whilst differences in the daily organisation of the behaviours of wild and captive flamingos are noted [14,23] captive birds can be excellent subjects for the scientific study and documentation of behaviour, and such information can be used to develop experimental designs and observational protocols for investigating novel or interesting behaviours in wild birds. Similarly, the density of nesting captive flamingos (especially when birds are sat on nest mounds) may make following of specific individuals tricky. Although the male flamingo in this observation did not attempt to move towards a breeding partner at the end of the encounter documented here, and therefore he may have been unpaired, the size and scale of the flock may have caused a challenge to the identity of any existing breeding partner (as this bird may have been sat on a nesting mound). Unpaired flamingos, and birds in same-sex partnerships can cause disruption to breeding attempts within a nesting colony [24] and therefore further explanations of his behaviour are possible (and are worth of further investigation).

Long-term mate fidelity in captive flamingos can be very high [11], contrary to the flexibility of partnerships (between seasons) seen in wild birds. Although large flocks of flamingos can display variation between non-breeding associations and pairings that form for the purposes of reproduction [12] it may be that such aberrant behaviour, as described in this paper, is more common in captive flocks when: (i) limited flock size when compared to the wild reduces the number of available mates, (ii) existing mate fidelity restricts breeding opportunities for all available birds and (iii) skewed sex ratios reduce the number of potential inter-specific pairings that could form.

The information presented in this paper may provide further evidence for zoological organisations to work together to increase flamingo flock sizes to provide maximal opportunities for mate choice and to ensure that the demographic structure of the flock promotes wild-type courtship display and reproductive activity. From a practical level, increasing access to mates and ensuring equal sex ratios within a captive flock may reduce aggression from unpaired males to females, but also promote opportunities for extra pair copulations between compatible flamingos if such behaviour is important to reproductive outputs in these species. Such management actions should be planned in advance, and the birds' responses observed, and data recorded systematically, to provide empirical evidence on the context behind and frequency of extra pair copulations in captive flamingos.

#### 5. Conclusions

This paper describes the interactions that occurred between a captive male and female Greater Flamingo with the intention of the male bird of performing a forced copulation that was successfully repelled by the female. The strength and ferocity of the female's response may be suggestive of an unpaired bird that could not rely on a bonded partner to assist in mate defence. The behavioural descriptions noted in this paper will hopefully be relevant to others studying flamingos in the wild (to judge the extent of such interactions in a free-living flock), as well as for captive flamingo managers who wish to maintain harmonious breeding colonies, by evidencing population management actions to reduce unwanted aggression from unpaired birds to other flamingos in the flock. Funding: This research received no external funding.

**Institutional Review Board Statement:** The information presented within this paper, and the final paper itself, were both reviewed by the Head and Deputy Head of the Living Collection at WWT Slimbridge prior to external dissemination. These greater flamingos are captive birds that have been housed by WWT since 1961. WWT has a zoo license that allows for the management a captive collection, as is standard practice for operational zoological collections. This research was a secondary artefact from a normal husbandry routine.

Data Availability Statement: Not applicable.

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