

2009

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Guyon, J.

Guyon, J. (2009) 'The impact of captivity on the behaviour of mute swans (*Cygnus olor*)', The Plymouth Student Scientist, p. 22-37.

<http://hdl.handle.net/10026.1/13869>

The Plymouth Student Scientist
University of Plymouth

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The impact of captivity on the behaviour of mute swans (*Cygnus olor*)

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Abstract

The mute swan (*Cygnus olor*) is a large water fowl species widely distributed in Great Britain. They are residential and territorial so often there is no interchange between groups. Swans face many injuries in the wild so are brought into wild life centres for treatment and rehabilitation. The aim of this study was to see if their captive behaviour differed from the behaviour of wild conspecifics. This was achieved by performing observations of captive and wild mute swans. From this it was found that several behaviours were more common in captivity these were standing, standing whilst preening or feeding, lying, lying whilst preening or content and walking. Whereas, in the wild behaviours such as swimming, loafing whilst feeding, preening or whilst alert and foraging occurred more often. I found that there was a lack of active behaviours in captivity when compared to the wild. This is due to space restrictions and the absence of enrichment. The importance of encouraging activity and the benefits of enrichment are well acknowledged in most species of animals. However, the use of enrichment for water fowl species has been overlooked. Future research is needed examining the behaviour of captive water fowl species and in the development of enrichment devices for this species.

1. Introduction

The comparison of behaviour between captive and wild populations of conspecifics is a useful tool as it is commonly believed that animals can suffer if they are unable to perform a full repertoire of natural behaviours (Veasey *et al.* 1996). The impact of captivity on wild-caught animals can lead to the aversive behaviours that are induced by environmental stress. Two main behaviours commonly displayed in captivity include stereotypical behaviour and abnormal behaviour.

Stereotypical behaviours are repetitive, unvarying and apparently functionless behaviour patterns (Kichen & Martin 1996). Common examples of stereotypical behaviour that are frequently observed in captivity include pacing, ritual head turning, repeated regurgitation and ingestion of food and stereotyped movements (Jordan 2005). These impacts have been extensively studied in a range of species including pacing in carnivores (Clubb & Mason 2003), stereotyped walking in fennec foxes (*Vulpes zerda*) and Black bears (*Ursus Americanus*) (Carlstead 1996).

Abnormal behaviours are defined by Bassett & Buchanan-Smith (2007) as “species-specific, self directed behaviours, coprophagy or agonistic behaviour that are viewed negatively and indicate tension and frustration”. The presence of abnormal behaviour increases in captivity and many examples of this have been demonstrated; such as excessive fear behaviours, aggression, panic and frantic escape attempts (Meeha & Mench 2002). In birds captive abnormalities frequently consist of extreme food possession, redirection of sexual behaviours, feather damage, self mutilation and frantic escape behaviour (Park 2003).

There is generally a lack of captive and wild behaviour comparison studies on birds. Previous studies have led to the assumption that the behaviour of animals is influenced by several factors including social grouping, activity levels and the environment. One concern is the impact of social grouping in birds and the activity levels within the group. This factor was established in early studies by Lazarus (1979), where it was found that higher group sizes in birds correlated with increased feeding rates. This is because as group size increases, vigilance is greater and the risk of predation declines. Subsequently, the behavioural patterns and time budgets in larger groups will be influenced by this (Lazarus 1979).

Since this development, many studies have focussed on the impact of social facilitation, which is defined by Klopfer (1959) as the “performance of an act by one individual, which is followed by the performance of a similar act by another individual”. Research has found that identical activity budgets occur in paired turkeys (Sherwin & Kelland 1998) and synchronisation of behaviours in Bengalese finch (*Lonchura striata var. domestica*) (Birke 1974) and domestic fowl (*Gallus domesticus*) (Hoppitt *et al.* 2007). Another consideration of these factors influencing activity levels is the condition of the individual. For example, Black-Legged Kittiwakes (*Rissa tridactyla*) with better body conditioning use energy for more ‘costly’ tasks such as foraging compared to individuals with poor body conditioning which allocate energy for self-maintenance (Angelier *et al.* 2007).

The environmental conditions are known to influence captive behaviour. Research has examined the impact of high levels of complexity on positive animal welfare. This

has been demonstrated in many species including tigers (*Panthera tigris*) (Pitsko 2003) and marmosets (*Callithrix jacchus*) (Kitchen & Martin 1996). High levels of complexity can help to promote bird health. In broiler chickens; enriching the environment with barriers between feeders and increasing light intensity resulted in higher loco-motor activities leading to higher levels of exercise and consequently improving leg conditions (Bizeray et al. 2002; Roberts & Davies 2000). Additionally feeding enrichment decreased the incidence of Bumblefoot in Waldrapps; which is a common disease in captive birds, by increasing active behaviours (Vargas- Ashby & Pankhurst 2007).

Another factor that helps to improve captive welfare is the use of enrichment this is beneficial as it stimulates wild behaviours (Huges & Price 2000). It has helped to reinforced positive behaviours in several birds species including reduction in aggressive behaviour in Hyacinth Macaws (*Anodorhynchus hyacinthinus*) (Reed & Price 2000), Waldrapps (*Geronticus eremita*) (Vargas- Ashby & Pankhurst 2007) and reduced injurious pecking in turkeys (Martrenchar et al. 2001). Although enrichment has demonstrated such beneficial results in many captive bird species, employing this to large water-fowl species such as swans has not been achieved.

The mute swan (*Cygnus olor*) is one of the most widely distributed wild waterfowl species in Great Britain (Kirby et al. 1994). They live in areas of slow- flowing waters in smaller rivers that contain a high density of vegetation (Glaser 1989) and are particularly abundant in the south-east of England (Kirby et al. 1994). They are generally residential birds and there is little or no interchange between groups that occupy different parts of the country or different locations of the same site (Kirby et al. 1994). They are territorial and the location and size of the territory is determined by the availability of food supplied in the form of vegetation, bread from the public and pasture to graze (Scott & Birkehead 1983). Territorial defence is particularly high when the swans have formed pairs (Glaser 1989).

Mute swans are brought into captivity when they suffer injuries such as ingestion of lead fishing weights (Kirby et al. 1994) or flight crashing. The length of time that they remain in captivity is dependent on their recovery time. When in the captive environment; like many other species, several natural behaviours may be restricted, such as flying and the ability to form territories. The differences in their behaviour to wild conspecifics has been unexplored in mute swans.

A very limited amount of research has been performed on swans and research on swan behaviour and welfare is virtually non-existent so this study is a novel investigation. I tested whether wild and captive populations of mute swans differ in their behaviour by observing several groups of wild and captive swans.

2. Methods

2.1. Animals and Housing

Study Captive Flock Population

Captive swans were studied at Swan Lifeline, a sanctuary based in Eton; Berkshire. The swans are housed in groups ranging throughout the experimental period from 6-31 mute swans (*Cygnus olor*) within each pen. The group mainly consists of swans that are rescued and rehabilitated from the Thames Valley region that will be eventually released back into the wild. A small proportion of the swans were reared from cygnets and were awaiting release, but the majority are adults brought in from the river. The groups are mixed sexes and mainly contained conspecifics with the exception of two enclosures that contained several ducklings, and one containing a pair of black swans (*Cygnus atratus*).

Four pens were studied during observations each which varied slightly in size and design. The pens were all surrounded with wire mesh, which allowed swans visual access to conspecifics and non- conspecifics but prevented direct contact. The flooring of the enclosures was made of concrete and had several mats to provide additional grip. Within the middle of enclosures were ponds which were also made of concrete and filled with water to allow for swimming.

The enclosure also contained several buckets with water, bread and grass which were changed daily. The number of these was dependent on the number of individuals present. Additionally a trough approximately 1.5m long was used to provide grain. All items were fed *ad libitum*. Two pens provided shelter; one enclosure had a wooden hut that provided shelter continually and in the other a shed was provided which was opened at night and during bad weather. Shelter was absent in the other enclosures. Caretakers had unlimited access throughout the day to all pens.

Wild flock

Behavioural observations of wild mute swans were conducted on the River Thames in Windsor, Berkshire. The size of the flock varies throughout the day from approximately 7- 30. The area where they are resident is a part of a busy stretch of river where recreational activities occur and the area is a tourist attraction, part of the attraction is feeding the swans. Observations were split into two sites within the river as shown in figure 1; to control for any effects of location.



Figure 1. Showing locations of the two observation sights for focal sampling of the wild swan populations (From: <http://maps.yahoo.com>).

2.2. Recording methods

Focal behaviour observations were performed for 14 consecutive days from the 15th August 2008 till 28th August 2008. Observations of captive and wild populations were performed on alternate days. They were performed twice a day, during the morning (08:30-13:30) and afternoon (14:00-18:00). Behaviours were recorded using an ethogram of swan behaviours (table1) and recorded on a data sheet (see appendix).

Focal instantaneous scan samples were taken for 12 daily periods; recording every minute over a total of 15 minutes. These periods took place for 6 consecutive periods in the morning and 6 consecutive periods in the afternoon. For each period a new individual was picked at random. Observations were performed for three swans from the same pen/ site and then repeated at a different pen/site, again observing another three individuals. The pens/study sites where observations took place was pre-determined so that combinations of two pens/sites were studied on a particular day (see appendix).

Identification of the focal individual was determined by hospital leg tags in the captive populations and darvic tags in wild populations. When these were not available individual trait differences between individuals were used, such as body size and plumage markings. If the birds could not be seen during the focal observation period 'out of sight' was recorded until the swan being observed could be seen again.

CODE	BEHAVIOUR	DEFINITION
LOA	Loafing	Floating on top of the water without active movement (i.e. without swimming, eating)
LAY	Lying	Base of body on ground, with no active movements with the legs.
FED	Feeding	Eating food present on top of the water; may be in movement.
WAL	Walking	Taking more then 3 steps within seconds.
FLY	Flying	Flying through the air for more then 4 seconds without any surface contact.
PRN	Preening	Running tip of bill along feathers or/and ducking and splashing water onto wings and body.
APN	Allo- preening	Bird using bill to preen feathers of another bird (Spoon <i>et al</i> 2007).
APS	Allo- preening solicitation	Focal bird places head under the bill of another.
SIT	Sitting	Resting on ground, head not in sleep posture, without any active movement, no contentment behaviour.
ALT	Alert	Stretched neck, erratic head movements.
STD	Standing	Standing without taking a step in 5 seconds, head not in the sleep posture, without any active movement, no contentment behaviour.
ABO	Aggression by others	Other individuals attacking or threatening focal swan.
AGR	Aggression	Aggressive behaviour (peck, chase) carried out by focal swan.
AGI	Agonistic interaction	Neck held in a arched curved posture with head pointing downwards, snorting and then hissing , fluffed out feathers with wings held over body in a arched position.
SLP	Sleeping	Head laid back with eyes closed, whilst standing or sat on ground.
DRK	Drinking	Moving bill into water and elevating neck into a vertical position.
SWM	Swimming	Active movement on top of the water.
CTSH	Courtship	Pair swimming closely together, curving their necks, turning necks from side to side, entwining their necks (Glaser 1989).
FOG	Foraging	Immerging head and neck under the water.
BOC	Boundary clash	Parallel swimming, raised wing displays and eventual retreat by both parties (Scott 1984).
CT+S/T/F/D/L	Contentment + behaviour displayed	One leg raised onto back, head lowered but not in head posture, eyes partially closed while swimming (CTS), sitting (CTT), loafing (CTF), standing (CTD) or lying (CDL).
PAC	Pacing	Repetitive unvarying walking patterns, typically near fencing whilst walking up and down continually for a substantial amount of time.
L	land	Bird is located on land.
W	water	Bird is located on water
OOS	Out of sight	Not in view of the observer.

Table 1. Ethogram of mute swan behaviour (Cygnus olor)

2.3 Ethical note

The observations were passed by the University of Plymouth ethical review committee. Pilot tests for both wild and captive populations of mute swans were performed to refine the method. The study did not cause any harm or any long-term effects, precautions were taken to ensure this. Behavioural observations were carried out at a distance with several breaks between periods of observations to prevent any disturbance from being caused. The captive swans remained within their pens throughout the study and were either returned to the wild when rehabilitated, but those with severe injuries remained at the sanctuary. Wild swans that were observed remained at the site and were not restricted.

2.4 Statistical analysis

Means and standard errors were obtained for the variables to gain a daily average of behaviours. Statistical analyses were conducted using SPSS version 16.0. The variables were tested for normality using Kolmogorov-Smirnov. To find significant differences between wild and captive behaviour, the variables were analysed. For behaviours which were normally distributed independent t - tests were used to compare between captive and wild behaviour. For behaviours where the data was not normally distributed non-parametric analysis using Mann-Whitney was performed to test for significance between captive and wild behaviour.

3. Results

Statistical analysis indicated several significant differences between the behaviour displayed between captive and wild mute swans. Some of these behaviours were displayed more often in captivity or in the wild; these results are shown.

3.1 Behaviours performed more in captivity

There were found to be significant differences in behaviour of captive and wild swans (Graph1). These behaviours included standing; and to stand whilst preening or feeding (table1). Also birds in captivity spent more time lying and lying whilst preening or content (table1) and additionally walked more often (table2).



Graph 1. mean number of occurrences (SE±) of behaviours that were performed more significantly in the captive population compared to the wild.

Abnormal behaviour

The presence of abnormal behaviour was not very frequent and no significant difference was found between wild and captive populations in pacing behaviour due to the low frequency that this behaviour occurred (Mann-Whitney U test: $U=21.000$, $N_1, N_2=7$, $p>0.05$) (table2). However, it was noted that pacing only occurred within the captive environment, in one observation where the individual spent 93.3% of time pacing in the 15 minute observation period.

Table 2. Degree of freedom (df) and p value indicating significance of behaviours between captive and wild populations of mute swans (*Cygnus olor*).

Behaviour	Sig. (2. Tailed)	Captive mean	Wild mean
Feed /stand	0.023	0.95±	0.21±
Swim	<0.001	0.34±	2.11±
Stand	<0.001	0.34±	0.45±
Preen / stand	<0.001	32.63±	10.00±
Walk	0.027	2.22±	0.40±
Feed / loaf	0.020	2.23±	6.43±
Preen /loaf	0.004	1.52±	1.26±

For all behaviours: $N_1= N_2= 7$. Standard error shown in graph 1 and 2.

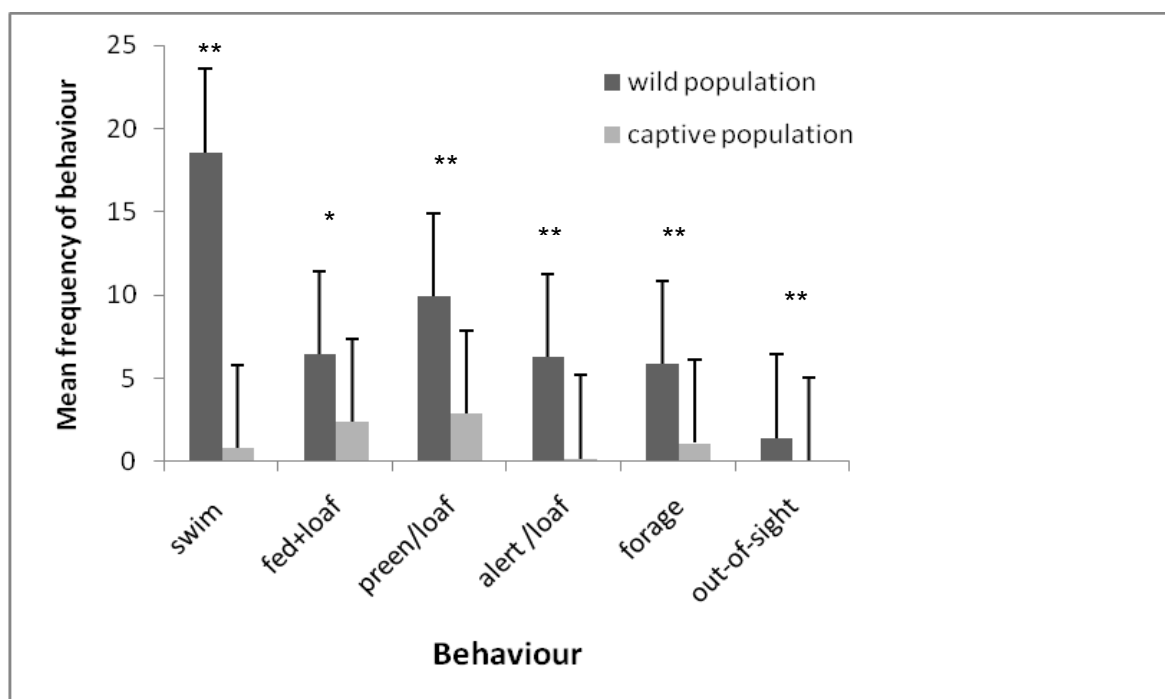
Table 3. U statistic and p value indicating the significance of behaviours between captive and wild populations of mute swans (*Cygnus olor*)

Behaviour	U	p	Captive mean	Wild mean
Preen/ lay	3.500	0.003	2.06±	0±
Lay	9.000	0.028	3.64±	0.40±
Forage	3.000	0.004	1.11±	5.88±
Alert / loaf	0.000	0.001	0.16±	6.27±
Content/ lying	7.500	0.023	1.19±	0.24±
Out of sight	0.000	0.001	0±	1.41±

All degrees of freedom=12 with the exception of feed/stand= 6.6 and stand= 8.9. Standard error is shown in graph 1 and 2.

3.2 Behaviours performed more in the wild

There were several behaviours that were performed significantly greater in the wild compared to captivity (graph 2). These behaviours included to swim, loaf whilst feeding, preening (table 2) and alert (table 3). Additionally observations of foraging and being recorded as out-of-site (table 3) were more common in the wild compared to captivity.



Graph 2. Mean number of occurrences (SE±) of behaviours that were performed significantly more in the wild population compared to the captive.

4. Discussion

The results indicate that there are several differences between the captive behaviour in Mute Swans compared to the behaviour of wild conspecifics. Research observing the captive welfare and behaviour of waterfowl species such as swans is very limited; there are a few more studies in wild behaviour but this is not wide-spread. I found from the results that wild swans spend a considerably greater time active by swimming and foraging. This is contrasted by captive birds which spent a lot of time stationary by lying and standing more often. The differences in these behaviours demonstrate that captivity does have an impact on wild swans leading to a reduction in activity levels.

4.1 Captive behaviour

The results indicate high levels of inactive behaviours such as lying and standing and also a high level of preening and walking in the captive environment; these factors and their impacts will be discussed.

Activity levels in captivity

The results found that out of all 7 behaviours that were displayed more often compared to the wild population; 6 of these were performed whilst stationary (Graph 1). It was found that the wild population of swans remained active by displaying a high frequency of swimming behaviour. Due to space restrictions that naturally occur in a captive environment the swans were unable to perform this behaviour at the level the wild populations did. As this behaviour could not be performed at the same frequency as the wild populations, the presence of inactive behaviours such as standing and lying are likely to be higher.

There is a lack of similar studies in this area; however de Vos (1964) considered inactivity in a captive study of Trumpeter swans (*Cygnus buccinator*). Similarly to the results here standing behaviour was also common in captivity. It was discovered that males stood more than females and males also had longer resting times than females (de Vos 1964). Additionally, de Vos (1964) found that males also had longer periods of sleep than females. The occurrence of sleep was frequent with the longest sleep period recorded as 85 minutes. The differences in sleeping behaviour may depend on the level of disturbances (Rees et al. 2005); I observed during a busy time of day which consequently had a high level of disturbances.

The high level of inactive behaviours in captivity can have an influence on the bird's health. Inactivity can lead to a detrimental effect on the animal's health. In captive waterfowl the presence of bumblefoot is greater in birds which are inactive. The presence of this disease was prevented with the use of feeding enrichment which encourages the birds to move (Vargas- Ashby & Pankhurst 2007). Furthermore, using environmental enrichment to increase the level of physical exercise in broiler chickens helped to improve leg conditions (Bizeray *et al.* 2002).

High presence of preening in captivity

Preening was commonly observed in the captivity particularly when the birds were standing or lying. Similar results have been observed in paired turkeys; these birds

also had a high level of preening whilst sitting and preening whilst standing. The reasoning behind this was related to age and musculo-skeletal weakness (Sherwin & Kelland 1998). These factors do not seem relevant to the results of the current study as ages within the flock varied and all animals were healthy or receiving treatment. Previous study on paired mute swans also found a high level of preening; males preened a total of 570 minutes compared to the female who preened a total of 562 minutes over 11 days (de Vos 1964).

It is thought that the reasoning for such a high occurrence of preening in captivity is due to a lack of natural behaviours. If natural behaviours are unable to be performed such as searching for food and the inability to flock, then the birds will fill the rest of their time up by preening (www.liv.ac.uk [20/02/2008]). However, this is not always demonstrated; chickens in restricted spaces show a reduction in preening behaviour (Baum *et al.* 1998) and it has also been found that preening levels can remain unchanged in captivity (Charmichael *et al.* 1999).

It was noted that preening was synchronised in the captive flock: when one bird preened many others would also follow this behaviour; although this was not tested in observations. This form of social facilitation is common in many bird species including the Bengalese finch (*Lonchura striata var. domestica*) where preening, feeding, beak-wiping and drinking behaviour are synchronised (Birke 1974). Also synchronisation of preening, sitting and dust bathing behaviours were observed in domestic fowl (*Gallus domesticus*) (Hoppitt *et al.* 2007). However, to make accurate assumptions of social facilitation in swans, further experimentation would be needed.

4.2 Wild behaviour

High occurrence of foraging

The wild population foraged more than the captive population of swans. This is because the ponds in captivity do not contain any food and on land the food is clumped and not scattered so birds cannot display this behaviour. This is consistent with previous research, wild birds will forage between 6-8 hours compared to captive birds which spend small proportions of time foraging once or twice a day. This was also because of food being offered clumped which reduced foraging opportunities (Vargas- Ashby & Pankhurst 2007).

Foraging behaviour is a common activity of swans in the wild. Mc Kelvey & Verbeek (1998) found that Trumpeter swans spent 57.6% of the time foraging during the day and even at night foraging remained a dominant activity with 47.2% of the time foraging for food. Similarly O' Hare *et al.* (2007) found that Mute Swans fed with their head submerged 20% of the time during feeding.

The presence of vegetation that consequently allows swans to forage has been found to influence the reproductive performance of Mute Swans. Territories that had a high density of aquatic vegetation led to females laying larger clutches and females that were generally a lot heavier (Scott & Birkehead 1983). This demonstrates that the high quality of this habitat was having a positive effect on their physiology.

The quality of the habitat and food abundance is thought to correlate with the frequency of head-dipping and the subsequent under water feeding time in swans.

The longer the underwater feeding time the poorer the habitat quality (Nolet *et al.* 2007). Additionally, the shorter trampling time indicates a shallow area containing food (Nolet *et al.* 2007). This would explain why the foraging behaviour was not as frequent as other behaviours displayed in the wild population. The swans receive food that is readily available from the public feeding them, so therefore reduces the need to forage and find food themselves. Also the stretch of river is relatively shallow so birds are able to reach plant material easily, therefore even when they did forage the bouts of this activity were short.

High presence of loafing

The results indicate that there was a higher proportion of time spent loafing in wild populations of Mute Swans than captive ones. Loafing was performed without any other active movement and also whilst feeding, preening and alert. Loafing is a resting posture, indicating that the bird is relaxed and content. Early studies found that loafing in captive paired Trumpeter swans was common throughout the day and mainly performed on land (de Vos 1964). This is contradictory to the results as loafing was not performed often in captive swans and the wild population displayed this behaviour more often in the water rather than land. O'Hare *et al.* (2007) also found that Mute Swans spent more time located in the river than the bank. This may be due to the busy environmental conditions of the observation area rather than species preferences. Jozkowicz & Gorska-Kleck (1996) found that the environment can impact on the exhibition of behaviours in Mute Swans. Urban swans spent greater time swimming and loafing than their rural conspecifics. The study area was an urban environment which demonstrates the consistency of these results with the behaviours I observed.

The combination of loafing and alertness represents a low status of risk to the swan, as the posture remained relaxed. Rees *et al.* (2005) states that Whooper Swans (*Cygnus c. Cygnus*) become less susceptible to disturbance when there is a high flock size and located a considerable distance from a road or track. The flock studied was large and was a small distance from a road and track. The large group size offers protection which makes vigilance less of a concern; which relates to the swan's posture of loafing. But as the bird is still in an area that has some level of disturbance, alertness is still warranted.

De Vos (1964) also found that several behaviours occurred simultaneously with loafing such as bathing, preening, sleeping, loafing and swimming (de Vos 1964). Similarly, when observing wild populations loafing was displayed in unison with several behaviours including feeding, preening and alertness. This shows that the absence of loafing behaviour in captivity may be a result of a restriction of natural behaviours by the environmental conditions of captivity.

Swimming behaviour

The large difference in average swimming time between wild and captive populations may be due to several factors including that the birds within the wild population generally seem to spend more time in the water than on land so corresponding behaviours are likely to be higher. Additionally, the ponds within the captive environment are smaller compared to the space that would be occupied by the wild flock.

There have not been many studies recording the presence of swimming behaviour in captivity. However, it was found that wild capybaras (*Hydrochoerus hydrochaeris*) used a water tank more than the captive born animals and this was related to escape behaviour (Nogueira *et al.* 2004). It may be that the wild population have to spend more time in the water as there is usually a high presence of people around their habitat. Although the captive population do not spend a lot of time swimming it was noted that they will often take refuge in the ponds when people enter the enclosure, so is consistent with the Nogueira *et al.* (2004) study.

It has been demonstrated that the exhibition of swimming behaviour can influence others. When one individual of a pair of Trumpeter swans swam, the other followed (de Vos 1964). Additionally both sexes had similar total swimming activity budgets over the study period. Males swam a total of 249 minutes and females 278 minutes (de Vos 1964). The experiment did not consider synchronisation of behaviour due to the sampling method used. But preening may also be a synchronised behaviour as discussed previously.

5. Conclusion

The results indicate clear differences in captive and wild behaviour of mute swans. The main considerations are the reduction in active behaviours such as swimming and foraging behaviour. These two behaviours could be encouraged by larger ponds so that all the swans have the opportunity to use it instead of a few dominant individuals occupying it. Simple enrichment could be used such as scatter feeding of grain to encourage foraging and feeding bowls floating on top of the water to encourage birds to use the pond. The use of more complex enrichment would require further research as there is none available that would be suitable for swans.

Expanding from this study a lot more research is required to focus on the behaviour of the captive populations of mute swans. This may include scan sampling the flock instead to see if social facilitation does occur, what happens after release to the swans and the impact of enrichment devices on their behaviour. This is vital because although these species are impacted by captivity their welfare has not been considered compared to the research that has been carried out in other species. This will improve the captive environment, promote health status and aid with rehabilitation.

Acknowledgments

I would like to acknowledge Sarah Collins for her guidance in preparing and writing up my experiment. Also Wendy Hermon at Swan Lifeline for letting me perform observations at the sanctuary and for her assistance during the project.

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Appendices

The appendices to this report can be viewed in the folder “Supplementary Files” located in the Reading Tools menu.