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*Hägnutnyttjande hos dholer (*Cuon alpinus*) i fångenskap och dess betydelse för djurvälfärden*

Trine Ravn Palmér

Skara 2014

Etologi och djurskyddsprogrammet

Photo: Palmér (2014)

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ABSTRACT

There are many obstacles to achieving optimal animal welfare in the zoo environment. Since animals in zoos are often of endangered status it is of great importance that the individuals in captivity experience good animal welfare. The numbers of dholes in the wild are declining with rapid speed and the wild dhole population has been estimated to consist of less than 2500 mature individuals. An inadequate environment can be a source of discomfort as well as stress, which can impact the animals' physiology, behaviour and welfare. A well designed enclosure, which provides sufficient space and enrichment, can be beneficial to all animal species. Understanding animals' utilization of space allows the design of captive environments to match the biological requirements of the animals, as well as maximize their welfare. To understand the space utilization of dholes, seven group held dholes kept at Parken Zoo, Eskilstuna were observed between March 4th and April 8th. Their space utilization was recorded and results showed that there was a difference in the animals' utilization of the different zones. The zones in which there was water areas were utilized the least during all observations in total. There were little to no differences in space utilization depending on if it was a feeding or non-feeding day. There were also little to no differences depending on time of day. Since the animals utilize all areas of the enclosure this particular captive environment should be seen as well adapted to the animals' requirements and needs.

INTRODUCTION

There are many significant obstacles to achieving optimal animal welfare in the zoo environment (Swaisgood, 2007). When animals are under human care there is always a possibility for issues regarding welfare, whether it is farm animals, pets, or animals kept in a laboratory environment. Keeping wild animals, such as in zoos, can perhaps pose an even greater risk of poor welfare. This is mainly because farm animals, as well as lab animals, are more genetically adapted to being held in captivity than wild animals are (Swaisgood, 2007). Furthermore, since animals at zoos are often of endangered status it could be debated that it is of even greater importance that these individuals experience a good animal welfare.

The dhole (*Cuon alpinus*)

The dhole (*Cuon alpinus*), which is also called the Asiatic wild dog, red dog, red wolf or whistling dog (Iyengar *et al*., 2005), have been kept in captivity in Europe since the 19th century (Maisch, 2010) and the species are to date at high risk of extinction (Iyengar *et al*., 2005).

Dholes are social canids living in packs (Maisch, 2010), and according to Iyengar *et al*. (2005) the dhole has an inflexible structure of fixed dominance hierarchies. Dholes display a high level of cooperative behaviour and have been seen living in packs of 3-20 individuals (Iyengar *et al*., 2005). Kawanishi and Sunquist (2008) similarly suggest that the dhole is a cooperative hunter which can form packs of over 30 individuals, but the most common pack size seems to consist of 5-10 animals.

The dhole is mainly a diurnal hunter which depends predominantly on prey of medium size, but has also been seen predating large ungulate prey (Andheria *et al*., 2007). According to Kawanishi and Sunquist (2008) the dhole has a diet preference of medium to large ungulates. Their diet can also include small prey such as badgers and the dhole also feeds on lizards, insects and birds as well as vegetable material, including leaves, grass and fruits (Selvan *et al*., 2013).

The numbers of dholes in the wild are declining with rapid speed (Maisch, 2010). The species was once widely distributed in central as well as southeastern Asia, but has disappeared from several countries over the last few years (Maisch, 2010) as the dhole has been eradicated from most of their former range (Thinley *et al*., 2011). They now remain in fragmented populations in southern and southeastern Asia (Thinley *et al*., 2011) and are distributed in only ten countries in the Asian continent (Selvan *et al*., 2013).

The wild dhole population has been estimated to consist of less than 2500 mature individuals (Thinley *et al*., 2011; Selvan *et al*., 2013), which is thought to be a consequence of human persecution, competition from larger carnivores and diseases (Bashir *et al*., 2013; Selvan *et al*., 2013). Depletion of their natural prey base is another factor influencing the dholes' future survival (Bashir *et al*., 2013; Selvan *et al*., 2013) as well as habitat fragmentation (Iyengar *et al*., 2005). Because of this, the species is listed as endangered in the IUCN Red List of Threatened Species (Durbin *et al.*, 2008).

Dholes in captivity

According to Maisch (2010) the dhole is active during daytime and moves around, plays and show an active interest in their surroundings as well as visitors. With a big enough enclosure dholes normally move around as a group rather than individually (Maisch, 2010). The enclosure has to be of a big enough size to permit the dholes to retreat completely and allow them to keep enough distance between themselves and the visitors (Maisch, 2010). The same author suggests that enclosures of 500-1000 m^2 are the minimum size for a small pack containing at least four adult members.

Providing the animals with enough space normally leads to the dholes remaining near the visitors, as opposed to them hiding out-of-sight if the enclosure is too small (Maisch, 2010). Maisch (2010) suggests that it is also important that the places that do allow the animals to hide also allow normal pack behaviour to occur, whereas a wooden box that only one dhole can lay in is not of adequate size.

According to the same author dholes can swim and are actually very well adapted to hunting both near and in water. After eating, dholes sometimes lay down in the water, which can also be used to cool the animals during hot days (Maisch, 2010). Dholes play in the water at all times of the year, even during winter (Maisch, 2010). The same author suggests that the water area should be constructed in a way that provides the animals with an area where they can lie down and still keep their head above water, as well as areas with deeper water to enable swimming.

Welfare in captivity

A consequence of keeping wild animals in captivity is the reduction of both space and complexity compared to the animals' natural habitat (Mallapur *et al*., 2002). Therefore, keeping animals in a captive environment has natural behavioural limitations on the kept individuals (Ross *et al*., 2009). As a result, a lack of good welfare can be a consequence of deviations from the animals' natural environment (Swaisgood, 2007).

An enclosure should be designed to provide animals with stimulating environments and offer them an opportunity to behave in a species-specific manor (Kistler *et al*., 2009). A more complex environment contains added opportunities for expressing different behaviours and is more likely to mimic the animals' natural environment (Swaisgood, 2007). On the other hand, barren environments restrict animals from performing species-specific behaviours both biologically and spatially (Mallapur *et al*., 2002). Therefore, a barren environment does not allow the animals to express as broad behaviour repertoire as a complex one does (Swaisgood, 2007).

Zoos aim to provide wild animals in captivity with a naturalistic environment (Wickins-Drazilova, 2006). However, this cannot be entirely done and there are many conditions that a zoo environment can not simulate, such as climate, migration, and hunting (Wickins-Drazilova, 2006). Even relatively naturalistic captive environments do not offer the same challenges and opportunities as does the wild (Mason *et al*., 2007). For example, wild animals use a wider area in their natural environment than they are provided with in zoo enclosures (Clubb & Mason, 2007). Another big difference between wild animals and conspecifics kept in captivity is the need for regular decision making and navigation, which is lacking in captivity (Clubb & Mason, 2007). Furthermore, Maple (2007) suggests that the quality of space may actually be more important than the quantity.

Beyond enclosure design, both rearing and husbandry are known to affect the behaviour and welfare of animals in captivity (Clubb & Mason, 2007). Carnivores are prone to react to potential negative effects of captivity, where feeding schedules can have a large impact on some species' behaviour and welfare (Gilbert-Norton *et al*., 2009). It is fairly well known that animals can be affected by the routine of predictable feeding in the way that it increases abnormal activity around the time of feeding (Gilbert-Norton *et al*., 2009).

Space utilization

An inadequate environment can be a source of discomfort as well as stress, which can have an impact on the animals' physiology, behaviour and welfare (Ross *et al*., 2009). On the other hand, a well designed enclosure which provides sufficient space and enrichment can be beneficial to a number of animal species (Ross *et al*., 2009), if not all of them. The same author suggest that understanding animals' utilization of space allows the design of captive environments to match their biological requirements as well as maximize their welfare, why measuring animals' space utilization is a method used to determine both positive and negative aspects of the environment in which they are kept. Therefore, examining the way animals utilize different resources in their enclosure is a valuable method to measure how appropriate the environment is and to enhance animal welfare (Ross *et al*., 2009).

Measuring space utilization may not function as a welfare assessment alone, but along with other measures such as preference test, behavioural measures and hormonal indicators it can be used to determine the effect a captive environment has on animal welfare (Ross *et al*., 2009). In other words, knowing how animals utilize the enclosure in which they are kept can be a useful method for both assessing and maximizing animal welfare.

Aims and objectives
The dholes are relatively new to the enclosure at Parken Zoo, Eskilstuna, why it is of interest to examine their space utilization as a method to assess the animals' welfare. The purpose of this study is therefore to examine how the dholes utilize their enclosure, whether or not they do so to its full extent and if the results indicate any welfare implications. This study can serve as a foundation for further behaviour studies on the dholes. To achieve the purpose the following questions will be investigated:

- How do the dholes utilize their enclosure?
- Are there any zones that are utilized more or less than the others?
- Are there any differences in space utilization depending on time of day?
- Are there any differences in utilization of space depending on if it is a feeding or day non-feeding?

MATERIAL AND METHOD

Subjects and observation area

The study was conducted between March 4th and April 8th in 2014 at Parken Zoo, located in Eskilstuna, Sweden. Seven group held male dholes were studied in their on- and off-exhibit enclosures. The on-exhibit enclosure was 3277 m^2, whereas the off-exhibit consisted of a back enclosure measuring 196 m^2 as well as a barrack of 38.7 m^2. The barrack could be temporarily divided into four smaller areas if needed. The animals had access to all areas at all times during the study. As far as social organization goes, the dholes were siblings from two different litters, with four of them born in April 2012 and the other three born in April 2013. The animals arrived at Parken Zoo from Kolmården Wildlife Park, Kolmården, Sweden on February 6th 2014. During the time of the study, the dholes were fed three times a week, normally on Mondays, Wednesdays and Fridays. The feeding occurred on an irregular time basis and on different locations in the enclosure to minimize feeding predictability.

Experimental design and sampling method

Details of the enclosure were gathered, both by measurements and from observations made at the enclosure. An already existing map of the enclosure was provided by the zoo management and a copy of the map was created with the gathered details marked on it, including trees, rocks, hills, huts and water holes found within the enclosure (Fig. 1).

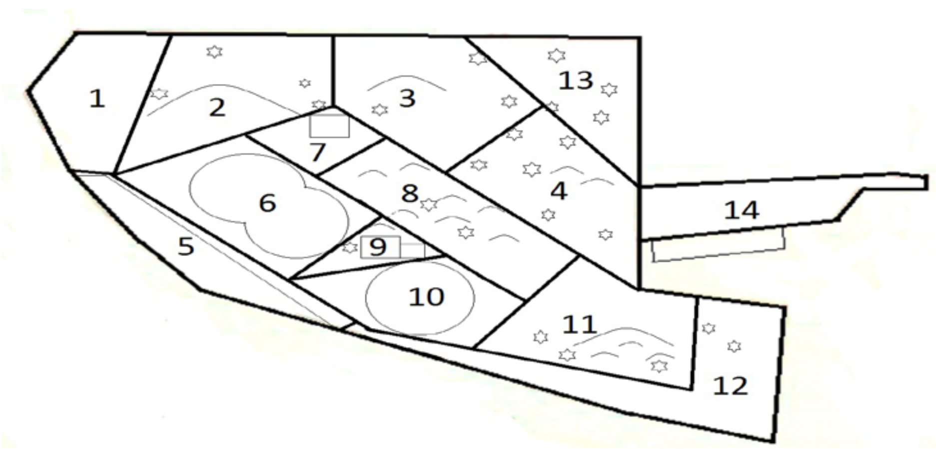

Figure 1. Map of the enclosure with marked zones and features such as trees (✡), hills (⌒) and huts (▭). The on-exhibit enclosure consists of zone 1-13, while zone 14 is an off-exhibit enclosure. Visitor viewing areas are situated beside zone 1, 5 and 12.

To study the dholes' utilization of space the enclosure was divided into 14 smaller zones (Tab. 1). The divisions were made so that certain resources, e.g. huts and water holes, were the focal point of a zone. The map was brought to the enclosure on each observation. To get an overview of how the animals utilized the enclosure scan sampling was used. With scan sampling the whole group of individuals were scanned at regular intervals. The enclosure was scanned from left to right every 3 minutes by the observer who was situated besides zone 5. The positions of the animals at that instant were recorded in a protocol. Since individual preferences were not of interest during this particular study the specific zone utilization of all seven animals were recorded at each scan.

Table 1. List of the 14 zones in the dhole enclosure with descriptions of their features.

ZONE	DESCRIPTION
1	Flat area in the front part of the enclosure, in close proximity to visitors with no objects.
2	Area containing a relatively big hill and some trees.
3	Secluded area away from visitors, containing a medium size hill and some scattered trees.
4	Semi-secluded forestry area containing a high number of scattered trees and some rocks.
5	Area in the front of the enclosure, in close proximity to the visitors, containing a long ditch.
6	Zone containing a big water area.
7	Area containing a wooden hut.
8	Rugged area with a number of scattered rocks and some trees.
9	Area containing two adjoining wooden huts as well as a tree.
10	Zone in close proximity to visitors containing a smaller water area.
11	Area in the front of the enclosure with rugged terrain. Including a hill, some scattered rocks as well as some trees and bushes.
12	Flat area in proximity to visitors containing a few trees.
13	Secluded area relatively far away from visitors containing several trees as well as rocks.
14	Back enclosure with adjoining barracks.

Prior to the actual observations a pilot study was conducted during two days and with a total of four observation sessions. As some changes were made after this to facilitate recording, the data from the pilot study was disregarded. The actual observations were then carried through. Each observation session consisted of a total of 90 minutes and 210 recordings, with scans every 3 minutes. Observation sessions were conducted two times daily, once in the morning (before 12 p.m.) and once in the afternoon (after 12 p.m.). The days on which the observations occurred were spread over time, ranging from the beginning of March to mid-April, all of which befell during off season while the zoo was closed to the public. A total of 24 observation sessions were conducted with an equal amount of sessions during feeding and non-feeding days, giving 12 observation sessions respectively. Altogether 36 hours of observations were made, with a total of 5040 recordings distributed on seven animals.

Data processing

All recordings were compiled in Microsoft Excel and the data were used to retrieve descriptive statistics.

RESULTS

Overall space utilization

Overall during all of the 24 observation sessions the dholes spent the most time in zone 12 (Fig. 2) with 17.8 %. This was followed by zone 3 (16.3 %) and zone 11 (12.2 %). The least amount of time was spent in zone 6 (0.3 %), followed by zone 10 (0.8 %) and zone 5 (1.6 %).

Zone 12 had the highest mean value with 37.29 recordings per observation session (Fig. 3). This was followed by zone 3 (34.29) and zone 11 (25.63). The zone with the lowest mean of recordings per observation session was zone 6 with a mean value of 0.542, which was followed by zone 10 (1.58) and zone 5 (3.42).

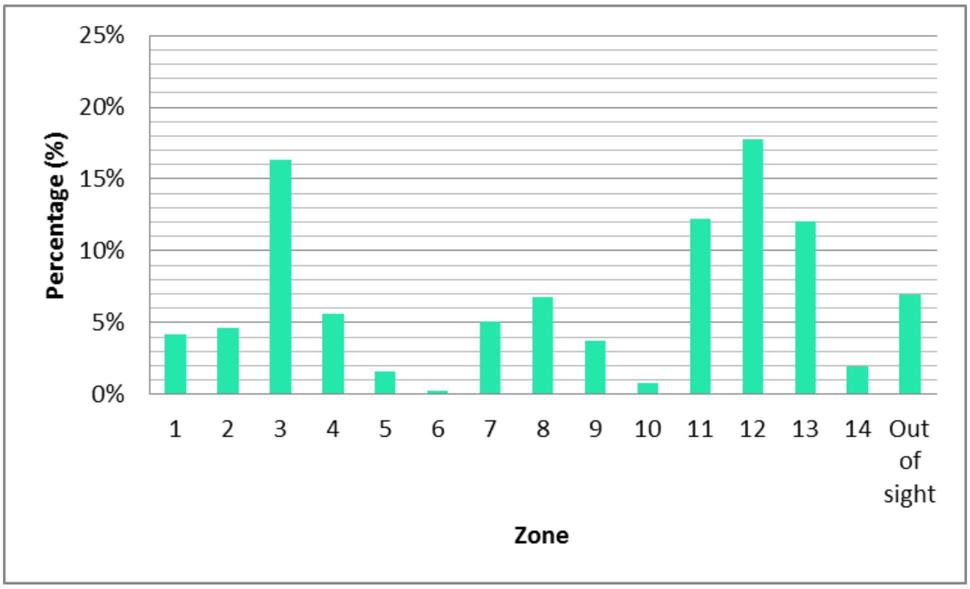

Figure 2. Utilization of space by the dholes described as a proportion of time spent in each zone during all observation sessions in total.

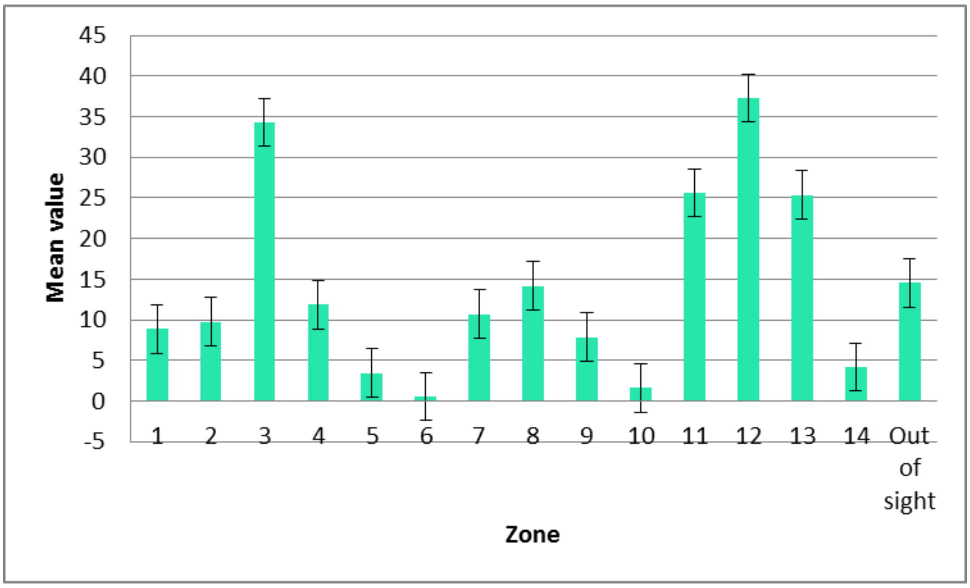

Figure 3. Mean value (±SE) of recordings per observation session of dholes for each zone respectively during all observation sessions in total.

Morning space utilization
Overall during the 12 morning observation sessions the dholes spent most time in zone 12 (Fig. 4) with 18.6 %. This was followed by zone 13 (16.5 %) and zone 3 (15.0 %). The zone least time spent in was zone 6 (0.3 %), which was followed by zone 10 (0.8 %) and zone 14 (1.2 %).

Zone 12 had the highest mean value with 39.08 recordings per observation session (Fig. 6). This was followed by zone 13 (34.58) and zone 3 (31.5).The zone with the lowest mean value of recordings per observation session was zone 6 with a mean value of 0.583, which was followed by zone 10 (1.75) and zone 14 (2.5).

Afternoon space utilization
Overall during the 12 afternoon observation sessions the dholes spent most time in zone 3 (Fig. 5) with 17.7 %. This was followed by zone 12 (16.9 %) and zone 11 (11.8 %). The least amount of time was spent in zone 6 (0.2 %), which was followed by zone 10 (0.7 %) and zone 5 (1.5 %).

Zone 3 had the highest mean value with 37.08 recordings per observation session (Fig. 6). This was followed by zone 12 (35.5) and zone 11 (24.75). The zone with the lowest mean of recordings per observation session was zone 6 with a mean value of 0.50, which was followed by zone 10 (1.42) and zone 5 (3.08).

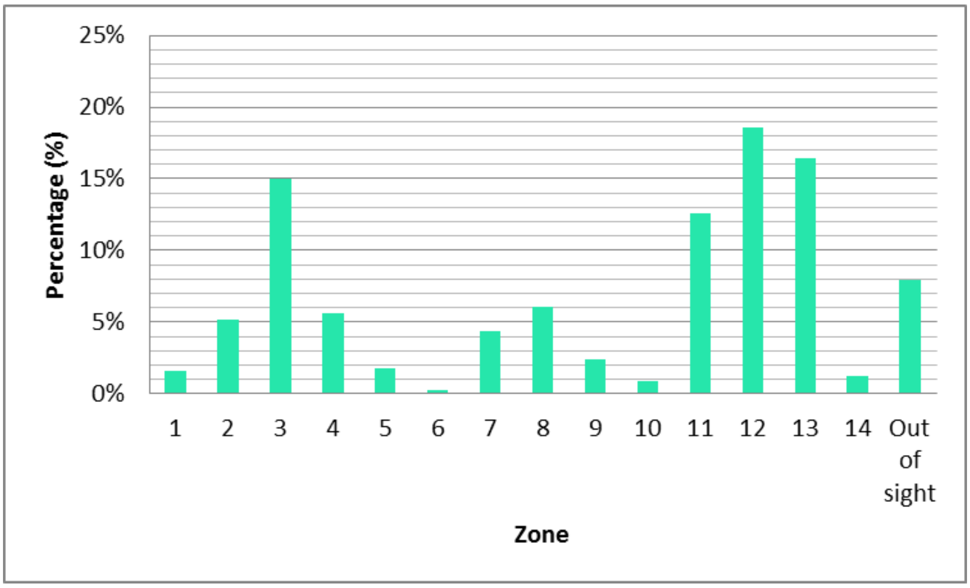

Figure 4. Utilization of space by the dholes described as a proportion of time spent in each zone during all morning observation sessions.

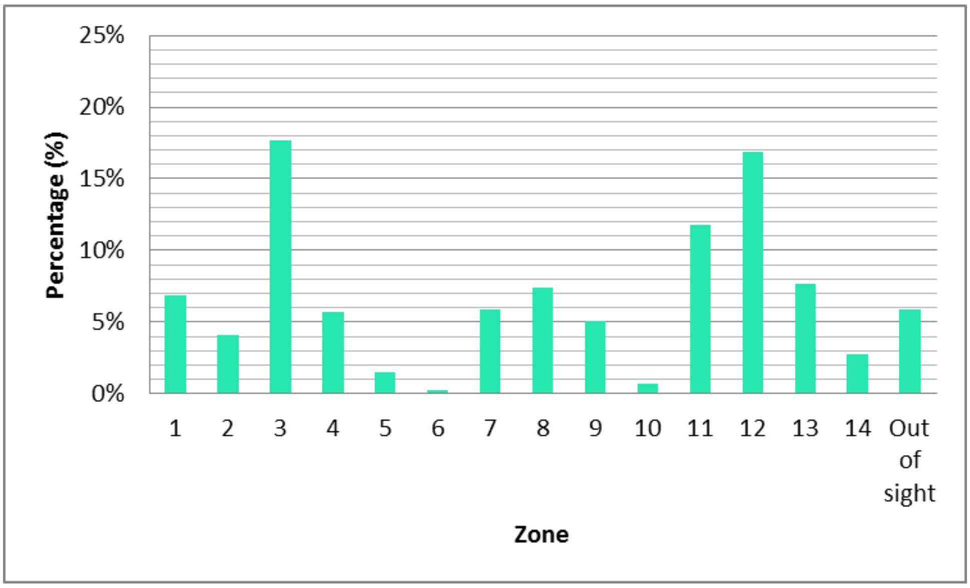

Figure 5. Utilization of space by the dholes described as a proportion of time spent in each zone during all afternoon observation sessions.

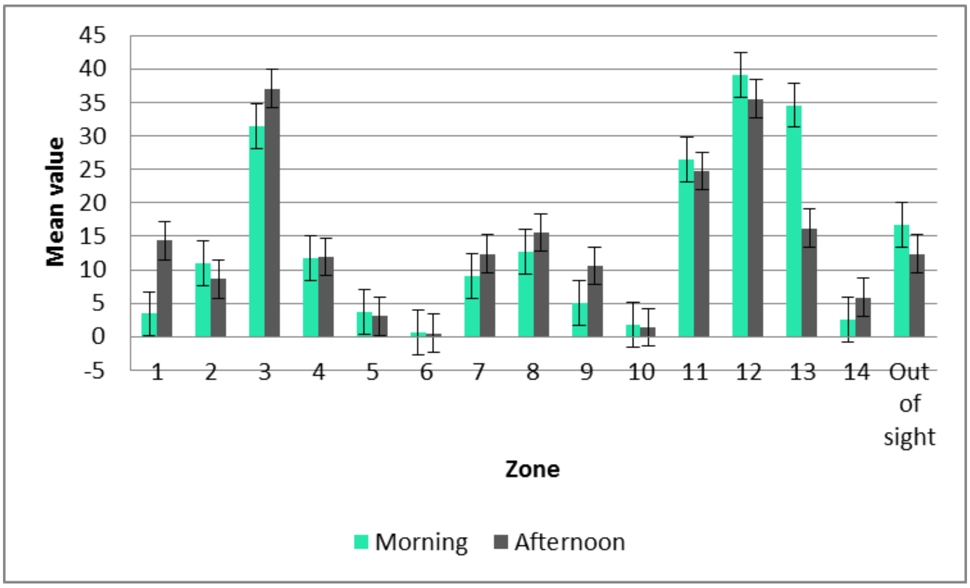

Figure 6. Mean value (±SE) of recordings per observation session of dholes for each zone respectively during morning and afternoon observation sessions.

Feeding day space utilization

Overall during the 12 feeding day observation sessions the dholes spent the most time in zone 3 (Fig. 7) with 17.2 %. This was followed by zone 12 (15.4 %) and zone 13 (13.2 %). The least amount of time was spent in zone 6 (0.2 %), followed by zone 10 (0.8 %) and zone 5 (2.1 %).

Zone 3 had the highest mean value with 36.17 recordings per observation session (Fig. 9). This was followed by zone 12 (32.25) and zone 13 (27.67). The zone with the lowest mean value of recordings per observation session was zone 6 with a mean value of 0.50, which was followed by zone 10 (1.67) and zone 5 (4.5).

Non-feeding day space utilization

Overall during the 12 non-feeding day observation sessions the dholes spent most time in zone 12 (Fig. 8) with 20.2 %. This was followed by zone 3 (15.4 %) and zone 11 (14.6 %). The least amount of time was spent in zone 6 (0.3 %), followed by zone 14 (0.5 %) and zone 10 (0.7 %).

Zone 12 had the highest mean value with 42.33 recordings per observation session (Fig. 9). This was followed by zone 3 (32.42) and zone 11 (30.67). The zone with the lowest mean of recordings per observation session was zone 6 with a mean value of 0.583, which was followed by zone 14 (1.08) and zone 10 (1.5).

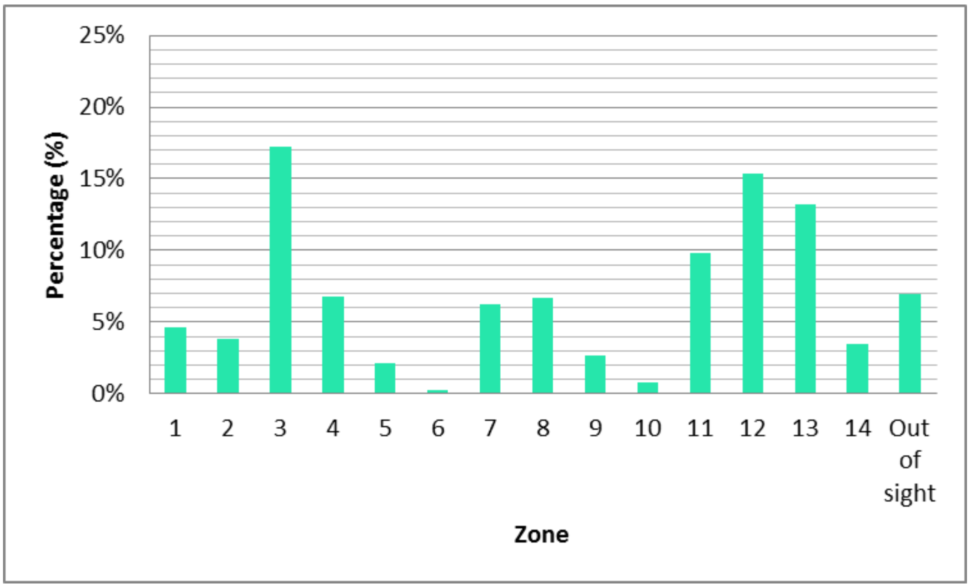

Figure 7. Utilization of space by the dholes described as a proportion of time spent in each zone during all feeding day observation sessions.

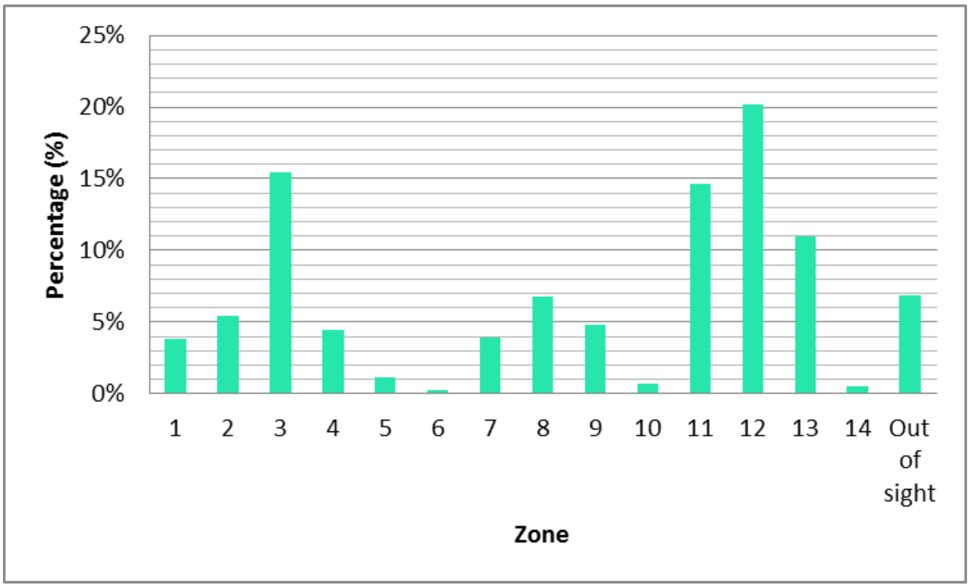

Figure 8. Utilization of space by the dholes described as a proportion of time spent in each zone during all non-feeding day observation sessions.

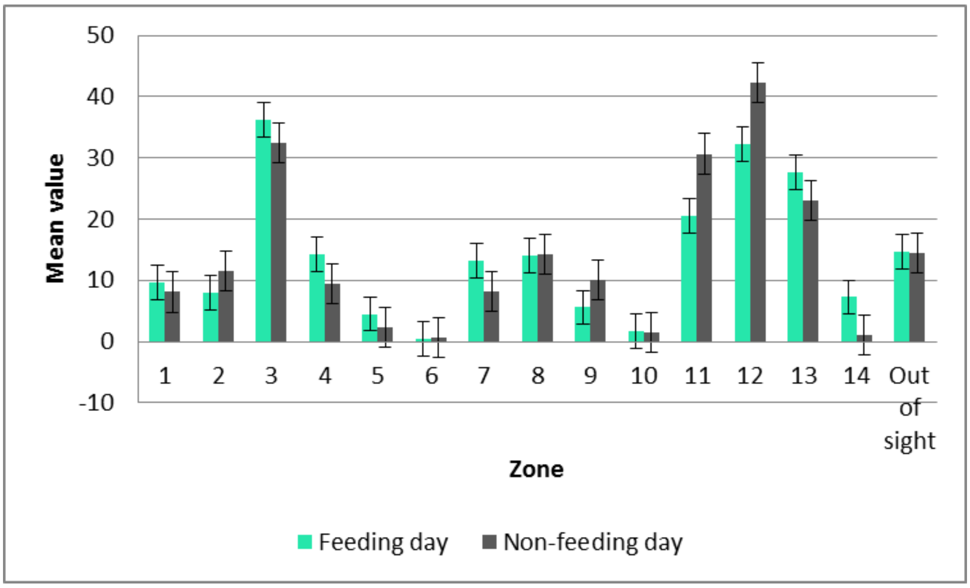

Figure 9. Mean value (±SE) of recordings per observation session of dholes for each zone respectively during feeding and non-feeding day observation sessions.

DISCUSSION

Overall space utilization

The aim of this study was to examine whether or not the dholes at Parken Zoo utilize their enclosure to its full extent and if there were any zones which were utilized less or more than the others. Based on the observations, the results show that all zones were used at some point but that there is a difference in utilization of the respective zones.

Overall, the dholes spent most time in zone 12 which is a flat area in proximity to visitors and animal keepers. Even though the zoo at the time of observations was closed for the public, there were some guided tour groups as well as animal keepers and other employees who passed the enclosure at several occasions. This could have affected the dholes' space utilization. Maisch (2010) suggests that if the animals have sufficient space this will lead to the dholes remaining near visitors as opposed to them hiding out-of-sight. The results imply that this is something which can be agreed upon since the dholes' often encountered people passing the enclosure. It could therefore be debated that the enclosure is of a sufficient size, leading to enhanced animal welfare for the dholes. However, whether or not the size of the enclosure is a factor influencing the dholes' space utilization has not been examined in this particular study. Nevertheless, Ross *et al*. (2009) suggest that different environments have a substantial effect on space utilization of captive animals.

According to Ross *et al*. (2009) the utilization of space is not only influenced by environmental preferences but also by biological factors as well as social factors. Because of the dholes' social lifestyle (Iyengar *et al*., 2005; Wang & MacDonald, 2009; Maisch, 2010; Selvan *et al*., 2013) there is a possibility that the animals are also susceptive to the presence of other species, such as humans. It is also evident that the dholes reacted primarily to the presence of the animal keepers, something which is not shown in the results but was seen during the observations. As previously mentioned, feeding schedules can have a large impact on the behaviour of carnivores and the animals can be affected by the routine of predictable feeding (Gilbert-Norton *et al*., 2009). At Parken Zoo the dholes were fed on an irregular time basis, but there is still a possibility that the animals associated the animal keepers with food and therefore spent time in zone 12 whenever there were keepers present, which was the case in many of the observations of dholes in zone 12. Clubb and Mason (2007) also suggest that husbandry is known to affect the behaviour and welfare of animals in captivity, which is strengthening this explanation.

The least amount of time was spent in zone 6, which is a zone with a large area of water. The next to the least time was spent in zone 10, also a zone containing a water area. These results could be seen as somewhat surprising, as according to Maisch (2010) dholes in captivity utilize water areas both during summer and winter if the area is well constructed. This article however, is only a review and several suggestions in it are referring to either unpublished or outdated studies which reduces the reliability of the source. As the results from this study show that the dholes do not utilize the water areas to great extent during the time of observations, which does not correspond with Maisch's (2010) suggestion, there seems to be a need for further studies regarding dholes' utilization of water areas. Furthermore, according to Ross *et al*. (2009) habitat selectivity, and therefore space utilization, may differ between individuals and social groups. Also, the activity budget of animals in captivity is influenced by the design of the enclosure (Mallapur *et al*., 2002). This could be an explanation as to why the dholes did not utilize the water areas as much as would be expected.

Another explanation for the lack of usage of zone 6 could be the fact that the water hole contained only little water. This, however, does not explain the lack of utilization of zone 10. A more probable explanation could therefore be that the water areas are not of optimal design and construction. There is also a possibility that the utilization of these zones would increase as the temperature rises. It is also of importance to be aware of the fact that the animals at the time of observations were relatively new to their enclosure, why the space utilization could change with time.

Comparison of morning and afternoon utilization

Regarding whether or not there are any differences in space utilization depending on time of day, a difference should be expected. According to Selvan *et al*. (2013) dholes are diurnal hunters and usually hunt early in the morning, which should affect the animals' space utilization depending on what time it is. The results, however, show that there is little to no differences. During morning observation sessions the dholes spent the majority of their time in zone 12, while they during afternoon observation sessions spent the most time in zone 3 followed by zone 12, giving only small differences in the utilization of these zones. Additionally, during both morning and afternoon observation sessions the dholes spent the least time in zone 6. However, there were noteworthy differences in the utilization of both zone 1 and zone 13.

Zone 1 is a flat area in the front part of the enclosure with close proximity to potential visitors. The zone is lacking any objects. During morning observation sessions, zone 1 was utilized considerably less than during afternoon observation sessions. An explanation for the big difference of usage of this particular zone can be, as previously discussed, the presence of animal keepers and other disturbances. According to Ross *et al*. (2009) space utilization is not only influenced by internal states of the animals, but also by external factors. There is a possibility that there were more disturbing factors outside the enclosure during the morning observation sessions than during the afternoon observation sessions. This could have influenced the dholes' space utilization. Another contradictory, however possible, explanation is that there were more disturbing factors outside the enclosure during the afternoon observation sessions, which attracted the animals to zones in closer proximity to these disturbances. This would have led to the same results as the previous explanation.

Zone 13, on the other hand, is a secluded area with several trees and rocks, relatively far away from potential visitors. The mean value of recordings during morning observation sessions for this zone was over twice as high as during afternoon sessions. The most probable explanation for the big difference in utilization of zone 13 is that there are three extreme observation sessions during the morning sessions which highly increases the mean value of 34.58. These three observation sessions have a value of 60, 77 and 119 recordings respectively in zone 13, which greatly exceeds the values of the other nine morning sessions. Whether or not these three observation sessions are normal can not be determined, as the study is of relatively small size, why the explanation for these divergent remains unclear. Further studies are needed to determine whether or not these extreme observation sessions are a coincidence or if they have significance.

Another possible explanation for the difference in utilization of zone 13 could be, as with zone 1, external factors. As zone 1 was utilized less in the morning than during the afternoon, while zone 13 was utilized more in the morning, there is a possibility that there is a correlation between the two zones. The two zones represent two very different environments within the enclosure, why a correlation is not entirely impossible. To establish correlation statistical analysis is needed and further studies might have to be conducted.

Comparison of feeding and non-feeding day utilization

One question aimed to be answered with this study is if there are any differences in the animals' space utilization depending on if it is a feeding or non-feeding day. The results show that there are little to no differences. During feeding days the dholes spent most time in zone 3 followed by zone 12, while they on non-feeding days spent the most time in zone 12 followed by zone 3. There is only a small difference however, which can be seen as a coincidence rather than an actual significant difference. Comparing the mean value results of feeding and non-feeding day while including standard error shows that there are only two actual differences, within zone 11 and zone 12, of which the cause of difference remains unknown. A possible explanation could however be that the two zones are adjoining and that there is a coincidence as to which zone was utilized. To further investigate significance statistical analysis is needed.

A possible explanation for the lack of differences between feeding and non-feeding days can be the impact of unpredictable feeding. In the wild, carnivores' access to food is unpredictable both in space and time which means they have to use certain skills to locate and exploit food resources (Kistler *et al*., 2009). The feeding of carnivores in captivity is on the other hand often predictable (Kistler *et al*., 2009). According to Gilbert-Norton *et al*. (2009) feeding the animals unpredictably at altered times and occasions can stimulate animals that normally spend time hunting, as well as increase levels of species-specific behaviour. Since Parken Zoo practices unpredictable feeding this can probably help reduce differences between feeding and non-feeding days as well as enhance animal welfare.

Implications for animal welfare

When keeping animals in captivity the size of the enclosure is of little relevance if not all of it is utilized. This is supported by Maple's (2007) suggestion that the quality rather than the quantity of space is of importance. The source is a peer reviewed article compiled of several different studies, which gives the statement a quite high reliability. However, many of the references are outdated, why the topicality of this suggestion could be questioned. Nonetheless, by understanding the dholes' utilization of space this allows the design of the enclosure to match the animals' biological requirements as well as maximize their welfare (Ross *et al*., 2009). By dividing the enclosure into different zones the results gave an inclination as to whether or not there were any zones which were not utilized by the dholes. As previously mentioned, Ross *et al*. (2009) suggests that this can work as a method to measure the appropriateness of the environment and therefore as a method to enhance welfare.

As it were, all of the zones were used at some point but some of them with less frequency than others. As according to Ross *et al*. (2009), by identifying preferred features this data may be useful in the future when designing new enclosures for both these animals and other dholes in captivity. Furthermore, by identifying resources that are not utilized at all, or very little, these resources do not have to be in abundance in future enclosure designs (Ross *et al*., 2009). As described by Maisch (2010), water areas could be seen as a valuable resource for dholes, but as mentioned this suggestion could be challenged as the results show that the two zones containing water areas were not utilized to a greater extent during this study. However, the explanation for the lack of utilization during this particular study could be that these areas are not of optimal design rather than the explanation that water areas in general are superfluous. There is a possibility that water areas of other design and location would be utilized more and correspondingly enhance animal welfare. Furthermore, a resource does perhaps not have to be utilized to a great extent to possess great value for the animals, why there is a need for preference studies. Therefore, further studies have to be conducted to establish whether or not the two water areas are utilized by the dholes and if they can be seen as a welfare improving feature.

Clubb and Mason (2007) suggest that it is not the actual lack of space that poses the greatest problem for zoo animal welfare, but rather the lack of stimuli and challenges that the animals are encountered with when ranging in the wild. By providing more viewpoints, more resting places and den sites, more variable and complex boundaries of enclosures, more spatial complexity and less predictability, the captive environment can be improved (Clubb & Mason, 2007). During Clubb and Mason's (2007) literature study a wide variety of stereotypy data were collected systematically along with data on wild behavioural biology of a variety of species. Because of the large size of the sample the source has a high reliability and their suggestions should be taken in to real consideration. Furthermore, because of the low number of only 2500 mature individuals in the wild (Thinley *et al*., 2011; Selvan *et al*., 2013) there is of great importance that dholes in captivity experience a good welfare, why the suggestions should be applied when designing new enclosures.

Method evaluation and sources of error
During the observational study, scan sampling was used. A large practical advantage with this method is that it reduces the workload for the observer compared to continuous recording (Martin & Bateson, 2007). Because of the reduced workload and demand on the observer's focus, scan sampling could also give more reliable results than continuous recording (Martin & Bateson, 2007).

While using scan sampling there is always a possibility that some behaviours are not recorded since scans are made with a set time interval (Martin & Bateson, 2007). However, the sample interval is rather short relative to the average duration of the dholes' utilization of the different zones, which was examined during the pilot study. Therefore, this method produced a record which approximates the one that would have been if continuous recording had been used. Furthermore, a shorter sample interval would have provided the observer with greater demands regarding focus which would have eliminated the practical benefits of using scan sampling instead of continuous recording (Martin & Bateson, 2007).

There is a possibility that random errors occurred during the observations (Martin & Bateson, 2007). Since the enclosure was divided in to only fictional zones, there is always a risk that the observer unintentionally slightly moved the borders of the zones as the observations ran. This could be seen as affecting the reliability of the results. However, the within-observer reliability was assessed throughout the course of the study to minimize this error. To avoid observer fatigue, which could have influenced the observer's ability to record accurately (Martin & Bateson, 2007); each observation session consisted of 90 minutes. This time length was chosen and altered after the conduction and evaluation of a pilot study.

There are many factors which could have affected the outcome of the results. The presence of animal keepers is probably one of the most influencing factors during this study, since their presence seems to affect the animals' behaviour. However, as the study is aiming to examine the dholes everyday space utilization, and the animal keepers are a part of the daily husbandry, this should not be regarded as a source of error. It could perhaps rather be seen as strengthening this study as it helps provide more truthful results on how the dholes' overall utilization is.

The fact that the study was not conducted during on-season of the zoo probably has a big influence on the results. If there were more visitors, the space utilization of the dholes would probably have been somewhat different. However, this study is to be served as a foundation for further studies which is why it was conducted while the zoo was closed to public, as this eliminates the factor of influence by visitors. A suggestion for further studies is to examine how the presence of visitors affects the dholes' space utilization.

CONCLUSION
The dholes at Parken Zoo utilize all the zones in the enclosure, why the captive environment should be seen as well adapted to the animals' requirements and needs. The animals utilize zone 12 the most, which could be an indication that the dholes react to visitors and animal keepers passing the enclosure. The animals do not seem to utilize the water areas with high frequency at the time of the observations, but this does not necessarily mean that these areas are superfluous. Further studies have to be conducted during other times of the year to establish their value regarding animal welfare. There were no major differences in space utilization depending on either time of day or if it is a feeding

or non-feeding day which could be an indication that unpredictable feeding is minimizing differences between the different occasions.

One of the objectives with this study was to serve as a foundation for further studies on the dholes at Parken Zoo as well as other dholes in captivity. As of today, studies regarding both behaviour of dholes and effects of enrichment dholes are lacking, why this study is a valuable contribution for present and future global ethological research. The comparisons made in this study can provide information regarding the relationship between animal welfare and enclosure design for both the management at the zoo in which it was conducted and for other scientists.

This study can also be used as a foundation for studies examining how enrichment affects the space utilization of the animals as well as for other studies regarding animal behaviour and welfare. Questions for future research could then regard whether or not enrichment can affect the dholes' space utilization and if water areas should be seen as a valuable resource for dholes. As a consequence of answering these questions, adjustments and improvements in enclosure design and management could be made, leading to enhanced welfare for dholes in captivity worldwide.

POPULÄRVETENSKAPLIG SAMMANFATTNING

Det finns många faktorer som kan påverka ett bra välmående hos djur som hålls i zoomiljö, något som är ännu viktigare för de djur som är av hotad art. Dholen, eller den asiatiska vildhunden, är just en sådan hotad art som finns på zoo i olika delar av världen. Den asiatiska vildhunden är ett socialt hunddjur som lever och jagar i flockar på upp till 30 individer. De föredrar byten av mellanstora hovdjur, men kan också äta mindre byten som till exempel grävling, ödlor, insekter och fåglar. Dessutom kan de äta växtmaterial så som gräs, löv och frukt.

Tidigare fanns den asiatiska vildhunden över stora delar av Asien, men på grund av mänsklig förföljelse, konkurrens från andra större rovdjur, sjukdomar och minskning av deras naturliga bytesdjur samt uppdelning av deras hemområden har arten minskat kraftigt i antal och utbredning.

När den asiatiska vildhunden lever i fångenskap har den setts vara aktiv dagtid och visar ett stort intresse både för omgivningen och för besökare. Den asiatiska vildhunden kan också simma och är väl utvecklad för att jaga både i och i närheten av vatten. Djuren använder också vatten för att svalka sig och leka i.

Ett problem med att hålla djur i fångenskap är minskningen av både yta och komplexitet i omgivningen jämfört med hur de lever i det vilda. Detta kan leda till att djurens välmående påverkas. En inhägnad bör vara konstruerad så att djuren får en stimulerande miljö, något som tillåter dem att bete sig på ett sätt som är normalt för djurarten. En mer komplex miljö bidrar till fler möjligheter för djuren att visa olika typer av beteende och är också mer trolig att efterlikna deras naturliga miljö. Djurparker syftar till att tillhandahålla djuren med just en naturlig miljö, men detta är något som kan vara svårt att uppnå då det finns vissa förhållanden som inte går att simulera. Exempel på sådana förhållanden är klimat, förflyttning över större områden och jakt. Även relativt naturliga inhägnader tillhandahåller inte samma utmaningar och möjligheter som det vilda då exempelvis ytan är mindre i djurparker.

Djur påverkas inte bara av själva inhägnaden de lever i utan också av uppfödningen och skötseln av djuren. Ett exempel är att rovdjur, så som den asiatiska vildhunden, lätt kan reagera på fasta tidpunkter för matning på så sätt att de uppvisar fler onormala beteenden runt tidpunkten för mat.

En bristfällig miljö kan leda till obehag och stress vilket kan ha stora konsekvenser för djurens hälsa, beteende och välfärd. Samtidigt kan en välkonstruerad inhägnad vara fördelaktig. Genom att förstå sig på hur djuren utnyttjar hägnet ges en möjlighet att anpassa miljön utifrån djurens biologiska förutsättningar och krav. Förståelsen av hägnutnyttjandet kan därmed användas för att öka djurens välfärd och fastställa både positiva och negativa effekter av miljön. Det är därför en värdefull metod för att förstå hur lämplig den miljö som djuren hålls i faktiskt är.

Syftet med studien var att undersöka hur dholerna på Parken Zoo i Eskilstuna utnyttjar sitt hägn och om de använder alla delar av hägnet. Vidare var syftet att undersöka om det finns någon skillnad i hägnutnyttjande beroende på tidpunkt på dagen samt om det finns någon skillnad beroende på om djuren utfodras eller inte under dagen. För att få reda på detta genomfördes en observationsstudie där de sju asiatiska vildhundarna på djurparken observerades vid 24 olika tillfällen från mars till april år 2014. Hägnet delades på en karta upp i 14 olika zoner och dholernas närvaro i en viss zon registrerades.

Resultaten visar att det finns en viss skillnad i utnyttjande av hägnet, där djuren totalt spenderar mest tid i zoner nära potentiella besökare och djurvårdare och minst tid i de zoner som innehåller vattenhål. Gällande skillnad i hägnutnyttjande beroende på tidpunkt på dagen visar resultaten att det endast är en liten skillnad. Den skillnad som finns kan ses bero på yttre faktorer så som närvaron av djurvårdare. Vad gäller utfodring och icke-utfodring finns det en viss skillnad, men skillnaden är så pass liten att det bör ses som en slump snarare än en faktiskt statistisk skillnad. Frånvaron av skillnad kan bero på att djuren utfodras slumpmässigt, vilket då minskar risken för att djuren uppvisar onormalt beteende vid tidpunkten för matning.

Genom att identifiera vilka områden i hägnet som djuren utnyttjar mest kan dessa resultat användas när nytt hägn ska konstrueras. Samtidigt behöver de områden eller resurser som används mindre inte finnas i överflöd i framtida konstruktioner. Det är dock svårt att helt fastställa vilka områden som kan ses som överflödiga bara genom en enstaka studie, varför ytterligare studier behöver genomföras vid flera tidpunkter på året. Trots detta kan denna studie fungera som ett underlag för framtida studier både på de asiatiska vildhundarna på Parken Zoo och på arten i fångenskap i andra delar av världen. Då studier på arten saknas överlag är denna studie ett värdefullt bidrag för framtida forskning.

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