

Environmental and Human-related Factors Affecting Zoo-Housed Otters

Subjects: Zoology

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Zoos and aquaria have the ethical responsibility to provide animals under their care with conditions that promote good welfare. This research evaluated the combined influence of human presence and environmental factors on the behaviour of zoo-housed Asian small-clawed otters (*Aonyx cinereus*).

Keywords: *Aonyx cinereus* ; animal welfare ; human–animal interaction ; zoo animals

1. Introduction

Zoos and aquaria aim to contribute to the preservation of wildlife through educational, research and conservation initiatives ^[1] and they must ensure good welfare for the animals in their care to meet these goals ^[2]. Studies of their welfare are important to guarantee high standards of animal husbandry and care in zoological institutions, and to enhance their role as conservation centers ^[3].

Animals experience optimal welfare when their physical, behavioral and psychological needs are met, when they have the opportunity to exert choice and control over the environment (e.g., opportunity to decide where, when and with whom perform certain behaviors), and when they mainly experience positive affective states such as a sense of security and comfort ^[4].

Enclosure design, environmental conditions, husbandry routine and exposure to animal care staff and visitors are among the most important features that can influence the welfare of animals within zoos and aquaria ^[5]. Scholars have usually tried to assess animal welfare by analyzing the effect of environmental and human-related factors on animals' behaviors separately ^[6]. A limited number of studies have recently focused on the integrated impact of these factors on animals' well-being (see for example: ^{[7][8][9][10][11]}), often indicating that visitor effect (i.e., the negative or positive influence exerted by visitors) has been over-estimated when other parameters (e.g., ambient temperature, time of day, weather conditions) were included in the analysis ^{[7][8][9]}.

In this study, researchers aimed to examine this still un-researched topic, focusing on a pair of zoo-housed Asian small-clawed otters (*Aonyx cinereus*, hereafter referred as ASCOs). *A. cinereus* is a good model species since it is the most common otter species housed in captivity ^{[12][13]} and, despite its popularity and high educational and conservational value ^[14], research on zoo-housed ASCOs' welfare is still scarce. Moreover, available studies have reported conflicting results relating to time budgets, and have often detected the occurrence of abnormal repetitive behaviors (ARBs; ^{[12][15][16][17][18][19][20][21][22]}), i.e., repetitive, unvarying and seemingly functionless behavioral patterns ^[23], which are usually interpreted as an indicator of poor welfare either currently or in the past ^[24].

In this study, researchers investigated the subjects' behavioural time budgets, the occurrence and potential causes of ARBs, and applied multivariate research methods to evaluate whether and how the otters' behaviours were affected by selected environmental and human-related parameters. Such a multivariate analysis has not previously been applied to the study of otter behaviour.

2. Methodology

This study was conducted on a pair of adult ASCOs housed at the Giardino Zoologico di Pistoia (GZP), Pistoia, Italy. Researchers collected data over two-month period (14 sampling days assigned randomly, from 19th of July 2020 to 6th of September 2020). Researchers video-recorded the otters' behaviours across six one-hour observations sessions (S1: 9:15–10:15 am; S2: 10:45–11:45 am; S3: 12:15–1:15 pm; S4: 2:45–3:45 pm; S5: 4:15–5:15 pm; S6: 5:45–6:45 pm). In this way, researchers could record data during different time slots across the public opening hours (9:00 am–7:00 pm), and could include keeper-otter interactions (e.g., feeding sessions and enclosure cleaning) in the data collection. During

each observation session, researchers recorded each individual for 30 minutes using a continuous focal animal sampling technique [25]. Researchers conducted 84 focal sessions for each subject, obtaining on average 40 hours of observation per otter. Following relevant scientific literature [7][8][9][12][22], researchers selected weather conditions, ambient and water temperature, wind speed, relative humidity, background noise level, visitor numbers, and caregiver presence as parameters to be included in the analysis. Researchers recorded humidity, ambient and water temperature, weather conditions, and wind speed at the beginning of each observation session. Researchers registered visitor numbers and background noise every five minutes and continuously recorded caregiver presence in and around the enclosure. Researchers analyzed data with generalized linear mixed models [8][9][10] coding the above-mentioned parameters and animal identity as fixed factors, date as a random factor, and behaviors as respondent variables.

3. Discoveries

Both otters were found to perform a rich behavioral repertoire [26]. Aggressive and avoidance behaviors were limited, suggesting that the subjects experienced mainly positive emotional states [4]. The otters could also exercise control over their environment, choosing where to perform behaviours almost 24 hours a day. The occurrence of potential ARBs was also limited.

The dominant category within the otters' behavioral time budgets was out of sight which accounted for 41.59% of the subjects' time budgets, on average. This concurs with the results of previous studies conducted on breeding pairs housed with offspring in naturalistic outdoor enclosures [12][18][19]. Conversely, pairs and triplets of siblings hosted in indoor enclosures with little natural vegetation and a limited amount of shelter were found to spend less time out of sight [20][22]. These findings highlight that providing otters with the opportunity to choose among different hiding options is one of the key requirements in captive settings, in accordance with husbandry guidelines [27]. Nevertheless, a larger sample size is needed to exclude the influence of group composition on the results.

When visible, the otters mostly engaged in resting, and performed vigilance behavior. The time allocated to resting was similar to that reported for breeding pairs held in family groups [12][17][19]. However, researchers found that the level of vigilance was slightly higher (16.70%) than found in other studies, wherein ASCOs spent less than 15% of their time budgets performing vigilance behavior [20][22]. Researchers also found that the otters engaged less in locomotion and affiliative interactions compared to the breeding pairs belonging to two family groups observed by Cuculescu-Santana and co-authors [12] and Owen [18]. The absence of offspring in this study could have reduced the occurrence of affiliative interactions and could also explain the lower level of locomotory behaviors, since the subjects were not involved in providing parental care (i.e., carrying, following, and feeding cubs) [27].

Regarding food-related behaviors, Gothard [19] found that a zoo-housed family group allocated 20% of its time budget to foraging and feeding, with a 13% increase when crickets and mealworms were scattered in the enclosure. Conversely, in all the other available studies, including the research, the time dedicated by otters to food-related behavioural patterns reached a maximum of half of that percentage. Considering that ASCOs in the wild usually spend 40 to 60% of their waking time searching for food [28], the implementation of an enrichment program with plenty of food-based enrichments (e.g. puzzle feeders) is highly recommended [1].

The results also confirmed the findings of recent studies that described how visitor presence is not the key factor affecting animals' behavior when other parameters are analyzed [7][8][9]. Indeed, researchers did not find an influence of visitor numbers or noise on the subjects' behavioural responses. Researchers did find an effect of time of day (i.e., observation session) on behaviors, as reported for other species in previous studies [7][8][9][11]. Moreover, individual identity was a significant predictor of vigilance, visitor–animal interaction, and juggling (i.e., fast, erratic movements that pass an object between the forepaws and sometimes the mouth, considered as a feeding anticipatory behavior [21]), in line with previous research conducted on birds [10]. Since personality influences how animals interact with humans and cope with the environment [29][30][31] assessing otters' personality traits could assist in planning enclosure design and daily husbandry routine.

4. Influences

This study was the first to investigate the integrated effect of environmental factors and human-related stimuli on the welfare of captive otters. It is worth noting that the small sample size does not allow researchers to generalize the results. Moreover, the limited number of video-recording devices might have led to an underestimation of affiliative and resting behaviors, since researchers could not record all the available shelters. In addition, the COVID-19 restrictions put in place by the host institution caused a reduction in visitor numbers [32]; hence researchers recommend further evaluation of the visitor effect in relation to other parameters.

Despite these limitations, this study helped to increase the understanding of a scarcely researched topic. From an applied perspective, this project helped to identify potential welfare issues which could negatively impact the welfare of the studied individuals. Concurrently, it also highlighted how enclosure design and husbandry routine, such as the presence of multiple hiding options and the 24 hour access to the outdoor section of the enclosure, played a key role in enhancing the subjects' welfare. From a methodological standpoint, it allowed investigation of a wider range of parameters compared to previous research [7][8][9][10][11], leading to a better characterization of the animals' experiences, and confirming the effectiveness of applying multivariate research methods to welfare assessment. Finally, it also provided meaningful recommendations, such as the implementation of new enrichments, that could further improve the welfare of the studied subjects.

5. Future perspectives

The findings emphasize the importance of conducting further studies to investigate the effect of personality and environmental enrichments on otters' welfare. Researchers also recommend 24 hour monitoring to analyse whether and how the subjects' behaviour and enclosure use changes, especially at night when the zoo is closed to the visiting public, and care staff are absent. Future research should also investigate how the otters' behaviour and space use changes between seasons, to identify any potential welfare issues related to low temperatures during winter. Such additional studies could be used to further optimise enclosure design and husbandry procedures, and hence to maximise positive experiences.

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