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Research article

Examining how a general audience rates herptile welfare in zoos

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Abstract

There is a demonstrated lack of research available in the realm of herptile welfare and the public perception of zoo animal welfare. This study examined zoo visitor perceptions of herptile welfare through delivery of a survey at three different zoos with the goal to elucidate the specific factors that influence visitor perceptions. Findings from this study suggest that there is a correlation between the frequency of annual zoo visits and welfare perceptions. There was an observed difference in welfare perceptions among five herptile species. Visitor perceptions of animal welfare were consistent across all study locations. These findings demonstrate consistent expectations of animal welfare held by this sample of zoo visitors. Responses from zoo visitors in this study demonstrate that they perceive zoos are successfully meeting the physical needs of herptiles but could improve upon meeting the affective needs of the animals.

Introduction

Positive zoo experiences are essential for encouraging learning and behaviour change in the visiting public (Ballantyne and Packer 2016; Clayton et al. 2009; Miller 2012; Yoon and Uysal 2005). Ensuring a positive visitor experience is a complex balancing act between business strategies and conservation-based educational experiences. A major aspect of this positive experience is the visitor understanding that the animals are receiving quality care (Ryan and Saward 2004). Currently, there is a lack of research examining zoo visitor perceptions and understanding of animal welfare. In particular, there is a lack of examination of the visitor's experience and how a visit to the zoo is influenced by these welfare perceptions (Learmonth et al. 2021a).

Perceptions of animal welfare

A singular definition of welfare relating to the scientific assessment of animals has yet to be agreed on; therefore, the use of the term welfare here shall henceforth be in reference to an individual's measurable physical and physiological state as a result of coping within its environment (Fennel 2015; Gray 2017; Hill and Broom 2009; Powell and Bullock 2014). This system of welfare is primarily about an animal's supposed subjective experience, or 'affective state', for which the framework is consistent with the recognition of 'animals of welfare significance' (Ledger and Mellor 2018). While this concept has been part of an ever-growing movement, it has been primarily applied to mammalian species with an emphasis on those within laboratory and agricultural settings (Lambert et al. 2019).

A global trend in growing public interest in increased animal welfare is derived from concerns about animals experiencing pain and suffering due to improper care or mistreatment (Caporale et al. 2005; Fennel 2013). However, a true effort towards the consideration of welfare in herptile species has continued to be largely ignored; this has been attributed to debates on the capacity of herptiles for sentience and other feelings of experience and emotional states that modern-day welfare is based upon (Lambert et al. 2019; Pasmans 2017; Whitehead and Certsam 2018).

In a zoological setting, the perceptions of animal welfare, both positive and negative, demonstrate a conflict between human-valued aesthetics and the actual needs of the animal. Visitors routinely demonstrate a preference for natural-looking exhibit spaces and a demonstration of active behaviours that show the 'wildness' of an animal (Melfi et al. 2004). In addition, the presence of enrichment within the animal's habitat is likely to positively influence visitor perceptions of welfare states and the quality of overall care provided to an animal (Razal and Miller 2019).

Perception of herptile welfare

The welfare requirements of herptiles are often overlooked or even ignored due to the lack of awareness or even acceptance of reptilian sentience needs and capacity of emotion (Learmonth 2020a; Phillips and McCulloch 2005). It is important to note that it has been scientifically proven that herptiles can experience a range of emotional states linked to sentience, including pain, stress, fear, frustration, suffering, anxiety and pleasure (Lambert et al. 2019). Each of these emotional states directly influences the affective states of an animal, which have the potential to impact welfare (Mellor 2016).

A better understanding of their sentience is critical for herptiles to be given the best quality of life. Though it is generally accepted that all vertebrates are sentient beings, there is an apparent lack of consideration for reptilian practices, indicating a lack of full understanding or wide acceptance (Lambert et al. 2019; Learmonth 2020a; Phillips and McCulloch 2005). However, small efforts have been made to create awareness about the lack of consideration of welfare for such animals. Studies on snake spatial insecurity and the negative effects that too little space can have on this class (Learmonth 2020a; Warwick et al. 2013, 2019) and establishing reliable indicators of reptile welfare as a whole (Benn et al. 2019; Warwick et al. 2013) have drawn further attention to the need for valid welfare assessment methods for these animals.

Current trends in reptile welfare research

There is a demonstrated lack of research available in the realm of herptile welfare. Brereton (2020) notes that no amphibian species have been used for enclosure use research, and almost all such studies focus on mammalian subjects. More research is needed in welfare and behaviour to support enclosure design to increase public perceptions of the facility's animal care programs and directly address reptile welfare concerns.

Furthermore, captive conditions for reptiles frequently do not match behaviours associated with biological needs, again often referring to such accommodations as a spatial range (Warwick et al. 2013), despite the need for spatially complex and dynamic exhibit spaces reflective of a species' natural history (Rose et al. 2014). There is limited research available on reptile enrichment practices and animal preferences related to enrichment (Learmonth 2020a). The work that does exist demonstrates the potential to increase welfare states by including targeted enrichment practices (Rose et al. 2014).

Human-animal interactions can significantly influence animal welfare (Cole and Fraser 2018; Mellor et al. 2020). For zoo animals, this includes the interaction with their human caretakers (Hemsworth et al. 2009) as well as the presence of zoo visitors (Sherwen and Hemsworth 2019). Reptiles are no exception, as the presence of visitors has been shown to alter social behaviours and increase aggression in Galápagos tortoises (Freeland et al. 2020). Additionally, the presence of visitors can influence the behaviour of crocodilians but may not directly impact welfare states (Riley et al. 2021). Preliminary research with tortoises suggests that these animals may demonstrate a preference for interacting with humans to a certain extent (Learmonth et al. 2021b), which is important as reptiles are popular participants for interactive programmes with visitors. It is estimated that 10% of all advertised animal interaction programmes feature reptiles (D'Cruze et al. 2019), yet there are limited measures of the impacts of their use in interactive programming.

It is important to consider the nature of how humans and non-human animals interact within the zoo environment (Fernandez et al. 2009; Learmonth 2019), particularly for non-avian reptiles. Recent research suggests that due to the sentience of reptiles, the ethical frameworks developed to guide welfare programmes for mammals and birds should be extended to reptiles (Learmonth 2020a). This understanding of human-animal interactions within zoos should also be extended to the visitor effect on reptiles, for which there is currently limited information available (Riley et al. 2021).

Many existing welfare practices for reptiles have been called into question and have been shown not to be guided by research. For example, Warwick et al. (2021) explored the rectilinear behaviour of snakes and found that many enclosure recommendations do not support this behaviour, which is essential and fundamental to snake health. Modern welfare programs for reptiles need to move away from a resource-based measurement system and instead emphasise developing an animal-based measurement system that mirrors those systems currently being implemented for mammals (Benn et al. 2019).

The present study

The purpose of this study is to examine the trends in how a general zoo audience apply animal welfare ratings to herptile species housed in a zoological setting. Additionally, specific welfare factors observed by zoo visitors were examined to understand the particular qualities of habitat design that influence a visitor's understanding of the care provided to the animals.

It was hypothesised that: 1) visitors desire to see animals exhibited in larger spaces, 2) animals housed in social groups in outdoor spaces would be scored higher on visitor-completed welfare assessments and 3) visitor demographics would influence welfare assessment scores.

Methods

Ethics compliance

All research activities were approved by Beacon College's Institutional Review Board. In addition, the research team received approval from each of the participating zoos adhering to the Association of Zoos & Aquariums' (AZA) research approval process. All participants in this study remained anonymous to the research team and no personal or identifying information was collected. Participants were required to provide consent to participate before answering any survey questions.

Procedure

Data were collected for a total of seven weeks at three metropolitan AZA-accredited zoos in the state of Florida. Participants were asked to complete a survey using their phone. Participants scanned a QR code posted outside of the corresponding exhibit and completed the survey. A passive recruitment method was selected to avoid an introduced bias or alteration of participant responses that

may stem from an active recruiting method (Pattison and Shagott 2015).

While the zoos clustered their herpetofauna in a similar manner, the three facilities exhibited a variety of species, with the American alligator *Alligator mississippiensis* being the only species featured in all three locations. As such, a decision was made to use the grouping of animal size instead of species. These groupings included American alligator, frog, large snake (greater than 2 metres in length), small snake (less than 2 metres in length), and turtle with a carapace of at least 30 centimetres in diameter.

Measures

The provided questionnaire contained a total of seventeen questions (see Supplementary Information for a copy of the survey instrument). The welfare assessment was modelled after Detroit Zoological Society's Individual Animal/Environment Welfare Assessment (Kagan et al. 2015). This assessment tool was selected due to the tool's universal applicability across species and facilities. In addition, the tool was designed to be used by parties other than the zoo's animal care professionals. In order to prevent participant fatigue, and maintain a consistent understanding of the measured welfare objective, the welfare assessment tool was limited to nine questions reflecting Mellor's (2016) Five Domains model. Each question was worth a possible two points, with 'yes'=2 points, 'somewhat'=1 point, 'no'=0 points, and 'not clear'=0 points. Thus, a maximum score of 18 points could be awarded by a participant. In addition, participants were asked three questions to measure their attitudes and perceptions of herptiles. These questions were modelled after previous research examining animal likeability (Tisdell et al. 2005). Participants were also asked to answer demographic questions, including annual visits to the zoo, membership status, herptile ownership status, education and gender.

Data analysis

Only those surveys that were fully completed by a participant were included for analysis. Incomplete surveys were removed from the data set. Descriptive and inferential statistics were calculated using the SPSS software package. Chi-squared tests were used to examine the relationship between specific variables (i.e. visitor demographics, participant rankings of likeability and previous experience) and the dependent variable (welfare ratings). A Spearman's rank order correlation test was performed to examine the relationship between the overall score provided by participants and their reported annual visits to the zoo.

Results

Participants

A total of 616 survey responses were included in the analysis. All participants were over the age of 18. Many of the participants (71%) identified as female and had some manner of university education (19% some university, 45% undergraduate degree, 23% graduate degree).

Approximately 46% of participants had a zoo membership, either for the zoo where they completed the survey (40%) or a different zoo (6%). The frequency of participants' annual visits to the zoo represented a range of options: 0–2 annual visits (44%), 3–5 annual visits (26%), or more than six annual visits (30%).

There was no relationship between a participant's gender and annual zoo visits, χ^2 (4)=8.977, P=0.062. A similar trend was observed with a participant's education level, χ(6)=7.997, P=0.238. As to be expected, there was a relationship between maintaining a zoo membership and an increased average number of annual zoo visits, χ^2 (4)=226.622, P<0.01.

Welfare ratings

When welfare objectives were ranked by mean score, the participants noted a clear impression that the zoo was meeting the basic needs of the animals. Those welfare objectives addressing the affective (behavioural) state of the animal were often ranked lower than those objectives measuring the physical states. In addition, the welfare objectives linked to human-animal interactions were also ranked low. Table 1 provides a detailed breakdown of rankings of welfare objectives by mean score across all assessed species.

As demonstrated in Table 2, the difference between participant-provided welfare assessment scores among species was statistically significant, χ^2 (64)=100.901, P=0.002. The difference in welfare assessment scores was not influenced by the specific

Table 1. Participant ranking of welfare objectives being delivered. *Identical mean score.

Participant ranking	Welfare objective
1	Physical condition of animal
2	Access to food, water and shelter
3	Social environments*
3	Complexity of habitat*
4	Free from disturbance by zoo visitors
5	Enclosure size
6	Free from disturbance by other animals*
6	Free from disturbance by husbandry events*
7	Provision of enrichment

Table 2. Mean welfare score for each assessed herptile species.

Species	Mean score	n	Standard deviation
Alligator	13.70	92	4.150
Frog	14.36	89	3.491
Large snake	14.24	184	3.763
Small snake	14.86	163	3.641
Turtle	14.40	88	3.656
Combined average	14.40	616	3.747

Table 3. Mean score for individual welfare objectives provided to each herptile

Welfare objective	Alligator	Frog	Large snake	Small snake	Turtle	Average	P-value
Access to food, water shelter	1.73	1.87	1.83	1.84	1.86	1.83	0.007*
Enclosure size	1.57	1.49	1.40	1.52	1.67	1.51	0.063
Complexity of habitat	1.49	1.74	1.68	1.73	1.66	1.63	0.652
Social environment	1.49	1.56	1.67	1.71	1.62	1.63	0.026*
Disturbance by guests	1.50	1.52	1.47	1.61	1.59	1.53	0.500
Disturbance by other animals	1.53	1.73	1.65	1.75	1.68	1.45	0.327
Disturbance by husbandry events	1.45	1.40	1.41	1.50	1.52	1.45	0.874
Enrichment	1.20	1.29	1.35	1.46	1.22	1.33	0.235
Physical condition of animal	1.76	1.85	1.90	1.88	1.92	1.87	0.018*

zoo, χ^2 (32)=36.630, P=0.263. The differences in the ability to meet welfare objectives among species were statistically different in three different measures. These differences were not observed in the other welfare objectives (P>0.05). Table 3 provides a summary of mean scores for each welfare objective shown by assessed species.

Influence of visitor demographics

There appears to be no relationship between a participant's welfare score and their education level, χ^2 (48)=63.030, P=0.072. Male participants provided a similar welfare assessment score (mean=14.41, SD=3.855) to female participants (mean=14.43, SD=3.667).

Participants who self-reported having a higher comfort level with reptiles provided a higher welfare assessment (mean=14.97, SD=3.464) than those who reported being uncomfortable with reptiles (mean=14.18, SD=4.024). This difference was significant, χ^2 (80)=179.362, P=0.001. The same trend was found with participants' ranking of the likeability of reptiles, χ^2 (64)=211.931, P<0.01; see Table 4 for a detailed description of scores. Those participants who reported having a positive experience with reptiles provided a more positive welfare assessment (mean=14.92, SD=3.498) than those who reported having negative previous experiences with reptiles (mean=12.71, SD=4.043), χ^2 (64)=98.542, P=0.004. Participants who did not have any reptiles as pets provided a lower welfare assessment score (mean=14.33, SD=3.676) compared to those who currently have a reptile as a pet (mean=14.46, SD=4.496) or previously owned a reptile as a pet (mean=14.71, SD=3.323). This difference was statistically significant, χ^2 (64)=99.743, P=0.003.

Those participants who had a zoo membership at the time of the study were more likely to provide a higher welfare assessment score compared to those participants who did not maintain a zoo membership, χ^2 (32)=47.941, P=0.035. There is also a relationship between the number of annual visits per year and a participant's perception of animal welfare, χ^2 (32)=64.945, P<0.01. There was a demonstrated weak correlation between a participant's provided score and the reported annual visits to a zoo, which was statistically significant (r^s(614)=0.130, P=0.001). Table 5 provides a summary of this observed trend.

Desire to see large, outdoor exhibit spaces

The physical size of enclosure was ranked fifth in terms of whether the objective was being met (mean=1.51). Those animals (alligators and turtles) displayed in outdoor exhibit spaces received the highest mean score (+0.15–0.18) in the enclosure size objective compared to animals housed solely indoors. The complexity of the enclosure was ranked third (mean=1.63) by participants. There was no direct connection between outdoor or indoor enclosure spaces; however, it appears that body size may have an influence. When examining mean scores, those animals with the smallest body size (frog) received a higher mean score (1.74) than large-bodied animals, such as large snakes (mean=1.68) and alligators

Table 4. Mean welfare score for each likeability rating of assessed species.

Likeability rating	Mean welfare score	n	Standard deviation
Highly likeable	15.29	273	3.366
Likeable	13.64	191	4.002
Neutral opinion	14.02	122	3.603
Unlikeable	13.16	19	2.363
Highly unlikeable	11.91	11	6.284

Table 5. Mean welfare score for each category of annual frequency of zoo visits.

Number of annual visits	Mean welfare score	n	Standard deviation
0–2 visits	14.02	269	3.821
3–5 visits	14.09	161	4.119
6+ visits	15.23	185	3.146

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(mean=1.49).

There was no observed difference in public perception of physical enclosure size among the three zoos, χ^2 (4)=1.457, P=0.834. There is no relationship between a participant's gender and their perception of the animals being afforded enough physical space, χ^2 (4)=2,664, P=0.615. However, there is a relationship with a participant's education level; those with a more advanced university education have a less favourable perception, χ^2 (6)=16.775, P=0.01. Additionally, there is a relationship between the number of annual visits and perception of enclosure size, χ^2 (4)=13.319, P=0.01. Those participants who visit the zoo more frequently are more likely to hold a more positive perception of the physical space afforded to reptiles.

Desire to see social groupings

The welfare objectives assessing social dynamics were moderately ranked by participants. The observed social dynamics were ranked third (mean=1.63) by participants. Snakes received the highest mean score (large snakes, mean=1.67; small snakes, mean=1.71). Social and semi-social animals, such as alligators, received the lowest mean score (mean=1.49). The ability to be free from disturbance caused by other animals was ranked low by participants (mean=1.45).

Influence of behavioural husbandry

The provision of enrichment received the lowest participant rating (mean=1.33) and was ranked last among the measured welfare objectives. There was no difference in perception of the animals being provided enough mental stimulation through enrichment among the three zoos, χ^2 (4)=2.359, P=0.670. This relationship was also true for other variables, including reptile ownership (P=0.183), gender (P=0.95), species observed (P=0.235) and annual zoo visits (P=0.247). Those who did not hold a college degree provided a more positive rating compared to those with a degree, χ^2 (6)=17.725, P=0.007.

Discussion

The purpose of this study was to examine the trends in herptile welfare rating provided by a visiting zoo audience. Findings from this study suggest that visitor characteristics can influence perceptions of animal welfare. Factors such as an individual's comfort level with the species, the perceived likeability of the animal and previous experiences with the animal were demonstrated to directly shape an individual's perception of animal welfare in a zoo setting. Additionally, the number of annual visits to the zoo can potentially influence the perception of animal welfare to a certain degree. However, it is important to note that frequent zoo visitors generally hold a more positive outlook on zoos and their practices compared to those who do not visit the zoo regularly (Davey 2007; Reade and Waran 1996) and this could have influenced these findings.

Visitors ranked the physical size of the enclosure lower than most other welfare objectives. Large snakes received the lowest welfare rating in this welfare objective and participants noted that enclosures for all assessed snakes were spaces that 'somewhat' meet their physical needs. Through the analysis of participant scoring, it can be theorised that participants were expressing a desire to observe animals in larger physical spaces.

It does not appear that animals housed in social groups in outdoor spaces would be scored higher on visitor-completed welfare assessments. While outdoor exhibit spaces received higher participant welfare scores compared to indoor exhibits, it did not equate to receiving higher scores when it came to exhibit complexity or presence of enrichment.

Welfare assessment scores did vary by animal type. In particular, alligators received a lower welfare score in the areas of 1) having access to basic needs, such as food, water and shelter, 2) proper social environment and 3) the physical condition of the animal. It is not clear why these scores were consistently low for this animal. Participants in the current study also indicated that they thought alligator exhibits lacked environmental complexity. It has been noted that exhibit aesthetics play a critical role in visitor perception of welfare (Melfi et al. 2004). This concept could serve as an additional explanation for the lowered welfare scores for these animals as outdoor alligator exhibits tend not to feature as much dense foliage or intricate decor placement as enclosed, indoor reptile exhibits. Razal and Miller (2019) state that visitors directly associate positive welfare with animal visibility. Additionally, Razal and Miller (2019) suggest that the specific type of enrichment present in an exhibit can influence a visitor's perception of animal welfare. As alligators are native to the state of Florida, participant perceptions of welfare for these animals may be altered due to viewing alligators in wild conditions. Prokop and Fančovičová (2013) have demonstrated that people often have a more negative response to reptiles when they are able to demonstrate their cryptic colouration or ability to hide.

Responses from zoo visitors in this study demonstrated that they perceive zoos are doing well at meeting the physical needs of herptiles, but could improve upon meeting their affective needs. Findings from the current study suggest that despite an apparent lack of understanding of reptile sentience and welfare (Lambert et al. 2019; Learmonth 2020a; Phillips and McCulloch 2005), zoo visitors appear to recognize the fact that these animals need complex environments to meet these affective needs.

Zoological facilities have the potential to increase conservation awareness and impact for herptiles by addressing human-animal interactions, including how the visitor is influenced by their perception of animal welfare (Learmonth 2020b). Visitors are more comfortable with zoos when there is a demonstrated commitment to animal welfare, and when accreditation is predicated on welfare standards (Warsaw and Sayers 2020). Understanding how the visitor perceives animal welfare will allow zoo managers to make effective decisions regarding the design of exhibits and how they display herptile species (Godinez and Fernandez 2019). Ensuring a commitment to welfare and educating guests about welfare practices will help to increase consumer confidence as well as overall satisfaction with their visit and perception of the facility (Ballantyne and Packer 2016; Clayton et al. 2009; Miller 2012; Yoon and Uysal 2005). These positive experiences lead to an increase in visitation (Ryan and Saward 2004), which leads to visitors demonstrating an increase in conservation knowledge (Ogle 2016).

Limitations and future research

The purpose of this study was to examine trends across a general zoo audience without comparing specific enclosures to one another. Due to the recruitment methods within a given area in the zoo, the survey instrument was limited to ensure full participation. As such, the complexity and depth of data collected was limited. The variables within the study may influence overall outcomes and individual variables could not be fully isolated for analysis. Findings are limited to a specific geographic region and may not fully represent general zoo audiences in other areas of the world. Due to passive recruitment techniques, participant responses could have been influenced by the participant's interest in the animals and may not fully represent the views of a general zoo audience.

Additional research needs to be conducted to examine specific welfare indicators in a more detailed manner. This examination should also include the gathering of qualitative data from zoo visitors. Future research needs to be completed to explore the

specific attributes of reptile enclosure design to which visitors pay the most attention, and that instil a positive perception of welfare. More research is also needed to build upon the findings of Razal and Miller (2019) to examine how specific uses of enrichment with reptiles are perceived by the general zoo audience.

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