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Research article

A comparative analysis of visitor knowledge and attitude towards the 'ignored taxa'

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Abstract
Zoos are in a unique position to enthuse visitors about biodiversity loss and inspire visitors towards conservation. However, some of the world's most threatened and endangered species are not the animals that zoo visitors are inherently interested in or want to see. It is essential for zoos to understand their visitors' knowledge and attitude towards less popular species, if they are to promote conservation for all endangered animals. This comprehensive study used a survey-based methodology to investigate visitors' knowledge and attitude surrounding species that are historically 'ignored' (reptiles, amphibians and fish) in zoos at five Irish institutions. Results varied between institutions but broadly indicated that visitors had higher mean attitude scores (0.83) than knowledge (0.68) scores on the survey. However, trends were not consistent across all institutions. Additionally, higher levels of self-reported knowledge were associated with increased attitude scores. Institution affected hypothetical donation choice, though collectively frogs, snakes and fish attracted the least support only receiving 9.8% of theoretical donations. Not littering and recycling were the most popular actions listed to help the ignored taxa at each institution. This leaves zoos with a challenge – how to engage visitors with often highly endangered, sometimes commonly kept, but less historically interesting or less appreciated species, such as reptiles, fish and amphibians. Zoos must leverage visitors' interest in animals and conservation with all of their species, if they are to drive forward their conservation agendas.

Introduction

Biodiversity is declining globally at a rate higher than it would if it were not for profound anthropogenic impacts (Cowie et al. 2022), with up to a million species threatened with extinction in the coming decades (IPBES 2019). However, there is considerable variability in extinction rates between taxonomic classes not only because of different threats, but also because of inconsistency and lack of information in reporting (Cowie et al. 2022). For example, in 2007, amphibians were reported as one of the most globally threatened taxonomic groups with more than a third of species threatened with extinction (Wake and Vredenburgo 2008). However, they are still under-represented in the International Union for the Conservation of Nature (IUCN) Red List assessments (Cowie et al. 2022).

The role of zoos in halting biodiversity loss and promoting positive conservation behaviour has become steadily more important (Moss et al. 2015; Nageotte et al. 2023). In fact, protecting and restoring biodiversity are included as Goal 15 in the United Nations' Sustainable Development Goals, a movement many zoos support (WAZA 2024). However, many of these stated goals have not yet been reached and biodiversity has continued to decline (Collins 2024). In terms of zoo-based research, reptiles, amphibians and fish are drastically understudied, with these species comprising only one percent of research projects in a decade (Melfi 2009). It is essential

for zoos to prioritize conserving the world's most endangered species. However, some of the world's most threatened taxa are underrepresented and potentially disliked in zoos by the public (Conde et al. 2011; Collins 2024).

Humans exhibit natural preferences for certain species (Morris 1967). For example, people are inherently drawn to animals with infantile-like facial features, including a large head and eyes with a small nose and mouth, which has been coined the 'baby schema' (Lorenz 1943; Borgi et al. 2014). This cute response or the tendency to prefer 'cute' animals (Lorenz 1943; Herzog 2021), also extends to animals favoured by zoo visitors, though it may also include powerful, impressive or dangerous animals revered for their charisma (Albert et al. 2018). However, species with baby-like features or animals perceived as charismatic by the public, are often not the world's most endangered species (Douglas and Winkel 2014).

Charismatic megafauna (e.g. tigers, elephants and the great apes) and animals that are more similar to humans generally draw far more attention and are preferred by people to invertebrates, fish, reptiles and amphibians in both in-situ and ex-situ conservation settings (Tisdell et al. 2005; Skibins et al. 2013; Colléony et al. 2017; Albert et al. 2018). In fact, reptiles and amphibians are often viewed with dislike by the public which makes their conservation more difficult (Ogle and Devlin 2022). Conde et al. (2011) reported that 41% of described amphibian species are listed as threatened or extinct in the wild; yet only 5% of endangered or critically endangered amphibians are represented in zoos. More recently, Collins (2024) found that there are only 771 species of amphibians kept in zoos, but there are over 2500 threatened amphibian species in the wild. Even zoological literature tends to overlook reptiles, fish and amphibians in favour of mammals (Rose et al. 2019).

This can lead to imbalanced decisions when it comes to conservation choices, both in terms of which species zoos choose to keep and which ones are prioritized in conservation efforts (Stokes 2007). Practically, zoos must also balance their collections with visitor interest and enjoyment. Several varying factors, such as species richness, conservation status and uniqueness, drive visitor attendance and ultimately in-situ conservation (Mooney et al. 2020). However, there is no doubt that visitors expect to see large, active, charismatic megafauna, generally mammals (Moss and Esson 2010; Skibins et al. 2017; Albert et al. 2018) during a zoo visit.

In a recent study at three AZA-accredited zoos in Florida, USA, Ogle and Devlin (2022) reported that adult visitors generally found turtles more likeable and snakes less likeable than other herpetofauna. Males, visitors without a graduate degree and people who previously owned herptiles as pets reported being more comfortable around reptiles and amphibians. Additionally, visitors who viewed the animals favourably were also more likely to have a positive perception of their welfare (Ogle and Devlin 2022), though this is dependent on other factors such as visitor characteristics, likeability of the species and the number of annual visits to a zoo (Devlin and Ogle 2022). These studies amend our understanding of visitor preferences and awareness of welfare; however, this research did not link visitor preferences with personal conservation-orientated behaviours, and importantly no differences between the study sites were reported.

If zoos are to enthuse their guests towards conservation of all species, and not just charismatic mammals, it is imperative for them to understand visitors' knowledge and attitude towards less popular species, and which aspects of the zoo environment influence this. Currently, there is only limited knowledge of zoo visitors' understanding of, or attitude towards reptiles, amphibians and fish (Ogle and Devlin 2022). Instead, recent publications regarding herpetofauna have focused on visitor effects, particularly during Covid-19 zoo closures (e.g., Boultwood et al. 2021; Riley et al. 2021; Hamilton et al. 2022), with even fewer focused directly on these species' welfare (Spain et al. 2020; Hoehfurtner et al. 2021). Fish, especially bony fish, are a particularly under-represented taxonomic group in the zoo literature (Oldfield and Bonano 2022). Even though they are the most abundant vertebrate class on Earth, little is known about their behaviour or welfare in captivity (Oldfield and Bonanoo 2022). Recent research offers some indication that viewing fish in an aquarium or zoo may have psychological and physiological benefits for visitors (Clements et al. 2019); however, fish (except sharks) are not considered charismatic by the public (Albert et al. 2018).

To effectively drive conservation forward and help conserve all species in the wild, it is essential to understand visitors' perception of traditionally unpopular animals across a range of sites (Tisdell et al. 2005; Ogle and Devlin 2022). Multi-institutionalising a zoo research study allows for broader generalisations to be made across sites and improves external validity of the study (Melfi and Hosey 2012; Mellish et al. 2019). Additionally, having multiple sites allows for comparison of results and interpretation of how site differences may affect outcomes (Mellish et al. 2019). The objective of the current research is to evaluate visitors' knowledge, attitude and willingness toward conservation action after visiting an exhibit with species that are traditionally considered unpopular by zoo visitors.

Materials and methods

This research received full ethical approval from the University College Cork Social Research Ethics Committee (UCC-SREC 2020-101).

Research sites and study participants

The research occurred between July and December of 2022 at five institutions in Ireland where a total of 543 participants were surveyed (Table 1A—B). The species included in this research project have previously been referred to as 'forgotten taxa' (Hill, 2018; Rose et al. 2019) because of a lack of interest from visitors and researchers alike. Here, following Rose et al. (2019), we consider reptiles, fish and amphibians as the 'ignored taxa.' The five included institutions housed at least one group of ignored taxa in the exhibit where the research occurred (Table 1A); however, these institutions had unique characteristics which created an opportunity to investigate visitor learning under different conditions. For example, Fota Wildlife Park and Dublin Zoo are long-established conventional zoos housing many different species. Many of the species at Fota Wildlife Park are housed in semi-free range or walkthrough type exhibits. Dingle Oceanworld Aquarium and Galway Atlantaquaria are traditional aquariums focusing predominantly on marine species. While the National Reptile Zoo houses only reptiles and some amphibians. However, following previous research (Skibins and Powell 2013), zoo, aquarium and wildlife park are judged similar enough in the context of this research to be referred to collectively as 'zoo' hereafter.

Participants in this research were visitors who visited one of the five institutions. The minimum age of participants was 10 years old (Table 1B). Research assistants administered the survey at either the general zoo exit or a specific exhibit exit (Table 1A). Every nth (an unspecified number) visitor to cross an imaginary line was asked to complete the survey, if the research assistant was not occupied with another visitor. No visitors were coerced into participating or purposefully included or excluded from the research. It was explained to visitors that participation was voluntary. All participants were given a printed information form

Table 1. A. The participating institutions with the corresponding number of surveys collected and taxa studied by the zoo in the research location and B. demographics of participants.

A. Institutions	No. of surveys collected		Research location	Taxa present
1. Dublin Zoo	168		Zoorassic World	Reptiles
2.Dingle Oceanworld Aquarium	81		Visitor Exit	Reptiles; Fish; Amphibians
3. Fota Wildlife Park	155		Tropical House	Reptiles; Fish; Amphibians
4. National Reptile Zoo	103		Visitor Exit	Reptiles; Amphibians
5. Galway Atlantaquaria	36		Visitor Exit	Fish
Total	543			
B. Participants	Female	Male	Age 10-17	Age 18 or over
1. Dublin Zoo	95	71	42	125
2. Dingle Oceanworld Aquarium	67	14	32	49
3. Fota Wildlife Park	108	47	22	133
4. National Reptile Zoo	61	39	17	81
5. Galway Atlantaquaria	15	21	5	31
Total	346	192	118	419

explaining the research, and they signed a consent form (a parent or guardian had to sign a consent form for children to participate in the study). Contact and discussion with visitors were kept to a minimum as they completed the survey. Visitors handed the survey back to the research assistant upon completion. This yielded a sample size of 543 surveys.

The survey instrument

The survey was designed to assess visitor knowledge, attitude and conservation actions towards reptiles, fish and amphibians. The survey and procedure largely followed the formatting and detail of previous surveys by the first author (see Collins et al. 2020) and included multiple choice, Likert-scale responses and open-ended questions. See Appendix 1 for complete survey. First, visitors were asked two questions on demographics (gender and age) (Table 1B). Next, the survey asked a question on visitor's perceived knowledge (Q1). Questions 2–5 and 10 were discounted from the analysis of results because visitors did not respond, or the survey item was no longer applicable to the research question. Following this were four selected response questions on broad conservation knowledge (Q6–9). The next questions focused on visitor attitude towards conservation and the ignored taxa (Q11–17). Finally, questions 18 and 19 focused on visitor action. For the questions on attitude, there was no correct or incorrect answer. However, the Likert-scale responses allowed for differences in attitude to be examined between the different study sites. A high score (5) was considered a favourable response (the most positive answer), which correlated to 'strongly agree', when the statement was positive. To avoid response bias, three out of seven attitude-based questions were negatively phrased (Q12–Q14) (Falk and Storksdieck 2010; Marino et al. 2010; Collins et al. 2020). To ensure consistency in scoring, these questions were reverse-coded so that a response of 5 ("strongly agree") reflected a positive attitude, and a response of 1 ("strongly disagree") reflected a negative attitude, aligning with the scoring of the other questions. Following Collins et al. (2020), the selected response options included one correct response, several incorrect choices, and an 'I don't know choice.' A correct response was given a score of (2), I'm not sure (1), and incorrect (0) (Collins et al. 2020). Including an 'I don't know' option allows participants to express that they are unsure of an answer, rather than forcing them to guess, which could lead to invalid results (Oppenheim 1992; Cohen et al. 2007). Here, 'I don't know' is counted as a middling score, as is generally typical in this area of research (e.g., Ballantyne et al. 2001; Jensen 2014). The final two questions of the survey (Q18–19) were designed to assess participants' intended conservation actions by asking visitors which animal welfare organisation they would donate a hypothetical €100 to (following Martín-López et al. 2007) and to list one action (following Moss et al. 2015) they could undertake to help fish, amphibians and reptiles in the wild. To provide quantitative data for open-ended questions, content analysis or the coding of the qualitative questions was done by a research assistant and checked for inter-rater reliability with the primary researcher. These data were used for all qualitative questions (Krippendorff 2004; Moss et al. 2015). The categories were based on themes that were identified from the responses. The surveys administered at the five research sites were identical; however, questions 2 and 5 were tailored with wording specific to each site.

Data Analysis

Knowledge and Attitude

To calculate proportional knowledge and attitude scores, each participant's total score was divided by the maximum possible score for both categories. Summary statistics were generated to describe central tendencies and variations in knowledge and attitude across demographic factors (age and gender) and different institutions. A Pearson correlation test was conducted to examine the relationship between knowledge and attitude scores. The most common response for each attitude-based question was also identified.

Table 2. Description of variables used in the extended-support beta regression

Variable	Description	Reference group
Response Variable		
Attitude Score	Proportional attitude score	
Explanatory Variables		
Age	Under 18 or 18 and over	18 and over
Gender	Male or Female	Female
Institution	Institution 1-5	Institution 1
Perceived Knowledge	Self-reported knowledge (Likert Scale 1-5)	1
Age x Gender	Interaction term between age and gender	

To examine the relationship between attitude scores and explanatory variables, an extended-support beta regression was employed (Table 2). Beta regression is suitable for continuous proportions bound between 0 and 1, while the extended-support allows for boundary observations (Kosmidis and Zeileis 2024), which were present in the data. The explanatory variables included age, gender, institution, and perceived knowledge, with an interaction term between age and gender to explore whether the effect of age differed by gender. All predictors were treated as categorical variables. The reference category for each variable, which serves as the baseline for comparison in the model, is presented in Table 2. To ensure the suitability of the beta regression model, model assumptions were evaluated using residual diagnostics, including PIT histograms and calibration (reliagram) plots. Model fit was further assessed using likelihood ratio tests (LRTs) comparing the full model with reduced models, pseudo-R^2 (Ferrari & Cribari-Neto 2004), and the root mean square error (RMSE). All analyses were carried out using the R program (version 2025.05.0+496) (R Core Team 2025). The maximal model structure can broadly be described as:

Attitude score~gender*age+institution+perceived knowledge

Donations and Action to Help

To summarise participants' preferences, the most common responses to the donation and action-to-help questions were identified, along with an analysis of the reasoning behind their donation choices. These patterns were also compared across institutions to highlight similarities and differences in participant responses between locations. A multinomial logistic regression model was used to assess whether participants' knowledge scores influenced their choice of donation category. Frogs, Snakes, and Fish (Category 5) was set as the reference category for the model, allowing comparisons between all other donation categories and this baseline group. A null model without the predictor was first fitted, and a likelihood ratio test (Chi-squared) was used to compare the null model to the full model including knowledge scores. The p-values for the regression coefficients were calculated using a z-test, while confidence intervals were obtained using the Wald method.

Results

Knowledge and Attitude

Summary Statistics

Knowledge scores ranged from 0 to 1, with a mean of 0.68 [95% CI: 0.66, 0.70] and varied between gender, age and institution (Table 3). The results from a Pearson correlation test indicated a weak but statistically significant positive correlation between attitude and knowledge scores ($r=0.16$, $P<0.001$). Attitude scores ranged from 0 to 1, with a mean of 0.83 [95% CI: 0.81, 0.84] (Table 3). Similar to knowledge, marginal differences in attitude scores were observed between gender, age and institution. Across the seven attitude-based questions, the most frequently selected response was 5 (strongly agree), representing the most positive attitude overall (Figure 1). Question 13, which asked participants whether they agreed that "snakes are scary," was the only item that elicited a predominantly negative response (Figure 1).

Predictors of Attitude Score

The beta regression model examined the relationship between attitude scores and the explanatory variables: age, gender, institution, and perceived knowledge (Table 4).

Demographics

The main effect of age was not statistically significant ($\beta=-0.034$, $P=0.722$). The main effect of gender was also not statistically significant ($\beta=0.119$, $P=0.069$). However, the age × gender interaction was statistically significant ($\beta=-0.314$, $P=0.036$), showing that the relationship between age, institution and attitude score differed by gender.

Institutions

Institution was significantly associated with attitude score. Compared with the reference institution, Dublin Zoo, participants from Dingle Oceanworld Aquarium (Institution 2) had significantly lower attitude scores ($\beta=-0.196$, $P=0.024$), as did participants from Fota Wildlife Park (Institution 3) ($\beta=-0.161$, $P=0.026$). Participants from the National Reptile Zoo (Institution 4) ($\beta=0.156$, $P=0.077$) and Galway Atlantaquaria (Institution 5) ($\beta=-0.040$, $P=0.746$) did not differ significantly from the reference institution.

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Table 3. Mean attitude and knowledge scores across age, gender, and institution.

	Overall	Age		Gender		Institution				
		Under 18	18 and over	Male	Female	1	2	3	4	5
Attitude	0.83	0.79	0.83	0.84	0.82	0.84	0.80	0.81	0.86	0.80
Knowledge	0.68	0.61	0.69	0.69	0.67	0.69	0.58	0.67	0.77	0.66

Institution legend: 1 = Dublin Zoo, 2 = Dingle Oceanworld Aquarium, 3 = Fota Wildlife Park, 4 = National Reptile Zoo, 5 = Galway Atlantaquaria

Perceived Knowledge

Perceived knowledge was significantly associated with attitude score. Compared with participants who rated their knowledge as 1, those who rated their knowledge as 4 had significantly higher attitude scores (β=0.485, P=0.011), as did those who rated their knowledge as 5 (β=0.717, P<0.001). Knowledge ratings of 2 (β=0.287, P=0.156) and 3 (β=0.331, P=0.087) were not statistically significant.

Model Fit

Model diagnostics indicated that model assumptions were adequately met. The full model had a lower AIC (-739.08) than the null model (-713.40). Likelihood ratio tests indicated that removing the age × gender interaction, institution, or perceived knowledge significantly worsened model fit.

The model's Ferrari and Cribari-Neto pseudo-R^2 was 0.088, indicating that approximately 9% of the variance in attitude scores was explained by the predictors included in the model. The RMSE was 0.102 on the 0–1 attitude score scale, indicating limited predictive accuracy. While the model provides insights into the relationship between the predictors and attitude scores, the relatively low pseudo-R^2 indicates that additional factors not captured in the current model may influence the outcome. Further exploration of other potential predictors could enhance the model's explanatory power.

Action to Help

Summary Statistics

The most popular action chosen by participants to help was Waste Management, with 228 selections (42%). This category includes actions such as not littering, using fewer plastics and microplastics, and recycling. The second most popular choice was Promote Biodiversity, selected by 78 participants (14.4%), followed by Reduce Pollution with 45 selections (8.3%) and Donate with 32 selections (5.9%). Other actions included Diet (16 selections, 3%), Fishing (13 selections, 2.4%), and Other, Education, and

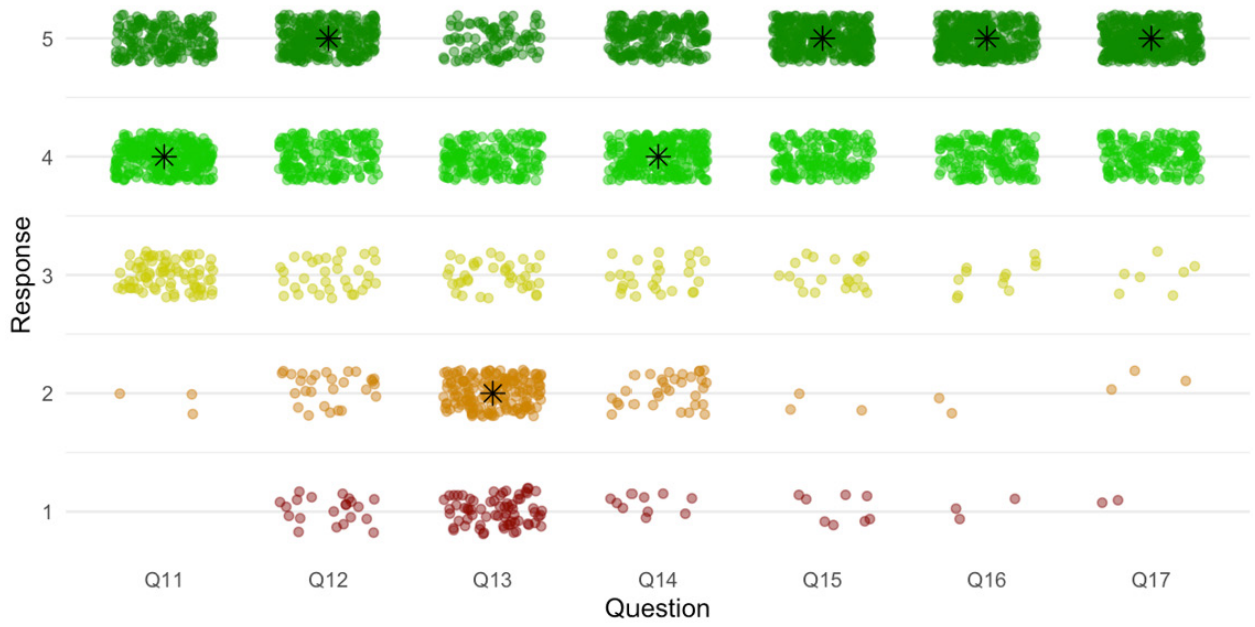

Figure 1. Distribution of responses to the attitude-based Likert questions, where a response of 5 indicates the most positive attitude. The black star marks the most popular response for each question.

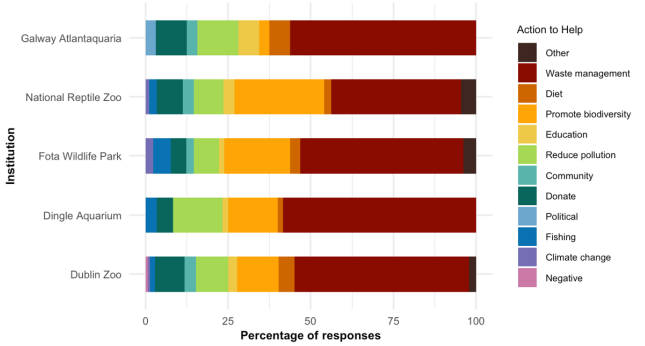

Figure 2. Participants' chosen conservation actions by Institution.

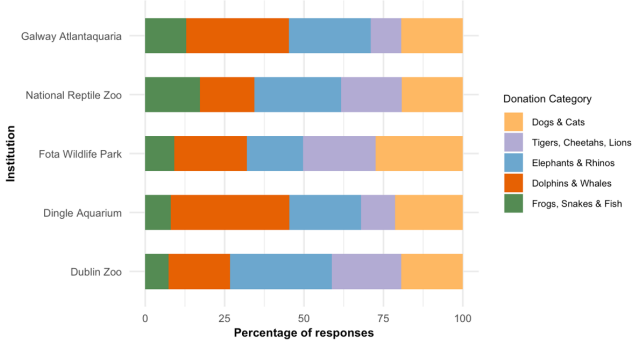

Figure 3. Distribution of participants' donation preferences across institutions.

Community, each selected by 12 participants (2.2%). Climate Change was selected by 5 participants (<1%), while Political and Negative actions received the fewest votes, with just 1 selection each (<1%). Also, 88 (16%) participants did not respond to the question.

Figure 2 shows participants' chosen conservation actions by institution, based only on those who provided a response. Overall patterns were broadly similar across locations, with Waste Management dominating in every institution. The main difference was in the selection of Promote Biodiversity, which was emphasised more strongly at the National Reptile Zoo (27%) and Fota Wildlife Park (20%), but was much lower at Galway Atlantaquaria (3%). For all other categories, institutional differences were relatively minor.

Donations

Summary Statistics

Across all institutions, hypothetical donations were most frequently directed towards Elephants and Rhinoceroses (24.3%), Dolphins and Whales (22.5%), and Dogs and Cats (21.2%), followed by Tigers, Cheetahs, and Lions (18.6%). Frogs, Snakes, and Fish attracted the least support overall, receiving 9.8% of the hypothetical donations. A small proportion of participants either left the question blank (2.6%) or provided illegible responses (1.1%). At the institutional level, some variation was evident, as illustrated in Figure 3.

The most common reason for selecting a donation category was Affinity with species, followed by Endangered/threatened and Example of threat. Less frequently selected reasons included Important species, Familiar/common, Underfunded, and Other (Table 5).

The Influence of knowledge on hypothetical donation preferences

The multinomial logistic regression model examined whether knowledge scores were associated with donation preferences, using Frogs, Snakes, and Fish as the reference category (Table 6). Higher knowledge scores were significantly associated with a lower likelihood of selecting Dogs and Cats compared with Frogs, Snakes, and Fish (β=-1.61, P=0.030). Knowledge score was not significantly associated with selection of Dolphins and Whales (β=-1.25, P=0.092), Tigers, Cheetahs, and Lions (β=-0.54, P=0.480), or Elephants and Rhinoceroses (β=-0.16, P=0.830), relative to the reference category.

A likelihood ratio test comparing the null model with the knowledge-based model indicated that including knowledge scores significantly improved model fit ($\chi^2(4)=10.11$, P=0.039). The AIC was slightly lower for the knowledge model (1647.74) than for the null model (1649.84).

Discussion

This study sought to understand visitors' knowledge and attitude to historically unpopular animals at five Irish zoos. The results of this research indicated that survey scores, particularly attitude, towards conservation and the ignored taxa were moderately high across all visitors, which supports previous research that zoo goers' attitudes towards conservation and zoo animals is mostly positive (Collins et al. 2020). Snakes were an exception to this, both here and in prior research (Clayton et al. 2009; Ogle and Devlin 2022), with most visitors agreeing that snakes are 'scary'. Male visitors tended to have slightly higher knowledge and attitude scores than females, which concurs with previous research (Ogle and Devlin 2022). However, we also found a significant interaction between attitude and age, with younger males having the lowest attitude scores. Collins et al. (2022) also reported that boys scored lower than girls, on a survey of attitude towards zoo animals, on a school field trip.

The results also indicated a positive correlation between knowledge and attitude scores. This connection has been difficult to establish with prior research finding only limited associations (Hines, et al. 1987; Bamberg and Möser 2007). Bamberg and Möser (2007) explain that knowledge gain may not lead directly to behaviour change, but it is likely to facilitate pro-environmental actions or behaviours (Borchers et al. 2014). Also, a lack of knowledge could impede behaviour change (Kuhar et al. 2010; Boeve-de-Pauw and Van Petegem 2011), but knowledge alone is not sufficient to change behaviour (Borchers et al. 2014). These results indicate that higher knowledge scores on the survey and perceived knowledge were correlated with higher attitude scores. Additionally, visitors with the highest knowledge scores were most likely to donate to frogs, snakes and fish, which suggestions a tentative link between knowledge and conservation action.

In the current study, when visitors were hypothetically asked which group of animals they would choose to donate to, less than 10% of those surveyed chose frogs, snakes or fish. Approximately

Table 4. Summary of the Beta Regression Model

Explanatory Variables	Estimate	Std. Error	z Value	P Value
pseudo-R^2 = 0.088				
Age: Under 18	-0.034	0.097	-0.355	0.722
Gender: Male	0.119	0.065	1.818	0.069
Institution 2	-0.196	0.087	-2.260	< 0.05
Institution 3	-0.161	0.073	-2.219	< 0.05
Institution 4	0.156	0.088	1.767	0.077
Institution 5	-0.040	0.124	-0.324	0.746
Perceived Knowledge 2	0.287	0.202	1.420	0.156
Perceived Knowledge 3	0.331	0.193	1.713	0.087
Perceived Knowledge 4	0.485	0.191	2.543	<0.05
Perceived Knowledge 5	0.717	0.218	3.293	<0.001
Age: Under18 x Gender: Male	-0.314	0.149	-2.102	<0.05

66% chose large, charismatic mammals and the remaining visitors chose dogs and cats. Empathy with an animal is of vital importance in the path towards pro-conservation behaviour (Skibins and Powell 2013; Howell et al. 2019; Costa et al. 2025). In the present study, the primary reason for choosing which species to hypothetically support was a feeling of affinity with those species, followed by the visitors' perception of them as threatened. Colléony et al. (2017) state that when they examined visitors' willingness to pay (WTP) the animal's charisma was more important than conservation status. However, those that chose to adopt a less likeable animal also contributed more financially, which the authors attribute to their conservation commitment (Colléony et al. 2017). Martín-López et al. (2007) found that of visitors who were hypothetically WTP for biodiversity conservation, unless they had specific conservation knowledge, biophilia and affective factors (e.g. similarity to humans) generally explained visitor support for various species in Spain. Results of other categories that visitors chose to donate to are variable, which underscores the many influences and previous experiences which affect visitor experience in the zoo (Ballantyne et al. 2007; Godinez and Fernandez 2019).

When survey participants were asked to list knowledge of one action that they could take to help fish, amphibians and reptiles in the wild, the majority of respondents named a waste management activity. This was followed by promoting biodiversity. The fact that more than half of the respondents listed knowledge of an action that they could reasonably carry out is encouraging and signifies environmental self-efficacy or a belief in one's own actions to help the environment (Hungerford and Volk 1990; Jensen 2014). Some respondents suggested more elaborate, less personally feasible actions, such as stop climate change or stop overfishing, while 16% of respondents did not respond to the questions. This finding is similar to Moss et al. (2015) who reported a significant increase in knowledge of actions to help protect biodiversity after zoo visit.

Learning varies between settings, and a complex combination of factors affect learning outcomes (Falk and Storksdieck 2005). Prior research has found that exhibit design within in a zoo impacts learning (Tofield et al. 2003; Moss and Esson 2010; Moss and

Table 5. Percentage breakdown of reasons for selecting donation categories

Reason	Dogs and cats	Tigers, cheetahs, lions	Elephants and rhinos	Dolphins and whales	Frogs, snakes, fish	Overall
Other	2.6	1	2.3	1.6	0	1.7
Endangered-threatened	0	34.7	38.6	18.9	11.3	22
Example of threat	13	9.9	30.3	18.9	7.5	17.6
Affinity with species	53	37.6	14.4	29.5	15.1	31
Underfunded	0	1	1.5	4.1	32.1	4.8
Familiar/common	13.9	0	2.3	4.1	1.9	4.8
Important species	5.2	1	0.8	6.6	22.6	5.4
No reason provided	12.2	14.9	9.8	16.4	9.4	12.8

Table 6. Summary of the Multinomial Logistic Regression Model

Category	Coef (Intercept)	Coef (Score)	P value (Score)
1. Dogs and cats	1.861	-1.605	< 0.05
2. Tigers, cheetahs and lions	1.023	-0.537	0.484
3. Elephants and rhinoceros	1.026	-0.159	0.830
4. Dolphins and whales	1.689	-1.246	0.092

Pavitt 2019), but fewer studies have evaluated learning outcomes between sites. In the current study, knowledge and attitude scores were highest at The National Reptile Zoo. It follows that visitors who chose to attend a reptile only zoo would have some interest and perhaps prior knowledge of the species kept there. Whereas visitors at Dublin Zoo may be predominantly interested in mammals and not have the same interest in reptiles as those attending a reptile zoo (Moss and Esson 2010). Furthermore, visitors at the two aquariums prioritised monetarily helping dolphins and whales, while those at The National Reptile Zoo were the most likely to choose frogs, snakes and fish. These findings suggest that study participants had an affinity with the species which may be closely associated with the site that the visitors were at. Visitors may lose interest in the ignored taxa when more charismatic species are present (Moss and Esson 2010).

Certain limitations occurred during the course of the research. The current research was interested in visitor experience at different zoological institutions so did not carry out a pre-post-survey design. Thus, it is not possible to know if visitors applied pre-existing knowledge to answer the question or if they learned something at the exhibit which helped them to respond to the question (Marino et al. 2010). Also, visitors' attitude and donation preference are likely influenced by factors not tested here such as prior experience, pet ownership and social groupings. We did not consider if frequency of zoo visits, might influence visitors' experience toward the ignored taxa, even though prior research has found a connection between frequency of visits and visitors' perceptions of animals (Devlin and Ogle 2022). Invertebrates were excluded from the study because of lack of representation in the collections included in this research, though they are indeed ignored and disliked by many zoo visitors (Brereton 2022; Geest et al. 2026). Animal proximity and activity also impact visitor experience and feelings of connectedness to an animal (Howell et al. 2019; Learmonth et al. 2021), but quantifying animal behaviour was out of the scope of the current study.

Although visitors demonstrate clear taxonomic biases, which many zoos and aquariums cater to, further work is needed to attractively display species from all taxonomic groups, inspiring visitors to care and take action. When displayed in appropriate habitats, with strong messaging, even traditionally unattractive species can be reframed in the visitors' eyes (Conway 1973), particularly if zoo presentations show material in an empathetic way (Geest et al. 2026). Furthermore, research has also shown that visitors have a keen interest in unique species (Mooney et al. 2020), which provides opportunities for traditionally ignored and under-represented taxa. Further work is needed by zoos to not simply accommodate visitors' preferences, but to actively try to change visitor perceptions of the ignored taxa, repositioning them as species in need of conservation action. Almost 30 years ago Reade and Waran (1996) suggested that research on the public's attitude to zoo animals should be conducted outside of zoos. This has been slow to occur, and we strongly suggest that future research consider the knowledge and attitude of all people towards conservation and not just zoo visitors, who are likely to have more in depth knowledge and better attitudes (Godinez and Fernandez 2019). Additionally, the authors recommend that future studies should consider replicating this research in reptile and amphibian rich countries, such as Brazil, to investigate how that might influence visitors' attitude and knowledge towards the ignored taxa.

Increasingly, zoos have been relying on animal-visitor interactions (AVI) experiences to bring people and animals together, and that limited, controlled and welfare assessed AVIs might benefit both visitors and animals (Lin et al. 2025). Kemp et al. (2025) state that the AVIs do not need to be hands-on to be effective and may increase donation giving. We suggest that certain species of the ignored taxa could be included in these activities, to elicit empathy and affinity towards these animals, which could lead to greater financial support and pro-conservation actions (Clayton et al. 2009; Godinez and Fernandez 2019). Of course, paid experiences may attract visitors with a pre-existing interest. Therefore, it may be helpful to offer some of these as unpaid experiences for visitors, who may not be inherently interested in a species, to try to develop a connection. Affinity with a species can be key to forming connections and promoting conservation related behaviour (Howell et al. 2019; Costa et al. 2025).

Zoos are potentially one of the most powerful forces for conservation on the planet (Barongi et al. 2015) and may serve as a bridge to reconnect people with nature (Costa et al. 2025). Results of the current study show that zoo visitors have some existing knowledge and positive attitudes towards the ignored taxa. The challenge is now for zoos to further ignite visitors' curiosity, empathy and fervour toward the ignored taxa to bring about pro-conservation actions, especially in settings where these species may have to compete for visitors' interest with more charismatic species.

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Conflict of Interest

The third author of this paper is employed by Dublin Zoo; however, they did not collect the data described here. There are no conflicts of interest to report in this research

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