Perceptions of zoo visitors about the suitability of Geochelone elegans as a pet based on exhibit design

Shannon Marie McKinney

Iowa State University

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Perceptions of zoo visitors about the suitability of *Geochelone elegans* as a pet based on exhibit design

by

Shannon Marie McKinney

A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Wildlife Ecology

Program of Study Committee:
Rebecca Christoffel, Major Professor
Fredric Janzen
Timothy Stewart
Robert Paul Lasley

Iowa State University

Ames, Iowa

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ABSTRACT

Globally, the pet trade plays an active role in society even though many of the species involved are not always ideal pets. Zoos and other institutes may inadvertently contribute to the problem by housing animals in exhibits which may mislead the public about an animal’s suitability as a pet. The primary goal of this research is to test whether visitor perceptions of the suitability of *Geochelone elegans* (Indian star tortoise) as a pet were affected by exhibit design. *G. elegans* was displayed in two different exhibits; a naturalistic exhibit design and a tank design. After setting up the contrasting exhibits in the Blank Park Zoo’s Discovery Center, zoo visitors were interviewed about *G. elegans* and its suitability as a pet after visiting one of the two test exhibits. Exhibit design did influence visitor perceptions of the space requirements of *G. elegans* (*p < 0.001*). Visitors viewing the exhibit treatment were more likely to agree with the statement “Indian star tortoise need an area the size of a child’s bedroom to live in”, while visitors viewing the tank treatment were more likely to disagree. Considerations such as cost (*p = 0.063*) and ease of care (*P = 0.065*) influenced whether or not a visitor perceived the Indian star tortoise as a suitable pet. However, other factors such as age (*p = 0.034*) and whether or not a visitor had children or grandchildren (*p = 0.032*) were associated with whether or not a visitor would consider *G. elegans* as a potential pet. Visitors in the age group 30-49 who had children were more likely to answer “no” when asked whether or not they would consider getting a tortoise as a pet.
CHAPTER 1. INTRODUCTION AND LITERATURE REVIEW

Globally, the pet trade plays an active role in society even though many of the species involved are not always ideal pets. As a result, wild populations are being exploited to meet the public’s demand for these exotic pets, leading to reductions in populations (Gibbons et al., 2000). Zoos and other institutions may inadvertently contribute to the demand for exotic pets by housing animals in exhibits that may be misleading to the public in regards to the specific needs of the animal and their suitability as a pet. For example if a reptile is housed in a small tank, the public may perceive that a small tank is all that animal needs, when in reality the visitor does not see all of the behind the scenes work required to keep the animal healthy. Reptiles and amphibians, animals that are popular in the pet trade are commonly displayed in potentially misleading exhibits such as the afore mentioned.

The pet trade industry has played an active role in the loss and near extinction of numerous herptiles globally (Gibbons et al., 2000). According to the Partners in Amphibian and Reptile Conservation (PARC), unsustainable use is one of the top six contributors to species extinction, but one of the top three contributors that we as humans can impact (Gibbons et al., 2000). Since 2000, the United States has imported more than 1.48 billion live animals legally for the pet industry and many more animals enter the pet trade illegally (Rosen & Smith, 2010). TRAFFIC, the wildlife trade monitoring network made 967 seizures from 1996 to 2008 with reptiles and amphibians comprising 69% of the 191,934 live wild-caught animals seized during that time frame (Rosen & Smith, 2010). Many of the species collected for the pet trade are listed on Convention on International Trade in Endangered Species (CITES), and as a result are disappearing quicker than they can be studied (Schlaepfer et al., 2005; Nijman & Shepherd, 2011). In Asia, the international pet trade has played an active role in high extinction rates of local turtle populations (Turtle Conservation Coalition, 2011). In Indonesia, 73% of local traders have indicated that some species have become scarce due to over-collection (Natusch &
Lyons, 2012). In the United States in 1994, Eastern box turtle (Terrapene carolina) populations plummeted in 16 states after almost 30,000 individuals were collected for the pet trade (Gibbons et al., 2000). Herptiles generally are the most vulnerable group to the pet trade for several reasons. They have delayed sexual maturity, high adult survivorship and low reproductive rates and many of the popular species have restricted ranges (i.e. tuatara, skinks, many gecko and snake species, turtles and tortoises) (Pough & Andrews, 2004).

At the same time that the pet trade is impacting the collected population, it is also causing problems in our local un-collected populations. Invasive species in the United States can be directly linked to the pet industry (Perry & Farmer 2011). Invasive species have also been listed as one of the top six conservation concerns established by PARC and is also one of the top three concerns that humans can address (Gibbons et al., 2000). Florida is a prime example of the huge impact that invasive “pet” species have had on the local ecosystem as well as human population. Florida has a history of successful establishment of invasive species due to global trade (Fujisaki et al., 2010). Recent increases in the popularity of exotic reptiles as pets has led to intentional or accidental release by pet owners and dealers (Fujisaki et al., 2010), resulting in many residents of south Florida daily reporting large snakes (pythons and boas) and lizards (tegus and monitors) in their yards. According to the 2012 South Florida Environmental Report, the number of nonindigenous species ranges from approximately 55 species in Kissimmee Basin, to greater than 150 in the Greater Everglades (Rodgers et al., 2012). In the Everglades region, more than 130 Burmese Pythons were removed from January to October 2011, and since 2001, 22 Northern African Pythons have been removed (Rodgers et al., 2012). Unfortunately snakes such as these have further made the news because of an instance in which the exotic “pet” escaped and strangled two small children (Hopper, 2013).
People get reptiles as pets for various reasons, (exotic, unique, and easy to care for) but often they realize too late that many reptilian species don’t make good pets. Many national pet store chains list animals such as ball pythons, tortoise, turtles and various frogs as “beginner” animals and recommend 20 -40 gallon tanks as appropriate habitats (Petco, 2012; Petsmart, 2012). These stores give the impression that such animals are easy to care for with simple habitat set ups, diets and cleaning routines that could easily appeal to any on-the-go family. However, further investigation into many of these species reveals a different story. They require larger habitats, extensive micro-climate control and diverse diets, making the captive care of a reptile not only expensive but time consuming (Highfield, 1996).

Zoos play an important role in conservation and have an important influence on the public regarding animals and their conservation. The Association of Zoos and Aquariums (AZA) recognizes this element by requiring all accredited institutions to have conservation and education programs as part of their daily operations (AZA, 2009). With the public spending literally seconds looking at exhibits, complex designs could speak volumes to visitors who may not read signage, making the exhibits part of the educational landscape (Moss & Esson, 2010). At the National Zoo’s reptile house, the mean time for exhibit viewing of all of their 74 exhibits (not individual exhibits) was 8 minutes (Marcellini & Jensswen, 1988). At the Gaherty Reptile Breeding Centre, the mean viewing time for 15 exhibits was found to be 6.38 minutes (Phillpot, 1996). Ninety-five percent of visitors at Edinburgh Zoo felt it was important that enclosures be made to look like the animals’ natural habitats (Reade, 1996). In the same study the general public listed conservation as a zoo’s top role in society and had the perception that zoos know what they are doing when it comes to captive management (Reade, 1996). Thus, if a zoo houses their herptiles in traditional jeweled box terrariums, the visitor’s take-away message may be that this is the proper way to keep these animals in captivity. The visitor doesn’t always see the behind-the-scene work required to keep a captive population healthy. Therefore, by properly displaying species, zoos can
inform visitors about the basic needs of these animals, preventing or at least reducing the assumptions that reptiles make good pets.

*Geochelone elegans*, the Indian star tortoise, is a popular pet that is easily purchased online through various dealers such as Black-water Reptiles ([http://www.backwaterreptiles.com/tortoises/star-tortoise-for-sale.html](http://www.backwaterreptiles.com/tortoises/star-tortoise-for-sale.html), accessed 20 April 2014). *G. elegans* is generally recommended for the dedicated hobbyist rather than beginners. This species is considered ideal due to its small size, beauty and interesting behavior. These animals on average measure twenty centimeters straight carapace length (SCL) for males and thirty centimeters SCL for females (Highfield, 1996). They are named for the yellowish “star burst” on their dark brown carapace that allows them to hide in grassy areas (Edqvist n.d.). Since they are successfully captive bred, they are deemed an environmentally and ethically sound purchase (Edqvist n.d.). In the wild, *G. elegans* inhabits a wide variety of habitats from semi-deserts to savannas and even deciduous forests throughout India, Sri Lanka and part of Pakistan (Highfield, 1996). While the habitats seem diverse, they all experience some sort of a dry season (Highfield, 1996). In the wild, *G. elegans* consumes grasses and succulents. During extended dry seasons some individual can even become inactive to counter the lack of vegetation (Edqvist n.d.). However, in captivity *G. elegans* appears sensitive to temperature and humidity as well as improper diet; the Tortoise Trust estimates that 95% of juvenile *G. elegans* die within six months of entering captivity due to improper care (Tortoise Trust n.d.).

Captive requirements for *G. elegans* are extensive and complex. Minimum enclosure size should be 1 - 2m² with a micro-climate of 21°C to a basking site around 32° C. Substrates can vary from sand/soil mixtures to cypress bark or even grass hay; the main requirement is that the substrate creates a dry environment (Highfield, 1996; Tabaka, 2006). However, many pet stores recommend 75-150L tanks with a single heat lamp for warmth and often recommend fir, alfalfa pellets or coconut husk as
proper substrates (Petco, 2012; Petsmart, 2012). Such tanks do not allow for proper ventilation. The recommended substrates harbor humidity, mold and chemicals and can easily cause respiratory problems or impaction if consumed (Highfield, 1996).

Improper nutrition is also a common source of death and deformation in Indian star tortoises. According to the Tortoise Trust and World Chelonian Trust, a proper diet for *G. elegans* should consist primarily of grasses, hays, weeds and flowers, with leafy greens as supplement during winter seasons. The diet should also include a calcium supplement, which when natural sunlight is unavailable should contain vitamin D3 for proper absorption and use of the calcium (Highfield, 2000; Tabaka, 2006). However, some pet stores simply report fruits and vegetables or herbivores for their diet description (Petsmart, 2012; Petco, 2012). Fortunately, the one item that sources seem to agree upon is the necessity for fresh water. Based on natural history, the discrepancies in captive management practices as well as the draw as a “pet” species, *G. elegans* is an ideal candidate for the focus of this research.

The primary goal of this research was to test whether or not exhibit design impacted visitor perceptions regarding the suitability of *G. elegans* as a pet. We tested whether there were differences in the perceptions of visitors who viewed *G. elegans* in a large naturalist exhibit with those of visitors who viewed *G. elegans* in a typical tank exhibit. Behavioral and health variations of the animals were also assessed to determine if there were any differences between a tortoise placed in the complex exhibit design and a tortoise placed in the common tank set up. Previous research has suggested that reptiles placed in naturalistic environments exhibit more natural or normal behaviors when compared to un-naturalistic environments and that naturalistic environments are less stressful on reptiles than un-naturalistic environments (Warwick et al. 1995). In our research we investigated whether or not visitor perceptions regarding the suitability of *G. elegans* as a pet differ based on exhibit design. We also investigated whether or not *G. elegans* exhibited different behaviors in a complex exhibit when
compared to a tank exhibit as well as whether or not health would differ in the complex exhibit when compared to the tank exhibit.
CHAPTER 2. MATERIALS AND METHODS

Study site

Research was conducted in the Discovery Center (DC) at the Blank Park Zoo (BPZ) in Des Moines, Iowa. Opened in 2001, the DC gives visitors an “immersive” experience in a complete ecosystem. The DC is a temperature-controlled exhibit housing a variety of free flight birds, live plants, tamarins, herptiles, and aquariums.

Specimens

Two adult male *G. elegans* were used in the research. They have been at BPZ since 2011 and prior to this research were kept behind the scenes in temporary housing. The first individual is numbered 2193 (an International Species Information System or ISIS number which is an identification number within many zoos), has a SCL of 20 cm, and weight of 620 g. The second individual, 2194, has a SCL of 19 cm and a weight of 570 g. Both individuals were deemed by BPZ’s onsite veterinarian as being in good health based on gross analysis, which includes a visual exam and fecal float. Throughout the experimental timeline, the onsite veterinarian was available to monitor and maintain the overall health and safety of the tortoises. The experiment included two exhibit designs, one being a 150 L tank design (91 cm L X 46 cm W X 46 cm H) and the other being a 2 m² naturalistic exhibit design (213 cm L X 91 cm W X 122 cm H).

Treatments

The 150 L Exo Terra® glass terrarium included a cypress bark substrate, one infrared heat lamp for a basking site, and a full spectrum fluorescent bulb. For tank furniture a commercial rock water dish and hide hut were provided. Temperature of the basking site was maintained at 32°-35°C, while ambient temperature was maintained above 24°C. The heating lamp remained on 24 hours a day and
temperature was checked daily using a laser thermometer at opening (0800 hours). Full spectrum light was provided from opening to closing (1700 hours). Fresh water and diet was provided daily based on current BPZ diet protocols for *G. elegans* (based on veterinarian and nutritionist recommendations). Cleaning and maintenance of tank set up was consistent with BPZ protocols and institutional standard for captive management. Time was allowed for the tank to be set up and optimal temperatures reached prior to tortoises being placed in the tank to avoid unnecessary stress on the individual tortoise.

In the naturalistic exhibit set up, the substrate was the natural soil mixture found in the DC as well as the same infrared heat lamp used in the tank setup for a basking spot with the same temperature requirements. Ambient temperatures were based on ambient temperature of DC, which was kept around 24° C and recorded daily using the same thermometer used in tank setup monitoring. Furniture included identical rock water dish and hide hut as the tank setup, but also any vegetation already growing in the site that included a variety of trees, bushes and ground plants and flowers. Steps were taken to confirm with horticulture staff that all plants were tortoise safe. The exhibit was constructed of an open-top Plexiglas walled design for easy viewing and ventilation. Fresh water and diet based on current BPZ diet protocols for *G. elegans* (based on veterinarian and nutritionist recommendations) were provided daily. Cleaning and maintenance of exhibit setup was consistent with BPZ protocols and institutional standard for captive management.

**Medical**

Prior to, and during the experiment, BPZ’s on-site veterinarian conducted health assessments to ensure the health and overall welfare of specimens. Treatments and veterinary recommendations were recorded for any health issues that arose during the experiment.
Visitor Survey

The experiment was conducted by two researchers during the “summer” season at BPZ (June – July 2013). The experiment consisted of two treatments labeled as “Tank” (n₁) and “Exhibit” (n₂) in the DC. Visitors (N = 300) were selected to answer a thirteen-question survey (Appendix A) after viewing *G. elegans* at one of the treatments (n₁ = 150 and n₂ = 150). At the beginning of each survey session, the sixth adult visitor to enter the area was the first surveyed and then every ninth adult following was surveyed on busy days. On slow days the session started with the sixth adult visitor to enter the area, followed by every fourth visitor to enter the area. These visitor selection numbers were generated from [www.random.org](http://www.random.org) to ensure selection of a random sample of visitors. The survey contained five statements designed to measure a visitor’s perception of *G. elegans*’ suitability as a “pet” species (1a, c, d, f and h) as well as a question asking if visitors would consider a tortoise as a pet. These statements were based on common concerns visitors might have when considering whether or not an animal would make a good pet such as cost, ease of care, required space, and activity level. Three control statements were also included in question 1, visitor answers to these statements were not expected to differ between treatments (1b, e and g) as well as demographic questions (2-4, 6). A larger set of questions were piloted during the 2012 “summer” season with visitors (N = 25) to the BPZ Aldabra tortoise exhibit. As a result of the pilot study, we were able to narrow down the key statements that were chosen to include in this survey. Visitor answers to the survey were recorded using digital voice recorders, and then transferred to Survey Monkey™. Both researchers double-checked the data transferred to electronic survey forms to minimize transfer errors. Survey results were then analyzed using SPSS Statistical program version 20.

Various statistical analyses were run using SPSS to determine the demographics of visitors’ surveyed and how they responded to survey questions based on which treatment they were viewing.
Reliability analysis was used to measure how closely related the statements in question one were, and a Cronbach’s alpha was calculated to determine if the scale used was appropriate. Means were determined based on a scale used to rank responses within each variable statement. For example; the statement “Tortoises can live more than 50 years”, Agree = 3, Unsure = 2 and Disagree = 1; whereas, the statement “Iceberg lettuce can provide a complete diet”, Agree = 1, Unsure = 2 and Disagree = 3. Questions with a yes/no response were scaled with Yes = 1, No = 2 and Unsure = 3. SPSS was then used to calculate mean based on this scale. One-way ANOVAs were used to determine if any significant difference existed between how visitors answered and whether they were viewing the tank or exhibit treatment. One-way ANOVAs were used to determine if any significant differences existed between how visitors responded to the question “Would you consider getting a tortoise as a pet?” and their demographic responses. Further n-way ANOVAs (or MANOVAs) were run to determine if significant interactions were present between treatments and demographics that may be associated with how visitors responded to each question. Significance values were set at p < 0.05. Based on the fact that we only wanted to determine if any differences in visitor response existed between treatments, we decided not to run one-tailed analysis. The ultimate goal was to determine what, if any message zoo exhibits send visitors in order to ensure the desired conservation message is getting to our visitors. Our overall analysis provided some interesting results.

**Behavioral observations**

While conducting survey sessions, behavioral observations of tortoises were recorded at the beginning, every hour during, and at the completion of each survey session. Eight behavioral categories were used for observing an individual’s behavior within each treatment based on previously observed behaviors. Definitions for behaviors include: (A) Hiding- under cover of object while actively searching or peeking out from underneath, (B) Inactive- not moving with eyes open or closed, (C) Foraging- eating
food, (D) Exploring- moving around enclosure with no obvious pattern while investigating items within enclosure, (E) Pacing- moving around enclosure in an obvious pattern repeated three or more times, (F) Basking- sitting under heat or UV lamps, (G) Interacting- moving towards public or following public’s movement and (H) Soaking- sitting in water dish. Because observations were recorded during survey sessions, times are estimated in 5 minute increments. Times were then added together for each individual in each treatment and compared to determine if trends existed in how each tortoise behaved in either treatment during the experiment. Results were also compared to determine any behavioral differences between treatments. These trends were then compared to how visitors responded to the statement “Tortoises appear very active” to determine if tortoise behavior may have impacted how visitors responded to this statement.
CHAPTER 3. RESULTS

Medical

Both specimens remained healthy throughout the duration of the research. No medical intervention was necessary. There appeared to be no difference in health each tortoise between treatments.

Survey results

The scale we constructed to measure respondents’ perceptions of the suitability of G. elegans as a pet yielded an initial Cronbach’s Alpha =0.038, indicating almost no cohesiveness to the items. Therefore, we analyzed each of the items within question 1 separately (as independent statements). ANOVA was primarily used to determine if significant differences existed between treatments for each item (Table 1 and Figure 1) and to investigate associations between demographic variables and individual item responses (Tables 2, 3, 4 and Figures 2, 3, 4). Other figures expressing percentage of visitor responses to each statement were used to determine trends than may have occurred in how visitors responded (Appendix B).

Table 1: Summary Analysis of Question 1 and 5: Mean responses of visitors (N=300) to each item in question 1 based on which treatment they were viewing (tank n = 150 and exhibit n = 150). Associated p-value (bold is a significant difference and * is a moderately significant difference) and Eta or effect size.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Tank Mean</th>
<th>Exhibit Mean</th>
<th>P-Value</th>
<th>Eta</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Tortoises appear easy to care for</td>
<td>2.72</td>
<td>2.57</td>
<td>0.065*</td>
<td>0.107</td>
</tr>
<tr>
<td>B. Tortoises can live more than 50 years</td>
<td>2.86</td>
<td>2.87</td>
<td>0.882</td>
<td>0.009</td>
</tr>
<tr>
<td>C. Tortoises can cost several thousand dollars to keep over their life time</td>
<td>2.47</td>
<td>2.29</td>
<td>0.063*</td>
<td>0.108</td>
</tr>
<tr>
<td>D. Indian star tortoise appears to need an area the size of a child’s bedroom to live</td>
<td>1.61</td>
<td>2.72</td>
<td>&lt; 0.001</td>
<td>0.592</td>
</tr>
<tr>
<td>E. Tortoises appear to learn from their environment</td>
<td>2.74</td>
<td>2.73</td>
<td>0.909</td>
<td>0.007</td>
</tr>
<tr>
<td>F. Tortoises appear very active</td>
<td>1.68</td>
<td>1.83</td>
<td>0.085</td>
<td>0.100</td>
</tr>
<tr>
<td>G. Iceberg lettuce can provide a complete diet</td>
<td>1.55</td>
<td>1.49</td>
<td>0.503</td>
<td>0.039</td>
</tr>
<tr>
<td>H. Tortoises appear to make a good pet</td>
<td>2.28</td>
<td>2.32</td>
<td>0.695</td>
<td>0.023</td>
</tr>
<tr>
<td>I. Consider getting a tortoise as a pet</td>
<td>1.79</td>
<td>1.89</td>
<td>0.111</td>
<td>0.092</td>
</tr>
</tbody>
</table>
Figure 1: Comparison of mean responses to items in Question 1 from visitors viewing the tank and naturalistic exhibit. (A) Tortoise appear easy to care for, (B) Tortoises can live more than 50 years, (C) Tortoises can cost several thousand dollars to keep over its life time, (D) Indian start tortoise appears to need an area the size of a child’s bedroom, (E) Tortoises appear to learn from their environment, (F) Tortoise appear very active, (G) Iceberg lettuce can provide a complete diet, (H) Tortoises appear to make a good pet and (I) Would you consider getting a tortoise as a pet?

Table 2: Summary analysis of question 5 by age range: Mean responses of visitors in each age range as to whether or not they would consider getting a tortoise as a pet (1=yes, 2=no and 3=unsure), associated p-values and Eta or effect size; 18-29 years (n = 90), 30-49 years (n = 174), 50-64 years (n = 29) and 65 and older years (n = 7).

<table>
<thead>
<tr>
<th>Consider getting a tortoise as a pet</th>
<th>Mean 18-29 yrs.</th>
<th>Mean 30-49 yrs.</th>
<th>Mean 50-64 yrs</th>
<th>Mean 65+ yrs.</th>
<th>P-Value</th>
<th>Eta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean response</td>
<td>1.71</td>
<td>1.91</td>
<td>1.9</td>
<td>1.57</td>
<td>0.034</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Figure 2: Comparison of mean for each age range: mean comparison for each age range based on how visitors’ answered the question “Would you consider getting a tortoise as a pet?” based on the scale Yes = 1, No = 2 and Unsure = 3.
Table 3: Mean responses, associated p-value and eta or effect size for male and female visitors to question 5, “Would you consider getting a tortoise as a pet?”

<table>
<thead>
<tr>
<th>Consider getting a tortoise as a pet</th>
<th>Mean Males</th>
<th>Mean Females</th>
<th>P-Value</th>
<th>Eta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consider getting a tortoise as a pet</td>
<td>1.81</td>
<td>1.85</td>
<td>0.598</td>
<td>0.031</td>
</tr>
</tbody>
</table>

Figure 3: Comparison of mean for male and female visitors’ responses to the question “Would you consider getting a tortoise as a pet?”

Table 4: Mean responses of visitors who had children or grandchildren and visitors who did not have children or grandchildren to the question “Would you consider getting a tortoise as a pet?”, with test of statistical significance and effect size.

<table>
<thead>
<tr>
<th>Consider getting a tortoise as a pet</th>
<th>Mean Yes Children</th>
<th>Mean No Children</th>
<th>P-Value</th>
<th>Eta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consider getting a tortoise as a pet</td>
<td>1.87</td>
<td>1.68</td>
<td>0.032</td>
<td>0.124</td>
</tr>
</tbody>
</table>

Figure 4: Means of visitors who had children and grandchildren and visitors without children and grandchildren to the question “Would you consider getting a tortoise as a pet?”
For statements “Tortoise appear easy to care for”, “Tortoises can cost several thousand dollars”, “Indian start tortoise needs an area the size of a child’s bedroom”, “Tortoises appear active”, and “Would you consider getting a tortoise as a pet?”, further n-way ANOVAs were run to test for significant interactions among treatments viewed and demographic responses in how visitors answered each statement.

There was no significant difference in response to the statement “Tortoises appear easy to care for”, regardless of exhibit design, age, gender and whether or not a visitor had children or grandchildren. Greater than 75% of visitors disagreed with the “easy to care for” statement regardless of exhibit treatment (Appendix B, Figure 9).

“Tortoise can cost several thousand dollars” differed by gender (p = 0.033, Eta = 0.571) and age (p = 0.065, Eta = 0.542), but there was no significant interaction between the two (p = 0.575). Visitors between the ages of 30-49 and male visitors were more likely to agree with the statement “Tortoises can cost several thousand dollars.”

For “Indian start tortoise needs an area the size of a child’s bedroom” responses differed significantly based on exhibit design that had just been viewed (p < 0.001, Eta =1.0). However, there was also a significant interaction based on a visitor’s age and whether or not a visitor had children or grandchildren (p = 0.041, Eta = 0.668). Visitors aged 30-49 with children or grandchildren were more likely to agree with the statement.

“Tortoises appear very active” did not differ regardless of exhibit design, age, gender and whether or not a visitor had children or grandchildren.

For the question “Would you consider getting a tortoise as a pet?”, visitors with children or grandchildren differed significantly in their responses from visitors without children or grandchildren regardless of what treatment they had just viewed (Table 4, p = 0.020, Eta = 0.124). Visitors with children were more likely to answer “No” regardless of treatment they were viewing. However, while
there were differences among age groups in responses (Table 2, \( P = 0.034 \)), there was no interaction effects between age and treatment. (\( p = 0.406 \)).

**Demographics**

Of the visitors surveyed (N=300) 70% were females, 58% were 30-49 years old and 83% had children or grandchildren under the age of 18 years of age (Figure 5).

![Figure 5: Demographics of surveyed visitors, (A) Gender, (B) Age ranges and (C) whether or not a visitor had children or grandchildren under the age of 18.](image)

**Behavioral observation**

In the naturalistic exhibit treatment, both tortoises were active but in very different ways. Tortoise 2193 spent > 43% of his time exploring the exhibit whereas tortoise 2194 spent > 51% of his time hiding from birds within the DC (Figure 6). In the tank treatment, both individuals spent close to 70% of their time inactive with another almost 20% of their time pacing the tank (Figure 7).
Figure 6: Behavioral observation of exhibit treatments. Cumulative amount of time each individual spent conducting each behavior with in the exhibit treatment.

Figure 7: Behavioral observation in tank treatments. Cumulative amount of time each individual spent conducting each behavior with in the tank treatment.
CHAPTER 4. DISCUSSION

Medical

Throughout the duration of the experiment both tortoises remained healthy regardless of which treatment they were placed in. This could be due to the fact that Tortoise 2193 was moved from a small temporary holding tank into the tank treatment; therefore stress may have been minimal since the spaces were similar in size. The tank treatment also provided the tortoise with more visual and auditory stimuli when compared to the temporary holding, perhaps leading to less stress. Tortoise 2193 was then moved to the exhibit, which based on previous research that naturalistic environments provide reptiles with the least amount of stress (Warwick et al., 1995); should not have been stressful. Tortoise 2194 was moved from the small temporary holding tank into the exhibit, which should not have caused additional stress, however it was expected that moving 2194 from the exhibit treatment to the tank treatment could cause additional stress allowing for illness. However this was not apparent, perhaps due to the short experimental time of 8 weeks or the fact that the first week in the exhibit, 2194 was mobbed by Silver eared Mesia (*Leiothrix argentauris*) living in the DC. As a result moving 2194 to the tank set up may not have been as stressful as was expected since 2194 no longer had to evade the Mesias.

Visitor survey

The goal of the visitor survey was to determine if visitors’ perceptions of *G. elegans* differed based on treatments and how they differed, in order to improve the messages, intentional or otherwise, that zoos are sending visitors. Question 1 statements were used to determine what, if any, differences exhibit design would have on visitor response. Responses to those items that we deemed as controls did not differ between treatments. This seemed to indicate that we had successfully selected items that would not be affected by immediate viewing differences. We obtained mixed results when it came to the items that we used as a measure of how suitable a visitor felt that a tortoise was as a pet.
While not statistically significant, there did appear to be a trend in how visitors responded to the statements “Tortoise appear easy to care for” based on viewing experience. Visitors viewing the tank were more likely to disagree with ease of care. This suggests that they may realize the amount of cleaning and maintenance required to keep a tank clean, whereas the exhibit, while labor intensive to set up, may appear to require slightly less maintenance over time due to the natural soil and plant life.

Visitors’ responses to “Tortoises can cost several thousand dollars to keep over their lifetime” did not differ significantly between treatments (Figure 6). However visitors viewing the tank tended to agree more with this statement than visitors viewing the naturalistic exhibit. This may have been because visitors were thinking of the cost of replacing substrate, the initial cost of the tank and any replacement tanks and cleaning supplies. The exhibit however may have given the impression to visitors that one can use soil out of the back yard and that one wouldn’t need to undertake costly changes of soil as often as changing substrate in the tank, if at all. Results from our n-way analyses suggest that other factors are associated with how visitors perceived of the cost of keeping a tortoise. The fact visitors in the age range 30-49 years were more likely to agree with the statement regardless of treatment viewed, suggests that they perhaps had prior knowledge regarding costs or that they viewed each exhibit as equally representative of expensive upkeep for tortoises. This age range was also more likely to answer “Yes” to having children or grandchildren so perhaps the added cost of a pet could be associated with their cost evaluation. Males were more likely to agree with the high cost of keeping a tortoise than were females. This finding would benefit from further research to determine why males were more likely to agree compared to females. In general however, over half of the visitors agreed that a tortoise can cost several thousand dollars to keep over its lifetime. Several visitors made comments to the effect of “all animals cost a lot no matter how long they live.”

A very different trend was apparent with the statement “Tortoises appear very active.” While not statistically significant, visitors tended to agree slightly more often with this statement when viewing
the exhibit setup versus the tank setup. This finding may have been caused by the level of activity that a given tortoise exhibited while a visitor was being surveyed. When Tortoise 2194 was in the exhibit he spent most of his time hiding, which may have been viewed as an inactive behavior. In the tank, both specimens spent some time pacing which could have been viewed as an active behavior. These behaviors may have influenced visitor responses.

The statement “Tortoises appear to make a good pet” did not differ between treatments; almost 60% of visitors disagreed with the statement regardless of which treatment they were viewing. An explanation may be linked to past experience with pets or knowledge of tortoises. Several visitors did make the comment/ questioned that “Turtles have salmonella, right?” indicating that there was more associated with how they responded to that statement, such are potential concerns that they or their children or grandchildren may be subject to disease from a turtles and tortoises.

How visitors answered the question “Would you consider getting a tortoise as a pet?” was interesting because it was apparent that multiple variables were associated with how visitors answered. While visitors’ responses did not differ significantly by treatment, there was a trend. Visitors were more likely to answer “no” while looking at the exhibit rather than the tank, however it was also apparent that demographics were associated with how visitors responded. Age and whether or not a visitor had children or grandchildren were strongly associated with how the visitor responded. Visitors between 30-49 years of age were more likely to answer “no” or “unsure” as were visitors with children or grandchildren. Not surprisingly, 67% of visitors who answered “yes” to having children/grandchildren were within the 30-49 years old age range. When visitors were surveyed, many made comments such as “No, I would not get a tortoise as a pet, because I would be the one taking care of it, not the kids” or “No, since I would be the one paying for it and cleaning it.” These comments also suggest that other factors are being taken into consideration. It also lends validity to the statements used in the survey as they captured many of the elements that visitors take into consideration when they choose a pet.
The most interesting results are those related to the statement, “The Indian star tortoise in front of you appears to need an area the size of a child’s bedroom to live in.” Visitors’ responses to this statement differed significantly with treatment. Visitors who were looking at the exhibit were far more likely to agree with this statement than visitors who were viewing the tank set up. This supports the idea of exhibit design as a part of the educational landscape in zoos (Moss & Esson, 2010). It was very clear that visitors were using the treatment that they were viewing to decide how much space the Indian star tortoise needed. This finding supports prior research conducted at the Edinburgh zoo in which visitors expressed an expectation that zoos display animals in enclosures that closely resemble the animal’s natural habitat (Reade & Waran, 1996). Therefore, if visitors are perceiving zoos as the experts and they see a reptile in a small tank, the resulting message could be that a tank is a suitable enclosure for captive reptiles, thus making them ideal pets. This result alone should encourage zoos to examine how they currently display animals to ensure that the display message matches the sign message.

**Behavioral observation**

When looking at the results of the activity analysis, it appears that both individuals spent a large portion of their time inactive or pacing in the tank, where as in the exhibit both were active but in different ways. Tortoise 2194 was randomly selected to be placed in the exhibit first. As a result, the Silver-eared Mesia alarm called and mobbed 2194 every time he tried to move for the first week. Thus he spent most of his time avoiding detection, which is a natural behavior. When Tortoise 2193 entered the exhibit however, the Mesia appeared fairly desensitized to the presence of a tortoise in that area. Tortoise 2193 was not mobbed to the same extent as 2194, therefore 2193 spent more time exploring the exhibit. These results support the idea that a naturalistic exhibit encourages more natural behaviors. Although 2194’s experience was different from that of 2193, he was still exhibiting natural behaviors, which is consistent with others’ research, that reptiles in naturalist exhibit are more likely to
display natural or normal behaviors (Warwick et al., 1995). The tank set up appeared to inhibit natural behaviors and instead promoted the stereotypical behaviors of pacing or inactivity, potentially due to small size or lack of complexity within the tank. In both set ups there did appear to be some interaction with the public. In the tank, Tortoise 2194 was observed following visitor fingers and hands with his head. In the exhibit, Tortoise 2193 was observed moving towards the front of the exhibit when visitors gathered there. He would also move to the side of his exhibit when visitors stopped to look at him. Because, that section of the enclosure was mesh, children could stick their fingers through the holes and Tortoise 2193 was observed moving from child to child, investigating fingers. This provided visitors with a unique experience and demonstrated that these tortoises do interact with their environment.
CHAPTER 5. CONCLUSION

While visitors may use several factors such as ease of care, cost, and an animal’s activity level, as well as whether or not they feel an animal makes a good pet when they consider getting a pet, it is clear that demographics such as age and whether or not a visitor has as children or grandchildren are also associated with that decision. Regardless of whether or not a visitor perceives an animal as a suitable pet, we have demonstrated that visitors obtain information about an animal’s captive requirements from exhibit design. As zoos move forward, it is apparent that greater thought needs to be placed on conservation messaging as a whole. It is not signage alone, but additional components such as exhibit design that also contribute to the conservation messages being sent to visitors. Visitors perceive zoos as the experts in captive management (Reade & Waran, 1996) and look to us to provide accurate information about an animal’s habitat and conservation needs. If we continue to house reptiles in small tanks or jeweled box exhibits, we will continue to mislead visitors about these animals, giving them the impression that reptiles only need a small space in which to live when in reality they need large, diverse habitats (Highfield, 1996). Couple this information with that provided by pet stores and it is easy to see why people might consider getting a reptile as a beginner pet. They may not realize the true investment needed for the captive care of that animal. Providing visitors with accurate information about an animal’s captive requirements not only allows visitors to make informed decisions, but it better explains the conservation perils many of these species face. If visitors perceive that these animals need small spaces to live, why then would signs and experts tell them to save large portions of habitat to protect these species from extinction? These are mixed messages that are being sent to zoo visitors.

Further research is needed to determine the entire suite of factors that influence visitors’ perceptions of *G. elegans’* suitability as a pet species. However, there are findings from this research that indicate that we can make a difference regarding how visitors view this species based on exhibit design. The naturalistic enclosure did encourage the tortoises to exhibit more natural behaviors than
the tank. Thus, by creating a more natural exhibit, visitors viewed a more accurate portrayal of tortoise behavior. Additionally, visitors beliefs about how much space such a tortoise would need was influenced by the exhibit viewed and this was reflected in their responses to the survey. If more zoos moved toward exhibiting reptiles in natural, complex enclosures they would send a clearer message to the public about the needs and difficulties in the captive management of exotic animals. It is hoped that this realization would lead to dissuading visitors from furthering the exotic pet trade and its associated conservation problems.
## APPENDIX A: SURVEY INSTRUMENT

### Perception of Tortoise as Pets

1. Please Indicate how strongly you agree or disagree with each statement below. Please mark one answer for each statement.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Disagree</th>
<th>Unsure</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Tortoises appear easy to care for</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Tortoise can live more than 50 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Tortoises can cost several thousand dollars to keep over their life time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. The Indian Star Tortoise in front of you appears to need an area the size of a child’s bedroom to live in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Tortoises appear to learn from their environment</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>f. Tortoises appear very active</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. Iceberg lettuce can provide a complete diet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. Tortoises appear to make a good pet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. What is your age?

- 18 to 29
- 30 to 49
- 50 to 64
- 65 or older

3. What is your gender?

- Male
- Female

4. Do you have any children/grandchildren under 18?

- Yes
- No

5. Would you consider getting a tortoise as a pet?

- Yes
- No
- Unsure

6. Are you viewing the exhibit or tank set up?

- Exhibit
- Tank
APPENDIX B: ADDITIONAL FIGURES

Figure 8: Visitor response to question 1D by treatment: Comparing visitor’s level of agreement to the statement “The Indian star tortoise needs a space the size of a child’s bedroom to live in” based on which treatment the visitor was viewing.

Figure 9: Visitor response to question 1A by treatment: Comparing visitor’s level of agreement to the statement “Tortoises appear easy to care for” based on which treatment the visitor was viewing.
Figure 10: Visitor response to question 1C by treatment: Comparing visitor’s level of agreement to the statement “Tortoises can cost several thousand dollars” based on which treatment the visitor was viewing.

Figure 11: Visitor response to question 1F by treatment: Comparing visitor’s level of agreement to the statement “Tortoises appear very active” based on which treatment the visitor was viewing.

Figure 12: Visitor response to question 1H by treatment: Comparing Visitor’s level of agreement to statement ”Tortoise appear to make a good pet” based on which treatment a visitor was viewing.
Figure 13: Visitor response to question 5 by treatment: Comparing visitor’s answer to question “Would you consider getting a tortoise as a pet” based on which treatment the visitor was viewing.

Figure 14: Visitor response to question 5 by age range: Comparing visitor’s answer to the question “Would you consider getting a tortoise as a pet” by age range.

Figure 15: Visitor Response to question 5 by children/grandchildren: Comparing visitor’s answer to question “Would you consider getting a tortoise as a pet” based on whether or not a visitor had children or grandchildren.
REFERENCES CITED


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