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Zookeeper–Animal Bonds and Their Relationship with Conservation Action

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Abstract: Human–animal relationships have been demonstrated to have impacts on animal and keeper welfare, although their impacts on zookeepers have been less studied outside of evaluating job satisfaction. Many zoological facilities are active in supporting conservation initiatives among staff, but current levels of zookeeper engagement in pro-conservation behavior and the motivations behind it are less studied. Some research indicates motivations for pro-environmental action, in general, may include empathetic connections with animals. To investigate connections between zookeeper–animal relationships and conservation participation, 144 zookeepers from various locations participated in an online survey responding to questions about their perception of their relationships with the animals in their care and current conservation participation levels. This study found zookeepers who report bonds with the animals in their care are more likely to participate in select conservation behaviors, such as reducing personal waste, than those who do not claim a bond with animals. Bonds did not predict involvement in larger conservation actions such as habitat restoration or citizen science participation. These findings have implications for how zoos might encourage engagement in pro-conservation behaviors and participation among their staff.

Keywords: human–animal relationships; human–animal bonds; conservation behavior; conservation culture

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1. Introduction

The impacts of human–animal relationships, particularly those between animals and their caregivers, have become an area of increasing interest among researchers [1–3]. These relationships are typically defined as a series of repeated interactions between two individuals that build on each other and ultimately allow those individuals to predict the future behavior of the other [2]. Under this definition, relationships can exist on a spectrum ranging from positive to negative. While this definition examines the interactions specifically between two individuals, it can also be used to explore how an animal can form a relationship with a group of individuals. In some situations, such as with a zoo animal and zoo visitors, animals may not be able to identify a single individual, and therefore use the characteristics of a group of individuals to determine overall relationship quality [4].

Positive relationships can evolve into bonds. Bonds are defined as relationships that are reciprocal, persistent, and beneficial to both parties [5]. Human–animal bonds increase the well-being of both parties, and for humans can lead to physiological benefits such as reduced blood pressure and psychological benefits such as reduced stress [2,6,7]. While the benefits for animals are more difficult to study [5], many animal caretakers report similar positive changes such as reductions in stress and positive impacts on traits such as reproductive success [2,8–10]. Many researchers consider the mutually beneficial aspect of bonds to be the main differentiating factor, but more research is needed regarding how bonds benefit animals in order to completely differentiate them from positive human–animal relationships [2].

Human–animal relationships and bonds have been studied in commercial agriculture, laboratories, and companion animals. These studies have revealed many potential benefits to both humans and animals. In commercial agriculture, husbandry methods that support positive interactions have resulted in increased productivity in a variety of cases. For example, reduced stress resulted in greater productivity and growth in pigs and increased milk yield in bovids [3,11,12]. Similarly, animals kept in laboratory environments, on farms, and in zoos that experience positive human–animal relationships display more indications of increased welfare through reduced stress [2]. Human–animal relationships can be reinforcing, as positive interactions fuel future positive interactions [13]. Animals experiencing positive relationships tend to have increased long-term welfare [1]. In general, the presence of positive human–animal relationships has also led to increased job satisfaction for animal care workers in a variety of settings [1]. It has been demonstrated that relationships with companion animals (pets) provide psychological and physiological benefits, such as reduced stress, improved mood, and improved general physical health in caretakers [2,14].

Research conducted within zoos appears to support patterns found in other fields, where indicators of strong positive relationships correlate with indicators of higher animal welfare and keeper workplace satisfaction [1,3]. These connections have been supported by research indicating several different physiological measures of welfare [3] such as the reduction in stress-related hormones and increased reproductive abilities [8–10]. In cheetahs, the presence of gastric lesions, a health issue typically attributed to high stress levels, has been correlated with overall fearfulness of people, indicating that negative human–animal relationships can lead to increased stress levels [1,3]. The creation of bonds between zookeepers and zoo animals also incurs several benefits to zookeepers including emotional and operational benefits such as increased ease of husbandry and the ability to spot signs of illness and distress [5]. While research on zookeeper–animal relationships has been an increasing area of focus, there has been less research undertaken to examine these relationships compared to relationships in other settings [2]. Research is still needed to determine if other patterns found in human–animal relationships will be present in zookeeper–animal relationships. For example, research on companion and service animals has found bonds tend to be stronger with dogs when compared to other types of animals [15]. While research on attachment to zoo animals has indicated taxon does not predict attachment level [15], other studies have indicated individual species characteristics such as social structure may impact bond formation and lead to certain species, such as social primates or some bird species, bonding more readily with human caretakers [1,4,15]. Additionally, little research has been conducted on how these relationships influence zookeepers, such as how these relationships might inspire keepers to take conservation action.

Another result of the formation of positive relationships with animals could be the creation of empathy for that animal, which could have important implications when considering zookeepers' attitudes towards the environment and their engagement with pro-environmental behavior. The creation of empathy may be one way to foster pro-environmental attitudes and support behavior change, as research has shown the creation of empathy can both create more positive attitudes towards the environment and act as a motivator for pro-environmental behavior [16,17]. The ability to observe and interact with wild animals in zoo settings may offer a unique environment for creating this empathy [17,18]. Zoological institutions are increasingly focused on conservation and promoting adoption of positive conservation behaviors by zoo visitors [19], although there is a lack of research on the impact of zoo animals on those that directly care for them in the realm of pro-conservation action. In this context, pro-conservation behavior change can include actions geared towards the preservation of individual species or towards biodiversity in general and can include actions that range from gaining information about environmental issues, donating to environmental causes, or participating in policy change endeavors [19]. Zoo visits can increase connections to animals and increase pro-environmental behavior in zoo visitors, although the types of behaviors that are supported are generally more focused

on individual animals or species and less directed at preserving biodiversity as a whole. The extent to which caring for an animal may increase caring for nature, in general, is less studied [20]. While visitors can develop empathetic connections to individual animals during zoo visits, it is unclear how much this translates into caring for whole species and acts as a motivator for concrete behavior change, as the extent to which empathy acts as a motivator for behavior change may depend on a wide variety of factors including the type of behavior and social context [18,21].

Our study answers two main questions in order to determine if the creation of zookeeper–animal bonds may influence pro-environmental behavior. First, how frequently do zookeepers form bonds with the animals in their care? We predict zookeepers are likely to form bonds with animals in their care, but these bonds will more likely be made with mammals or birds and will depend on the length of time that the keeper has worked with that individual animal. Second, are zookeepers who do form these bonds more likely to engage in conservation behaviors than those who do not? We predict that keepers with bonds to an animal in their care at the zoo will engage in more conservation behaviors and activities than a keeper without bonds, even if those behaviors and activities do not have a direct impact on the species they have bonded with. The findings of this study can serve to increase the body of knowledge around the effects of zookeeper–animal bonds on zookeepers and could inform new approaches to supporting conservation initiatives among zoo staff.

2. Materials and Methods

We designed a 17-question survey to examine keeper experiences and attitudes toward zookeeper–animal relationships and their current level of participation in conservation projects using a mix of open-ended, multiple-choice, and 5-point Likert-type scale-based questions. Surveys were distributed online using the Qualtrics survey platform. The survey consisted of three sections: demographic data, zookeepers' attitudes towards relationships and bonds, and zookeepers' participation in conservation activities. No information was collected on the participant's location or on the zoo they worked for. The full survey can be found in Appendix A.

2.1. Study Population

This survey was distributed for 5 weeks in October 2021 to individuals who work in an animal care capacity within a zoological facility. The survey was posted in the zookeeper-specific Facebook groups "Zookreepers" and "You Know You're a Zookeeper When," and was distributed via email to zookeepers working for the Wildlife Conservation Society, which operates four zoos and an aquarium in the New York City area. Participation in this survey included zookeepers from both professionally accredited and non-accredited facilities.

2.2. Survey

2.2.1. Demographic Information

The first four questions of this survey focused on demographic information. Respondents were requested to provide their age, gender, number of years working in the zoological field, and what taxa they have worked with.

2.2.2. Attitudes on Keeper–Animal Relationships and Bond Formation

The second subset of the survey focused on keeper attitudes towards the formation of bonds. Participants were asked to rank their agreement with given statements using a 5-point Likert-type scale. There were several open-ended questions such as, "With what species, if any, have you developed a bond?" and if the keeper feels they and the animal have benefited from this bond.

Definitions for the terms "relationship" and "bond" were provided at the start of the survey. Respondents were also asked to indicate how frequently they engage in different

types of activities with the animals they have formed bonds with such as shifting or training, performing visual inspections, restraining, or feeding and cleaning. For these questions, keepers could choose between the options rarely, once a month, once a week, or multiple times daily. The wording for the questions in this portion of the survey were modeled after surveys on zookeeper–animal relationships distributed by Hosey and Melfi [5] and Hosey et al. [13].

2.2.3. Participation in Conservation

The final subset of the survey focused on participation in conservation activities and professional development. Participants were asked to rank how frequently they participated in different conservation activities. These activities were grouped into four larger categories of participation in a conservation action including: raising awareness on conservation issues, waste reduction activities, habitat clean-ups or citizen science projects, and donations or fundraising for conservation organizations.

Respondents were also asked: (a) if they had participated in professional development within the last two years and (b) to indicate their level of agreement with several statements about motivations for participation in conservation activities and professional development. Questions about conservation participation were modeled after surveys distributed by Maynard et al. [22]. Finally, two open questions were included that allowed participants to share any additional information they felt was relevant and asked what barriers to conservation participation they faced.

2.3. Data Analysis

Responses were reviewed to ensure they were complete, and any incomplete responses were dropped from analysis. Data on the formation of bonds and relationships were compared using a test of independence chi-square analysis. Percentages were calculated to compare how often bonds were formed with individuals from each taxon, and the frequency of bond formation for each taxa type was compared using chi-square tests for independence. For Likert-type scale questions, we calculated the percentage of respondents in each group and performed a chi-square test.

Open-ended question responses were coded using in vivo coding and grouped into generalized sub-categories based on overall similarities of responses. Answers were reviewed by the researchers and major keywords mentioned in each response were recorded. For example, for the open-ended question about the benefits of bonds for keepers, categories included mental health benefits, improvement of individual character, increased ability to evaluate animal health and perform other job duties, increased effectiveness of animal training programs and trust building, as well as no benefit seen. Each category was then assigned a number code and each response was coded accordingly. Some answers included multiple keywords and were coded with both applicable categories. The percentage of responses that included each sub-category was calculated.

Individual questions on participation in conservation activities were grouped into four main categories of participation: conservation-awareness-raising activities, waste reduction or sustainability-related activities, habitat clean-ups or citizen science, and donating or fundraising for conservation organizations. Responses within this section were assigned points based upon the amount of time and effort needed to participate in each behavior (Table 1). Activities that required minimal time or effort were given low point values. Point values increased as the amount of time and effort needed to accomplish that activity increased. Point values were also increased to consider if participants were required to donate money in addition to time and effort. Points were summed for each respondent in order to create a conservation score.

Table 1. Point value assignments for reported conservation activities.

Behavior	Score				
	Never	**Sometimes**	**About Half the Time**	**Most of the Time**	**Always**
Spread environmental information through personal networks or social media	0	0.5	1	1.5	2
Spread conservation messages about the animal species in my care through personal networks or social media	0	0.5	1	1.5	2
Recruit others to join in conservation activities	0	1	1.5	2	2.5
Join or participate in a conservation organization	0	1	1.5	2	2.5
Participate in political advocacy for conservation through supporting new policies or laws, signing petitions, or contacting politicians regarding conservation issues	0	1	1.5	2	2.5
Seek out resources to learn more about environmental issues	0	1	1.5	2	2.5
Reduce personal waste through activities like recycling, reusing old items, or reducing activities that create waste such as driving	0	0.5	1	1.5	2
Purchase items designed to reduce waste or support environmental causes	0	1	1.5	2	2.5
Participate in citizen science projects that directly benefit a specific species or habitat	0	2	2.5	3	3.5
Participate in habitat restoration projects, either through reducing impact on that habitat, directly restoring habitat, or collecting resources for restoration projects	0	2	2.5	3	3.5
Donate to conservation organizations	0	1	1.5	2	2.5
Fundraise for conservation organizations	0	2	2.5	3	3.5
Volunteer for conservation organizations	0	2	2.5	3	3.5

The average conservation scores between the group reporting a 'bond' and 'no bond' were then compared using independent two-sample *t*-tests. *T*-tests were performed for each conservation activity category, as well as for total score. Test of independence chi-square tests were used to examine differences between groups for individual questions. Regression analyses were also performed in order to determine if demographic variables impacted any category of conservation activities. The variables included were age, career length, the types of animals the respondent worked with, and the presence of a bond. Gender was not included as a variable as such a large percentage of respondents identified as female.

3. Results

3.1. Demographic Information

We received 211 responses from zoo and aquarium animal care professionals from a variety of zoological institutions. In total, 144 complete responses were used for analysis. The majority of respondents were under 50 (84.62%), with just under half of respondents (45.45%) falling into the 18–30 age group. Most respondents (77.5%) had been zookeepers between one and fifteen years, with 21.83% working 1–5 years, 39.44% working between 6–10 years, and 16.2% working 11–15 years. Only 22.54% reported working as a zookeeper for more than 15 years. Most (75.9%) reported working with multiple taxa (Figure 1).

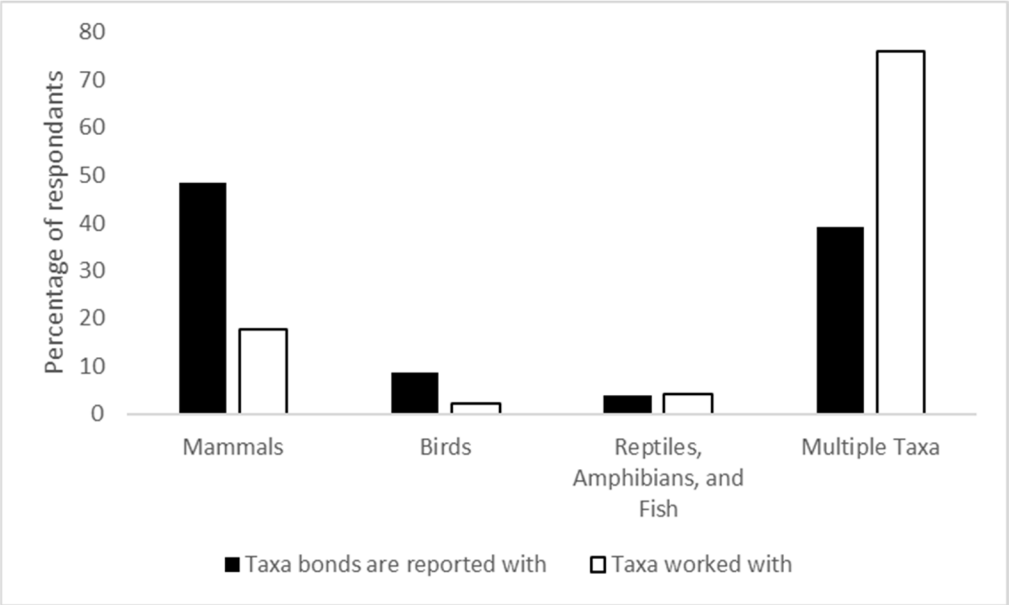


Figure 1. Range of taxa zookeepers have reported working with and bonding with. Dark bars represent taxa with which respondents reported forming bonds with; light bars represent taxa with which respondents reported working with.

3.2. Attitudes on Keeper–Animal Relationships and Bond Formation

Of the zookeepers surveyed, 88.9% ($\chi 2 = 87.11$, df = 1, $p < 0.001$) reported they had a perceived bond with a zoo animal in their care during their career. However, no variables used in the regression analysis were significant predictors of bond formation. While most keepers reported working with multiple taxa, 48.8% of respondents ($\chi 2 = 74.81$, df = 3, $p < 0.001$) reported perceiving a bond with a mammal as compared to other types of animals (Figure 1). Within the mammal group, half of participants had perceived bonds with multiple species. Of the keepers that work with multiple groups of animals, 39% of keepers reported having perceived bonds with animals in multiple taxa (Figure 1). Keepers also viewed bonds favorably, with 94.4% ($\chi 2 = 289.54$, df = 4, $p < 0.001$) of all keepers indicating either somewhat or strong agreement with the statement, "The relationship I have developed with animals in my care enables me to better evaluate their needs". Similarly, 97.2% ($\chi 2 = 339.83$, df = 4, $p < 0.001$) of all respondents indicated somewhat or strong agreement with the statement, "I feel a relationship positively impacts my ability to assess the welfare of the animals in my care".

Open-ended responses revealed the keeper's perceived bonds result in a variety of mental health and job benefits. Many responded with sentiments such as, "Bonds with our animals are the most rewarding aspect of this job. I am excited to come to work every day to be able to see these animals and work closely with them. I feel that my mental health benefits from these animal bonds". While many keepers listed more than one benefit, 51.53% of respondents listed mental health benefits such as feelings of greater success at their job, increased connection to nature, and reduced stress. Keepers also reported bonds

made their jobs easier for a variety of reasons including reductions in animal stress level (40% of responses) and facilitated animal training and trust-building (20% of respondents). Only two respondents reported they did not benefit from a bond formed with an animal.

Many respondents reported they felt bonds positively impacted the animals in their care, often for multiple reasons. Reduction of stress for the animal and increased ease of husbandry were mentioned in 59.72% of responses. Some respondents also felt bonds resulted in increased welfare for the animal (16.67% of responses), with some responses indicating the animals in the bond appeared to find that bond intrinsically reinforcing (22.92%). However, some respondents seemed unsure if the bond benefited the animal (9.72%), and some noted they felt the animals benefited but were unsure how (2.78%). Two respondents noted extremely strong bonds could increase stress for the animal if they were separated from the keeper they are bonded with or become aggressive to other keepers.

3.3. Participation in Conservation

The majority of respondents (94.4%) indicated they somewhat or strongly agreed with the statement "I believe zookeepers should act to conserve the environment". Similarly, 87.4% of keepers indicated they agreed with the statement, "My relationships and experiences with animals at work motivate me to participate in conservation work". Only one category of conservation activity showed a significant difference ($t(16) = 3.13$, $p = 0.006$) in participation between keepers who reported a bond and keepers who did not. Keepers who reported a perceived bond (M = 3.3, SD = 0.74) were more likely to engage in waste reduction behavior than those who did not report a bond (M = 2.34, SD = 1.19) (Table 2). Regression analysis indicated the presence of a bond was the only variable that significantly predicted participation in this type of conservation activity ($\beta = 0.134$, $p = 0.008$). Age ($\beta = -0.24$, $p = 0.31$), career length ($\beta = 0.049$, $p = 0.29$), and the taxa the keeper worked with ($\beta = -0.02$, $p = 0.73$) were not significant predictors of participation in conservation activity.

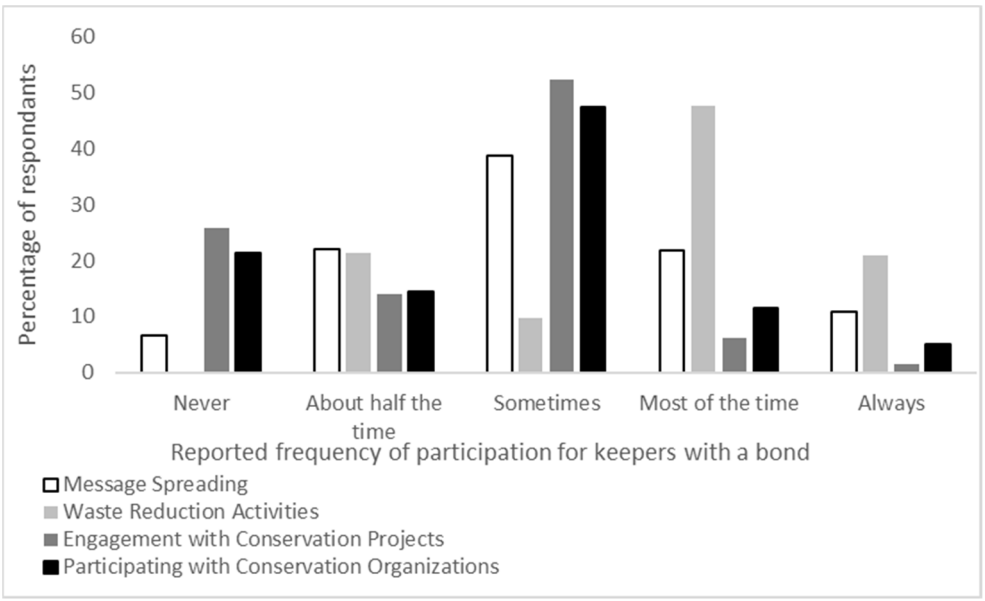
Table 2. Mean conservation scores for each group of behaviors and the total conservation scores for keepers who reported a perceived bond with an animal and keepers who did not. An asterisk denotes a statistically significant difference was found in this category.

	Message Spreading		**Waste Reduction Activities ***		**Engagement with Conservation Projects**		**Participation with Conservation Organizations**		**Total Conservation Score**	
	Mean Score	**SD**	**Mean Score**	**SD**	**Mean Score**	**SD**	**Mean Score**	**SD**	**Mean Score**	**SD**
Bond reported ($n = 128$)	7.57	2.64	3.3	0.74	3.28	1.75	4.59	2.28	20	5.18
No bond reported ($n = 16$)	6.97	3.29	2.34	1.19	3.25	1.4	4.25	2.71	17.72	6.4

No significant differences were found between groups for any other conservation category, as well as for total conservation score (Table 2). For participation in awareness-raising activities, keepers reporting perceived bonds had a mean conservation score of 7.57 (SD = 2.64) while keepers not reporting bonds had a mean score of 6.97 (SD = 3.29), $t(17) = -0.703$, $p = 0.49$. Regression analysis indicated age ($\beta = -0.56$, $p = 0.46$), career length ($\beta = 0.11$, $p = 0.75$), and the taxa the keeper worked with ($\beta = -0.03$, $p = 0.88$), and the presence of a perceived bond ($\beta = 0.15$, $p = 0.34$) were not significant predictors of participation in conservation activity. Participation in activities such as citizen science projects or habitat cleanups was very similar between groups, as keepers reporting a perceived bond had a mean conservation score of 3.28 (SD = 1.75) while keepers reporting no bond had a mean score of 3.25 (SD = 1.4), $t(21) = -0.08$, $p = 0.94$. Regression analysis indicated age ($\beta = -0.30$, $p = 0.54$), career length ($\beta = 0.08$, $p = 0.43$), and the taxa the keeper worked with ($\beta = -0.06$, $p = 0.66$), and the presence of a perceived bond ($\beta = -0.07$,

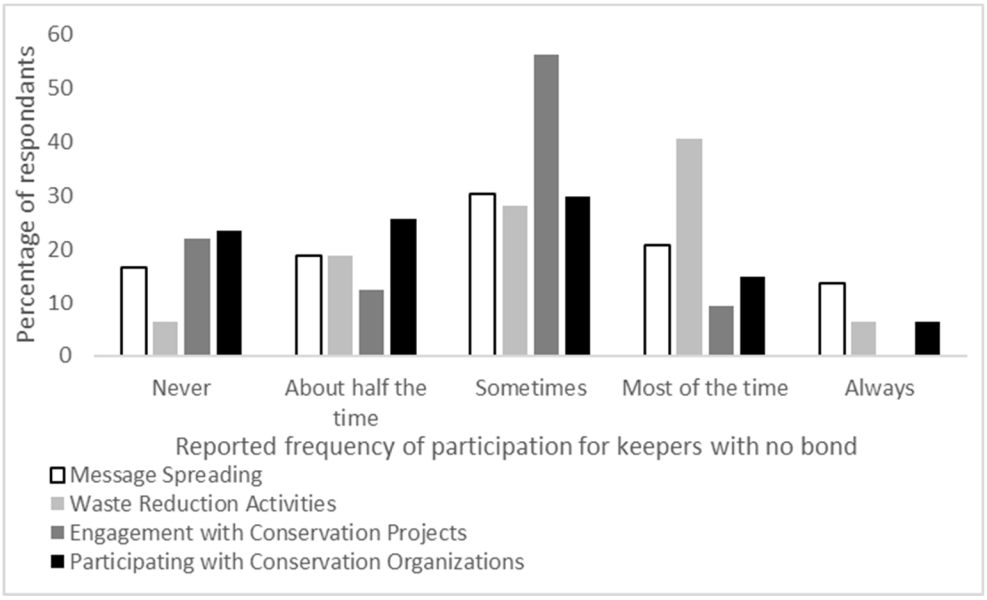
p = 0.48) were not significant predictors of participation in conservation activity. The mean conservation score for keepers reporting perceived bonds for activities relating to fundraising or donating to conservation groups was 4.59 (SD = 2.28), compared to 4.25 (SD = 2.71) for keepers who did not report a bond, t(18) = −0.48, p = 0.64. Regression analysis again indicated age (β = −0.33, p = 0.60), career length (β = 0.15, p = 0.24), and the taxa the keeper worked with (β = −0.23, p = 0.18), and the presence of a perceived bond (β = 0.14, p = 0.31) were not significant predictors of participation in conservation activity.

For the total conservation score, zookeepers reporting a perceived bond had slightly higher scores (M = 20, SD = 5.18) than keepers that did not report a bond (M = 17.72, SD = 6.4), but this difference was not significant, t(18) = −1.10, p = 0.29. Again, no variables were significant predictors of participation in conservation activities including age (β = −1.43, p = 0.38), career length (β = 0.38, p = 0.23), and the taxa the keeper worked with (β = −0.28, p = 0.54), and the presence of a perceived bond (β = 0.35, p = 0.31). In general, zookeepers reported they were not as likely to participate in citizen science, habitat restoration, or donate to conservation organizations when compared to the likelihood they participated in awareness-raising or waste reduction activities (Figure 2). Zookeepers did report they were likely to participate in professional development (76.92% of total responses), but the likelihood of participation did not increase if a perceived bond was reported (χ2 = 0.896, df = 1, p = 0.344). While few respondents reported participating in more time-consuming participation activities such as habitat clean-ups and citizen science projects or activities relating to fundraising, 88.89% of keepers indicated they would participate in conservation activities if opportunities were provided by their zoo. Additionally, while 69.23% of keepers reported somewhat or strong agreement with the statement "I choose to support conservation projects based on their impact on animals I have formed relationships with at work", there was no statistically significant difference between responses from keepers who had reported a bond and those who did not (χ2 = 1.90, df = 4, p = 0.75).



(**a**)

Figure 2. *Cont.*



(**b**)

Figure 2. Likelihood of keeper participation in different types of conservation activities that reported a perceived bond with an animal (**a**) and those that did not (**b**).

When asked in an open-ended question about what barriers prevented them from participating in conservation as much as they would like, 76 of 144 zookeepers gave responses. Their answers tended to fall within three categories, although many responses indicated more than one reason. The most listed reason for not participating in conservation action was lack of time, which was mentioned by 65.79% of respondents. Other common reasons included lack of money (28.95% of responses) and lack of institutional support for participation (mentioned by 23.68% of participants). Less common reasons included lack of energy (14.47%), lack of knowledge about where to start (5.26%), and other reasons, including COVID restrictions (10.52%).

4. Discussion

These findings support those found by Hosey and Melfi [5] who found keepers listed similar benefits to both humans and animals. Much of the previous research surrounding the development of zookeeper–animal relationships has focused on workplace benefit impacts such as job satisfaction [1]. While keepers with strong perceived bonds tended to list higher job satisfaction among the benefits gained, many respondents also listed emotional benefits such as feelings of joy from being around the animal, gaining satisfaction from a greater understanding of the animal's emotional and physical state, as well as the feeling that this positive state was shared by the animal they bonded with. These findings support those found by Hosey and Melfi [5] who found keepers listed similar benefits to both humans and animals.

The results of this survey indicate that zookeepers overwhelmingly believe they should engage in conservation activities, and many are motivated to do so by their experiences at work. However, while zookeepers who form bonds with the animals in their care are more likely to engage in certain conservation behaviors, there are limitations to the extent of influence of this relationship. Critically, zookeepers are not engaging in certain types of pro-environmental behaviors, although many express that they view participation in conservation as a part of their job and indicate a desire for an increased ability to contribute. Based upon open-ended responses, the respondents' consideration of what constituted participation in conservation ranged from actions that occur normally within a zookeeper's role, such as partaking in captive breeding programs for endangered species, to those that do not, such as involvement in research or in situ conservation. Stern [21] contends that

conservation behaviors can be grouped into various classes, such as activism, non-activist behaviors that occur in the public sphere, or behaviors that occur in the private sphere, and the likelihood these behaviors might occur can be determined by a wide variety of factors.

Overall, zookeepers who reported a perceived bond with a zoo animal participated in activities that required little additional time or training, specifically partaking in activities such as reducing personal waste or purchasing items that support environmental causes. Fewer differences between zookeepers reporting perceived bonds and those who do not report bonds are evident in engagement in pro-environmental behaviors that require more time or resources, and participation in these types of conservation activities fell sharply among all respondent groups. These behaviors include things such as participating in citizen science projects, habitat restoration projects, or volunteering for conservation organizations. In general, zookeepers appear to be engaging in behaviors that can be accomplished individually without a large investment of time or money and do not require additional training. Less engagement occurs with organized group conservation activities that require a significant investment of time and energy to participate in. These patterns indicate that barriers such as cost and ease of participation in pro-conservation behavior and a greater understanding of zookeeper perception of how effective their actions could be are critical to understanding the gap between intent and action within this group [21,23]. Further research may uncover if the bonds made with zoo animals influence zookeepers' feelings of responsibility towards the species, as this may also influence how likely people are to take certain environmental actions [21].

The sharing of positive states and feelings of mutual understanding such as those described by survey respondents are important parts of building empathy [16,18]. Empathy can be an important internal motivator for pro-environmental behavior [18] and the process of caring for one animal may extend concern to the animal's species in general [19]. The perceived bonds reported by keepers in this survey could potentially lead to strong empathetic connections to those animals, or those species as a whole. Previous research has shown that in some cases, evoking empathy can activate some types of pro-environmental behaviors [16], but this is only partially supported by the results of this study. While zookeepers who reported they formed a perceived bond with an animal in their care tended to have slightly higher mean conservation scores than those that did not form bonds, the differences were only significant for participation in waste reduction activities. Additionally, the sample size for keepers who reported they did not bond with an animal was very small, which may have influenced these results, so further study may be needed to more completely examine these differences. Further, while many zookeepers did appear to be internally motivated to participate in pro-conservation behavior, these internal motivators were not strong enough to lead to actual participation for some groups of behaviors. Context and the requirements to perform certain behaviors can be important components in if a behavior occurs [21], and more research may be needed in order to determine what factors are necessary to support participation in pro-environmental behavior among zookeepers.

Some studies suggest the establishment of relationships between zookeepers and zoo animals and the strengths of those relationships could be somewhat impacted by the culture of the zoological institution [15]. Similarly, participation in conservation can be supported by the establishment of cultures of conservation within zoological facilities and requires zoos to build a foundation with staff, although the dedication to conservation is clearly apparent for those working in animal care [24]. The results of this survey support the idea that many zookeepers view conservation as a part of their job, but how this translates into concrete action is less certain. Some respondents indicated aspects of their daily jobs do include conservation activities, but many also indicated their motivation to participate in conservation went beyond what is constituted by their daily jobs. Further research is needed in order to determine if these factors relating to bond formation, participation in conservation culture, and institutional culture interact, and could ultimately support increased involvement in conservation activity. While data on training on welfare science concepts was not collected in this study, future research may also examine how training

in this area also impacts bond formation and interest in participation in conservation activity. Many behavior change theories support the idea that the creation of empathy can be important in motivating pro-environmental behavior [16], but other elements such as economic and social factors are also critical to supporting behavior change [21,23], so zoos looking to increase conservation culture among staff will need to address a variety of factors in order to be successful.

In motivating pro-conservation behavior, it is critical to understand why certain groups may not be participating in conservation so that those barriers can be addressed [25]. Many keepers responded that they do not currently participate in conservation to the extent they would like. The results from this survey indicate many zookeepers already possess many of the internal factors that would lead to pro-environmental behavior such as motivation, knowledge of issues, pro-environmental values and attitudes, and emotional involvement. Therefore, the lack of participation in pro-conservation behavior in this group could be due to external factors [23]. The barriers to participation most listed by respondents were centered around the time required to participate, lack of monetary funds to support conservation activities, and a lack of support from their zoological institution. In some cases where individuals are motivated to conserve, reducing the barriers to conservation action can act as an additional motivator and increase conservation action [26]. Zoos interested in increasing zookeeper engagement in conservation may look to reduce some of these barriers, either through the creation of local conservation projects keepers can readily join or by integrating conservation goals with day-to-day zoo operations. An example of this type of program was initiated by the Houston Zoo, where opportunities to participate in conservation activities such as monarch butterfly tagging or jetty cleanups were offered to staff. Increases in staff participation in conservation as well as increases in staff performance were reported as a direct result of this program [27].

The results of this survey provide intriguing new directions for future research. This survey was administered over a fairly short time period through social media channels. The demographic information gathered indicated respondents were largely female, under the age of 40, and had been involved in zookeeping for less than 10 years. While zookeepers tend to be female [28], future research could extend the reach of this survey to attempt to ensure these trends are viable across a larger sample of this population. Since this survey was also distributed through social media, future research could examine if the age trends found in this survey are consistent among larger sample sizes. Additionally, while some keepers did report specifically in their surveys that the bonds they have formed with the animals in their care do motivate their conservation actions, some indicated that their interest in conservation is independent of the relationships formed at work. Future research could attempt to understand what additional factors motivate conservation behavior in order to better create programs that facilitate keeper involvement in conservation activities. Research in this area may also ultimately inform methods for increasing zoo visitor engagement with pro-conservation behavior.

5. Conclusions

This study shows support for the formation of bonds as an important source of motivation for zookeeper participation in conservation behavior, although this motivation is insufficient to overcome other barriers to engage in conservation in some cases. Many zookeepers view the creation of bonds as beneficial to both themselves and the animals in their care. Results from this survey indicate these bonds promote job satisfaction, reduce stress, and assist keepers in caring for animals through an increased ability to identify the animal's needs. Many keepers indicate they view conservation as a component of their job but often feel that they are not participating in conservation as much as they would like. Human–animal bonds are an area of growing study, and zoos may benefit from an increased understanding of how bonds are influencing both keepers and animals in order to promote human and animal welfare along with increasing keeper engagement in conservation activities. In order to more effectively support conservation action for

staff, zoos must evaluate how they can reduce barriers to action in order to create more opportunities that are available to keepers.

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Institutional Review Board Statement: Ethical review and approval were waived for this study by the Miami University Institutional Review Board (reference number 03975e) in August 2021, as the research meets the criteria of at least one exempt category included in 45 CFR 46 and associated guidance. This research met the criteria in category 2 for exemption from Institutional Review Board review.

Data Availability Statement: The data from this study can be made available upon reasonable request to the corresponding author.

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Appendix A

Survey Instrument: Zoo-Keeper Animal Relationships and Conservation Action Survey

Research Consent Information: The Impacts of Keeper-Animal Relationships

You are invited to participate in a research project being conducted by Veronica Thomas, a graduate student at Miami University under the advisership of Jamie Bercaw Anzano. The purpose of this study is to examine relationships between positive keeper-animal relationships and participation in conservation action. This research will ask you questions about your relationships with zoo animals and your participation in conservation activities. Participation in this research is restricted to persons 18 years of age or older.

Completing this online survey should take about 10 min. Taking part in this survey is completely voluntary, and you may stop your participation at any time. You are free to skip any question you do not want to answer. There are no foreseeable risks involved in participation in this study.

Your name and identity will not be collected as part of this survey, and no identifiable information will be used in reports or presentations of this research. If you inadvertently include identifying information, such information will be removed from the stored data. Only the researcher will have access to individual survey responses. Results of the survey will only be presented as aggregate summaries.

If you have any questions about this research or you feel you need more information to determine whether you would like to participate in this study, you can contact me at thomasvk@miamioh.edu. My advisor, Jamie Bercaw Anzano, can be contacted at bercawj@miamioh.edu. If you have questions or concerns about the rights of research subjects, you may contact our reviewing body: Research Ethics and Integrity Office at Miami University at (513)-529-3600 or humansubjects@miamioh.edu.

Please keep a copy of this information for future reference.

Thank you for your participation,

Veronica Thomas

* Questions from this survey are adapted from surveys used in:

Hosey, G.; Melfi, V. Human-animal bonds between zoo professionals and the animals in their care. *Zoo Biology* **2012**, *31*, 13–26.

Hosey, G.; Birke, L.; Shaw, W.S.; Melfi, V. Measuring the strength of human-animal bonds in zoos. *Anthrozoös* **2018**, *31*, 273–281.

** Questions regarding conservation behaviors are derived from categories described by:

Maynard, L.; Monroe, M.C.; Jacobson, S.K.; Savage, A. Maximizing biodiversity conservation through behavior change strategies. *Conserv. Sci. Pract.* **2020**, *2*, https://doi.org/10.1111/csp2.193.

Definition of a relationship—a series of repeated interactions between two individuals that build on each other and ultimately allow those individuals to predict the future behavior of the other [1].

Definition of a bond—a very good relationship that is reciprocal, persistent, and beneficial to both parties [5].

1. Background information
    a. What is your gender?
    b. What is your age group?
        i. 20–30
        ii. 30–40
        iii. 40–50
        iv. 50+
    c. How long have you been working with animals?
    d. With what taxa have you worked?
2. Attitudes on forming relationships and bonds with animals—indicate agreement on 5-point Likert scale
    a. I feel I have developed relationships between myself and zoo animals in my care.
    b. My colleagues have developed relationships with animals in their care.
    c. I feel an emotional relationship positively impacts my ability to assess the welfare of the animals in my care.
    d. The relationship I have developed with animals in my care enables me to better evaluate their needs.
    e. It is not professionally appropriate to develop relationships with wild animals in a zoological setting.
    f. I have developed a bond with an animal at work.
3. Questions about bonds
    a. With what species have you developed a bond?
    b. How often do you interact with this animal in the following ways? Indicate frequency: rarely, once a month, once a week, daily, multiple times daily
        i. Visual inspection
        ii. Feeding or cleaning
        iii. Interacting with the animal (for example training)
        iv. Moving animal without tactile contact (ie shifting)
        v. Physical contact with the animal
        vi. Aversive contact (ie restraining for veterinary procedures)
    c. Do you feel you have benefited from this bond? If yes, how?
    d. Do you feel the animal has benefited from this bond? If yes, how?
4. Questions about pro-conservation action—Indicate on a 5-point scale from never to frequently
    a. How often do you engage in the following activities?
        1. Spread environmental information through personal networks or social media.
        2. Spread conservation messages about the animal species in my care through personal networks or social media.
        3. Recruit others to join in conservation activities.

4. Join or participate in a conservation organization.
5. Participate in political advocacy for conservation through supporting new policies or laws, signing petitions, or contacting politicians regarding conservation issues.

b. How often do you seek out resources to learn more about environmental issues?
c. How often do you do the following activities?
   1. Reduce personal waste through activities like recycling, reusing old items, or reducing activities that create waste such as driving
   2. Purchase items designed to reduce waste or support environmental causes
d. How often do you do the following activities?
   1. Participate in citizen science projects that directly benefit a particular species or habitat.
   2. Participate in habitat restoration projects, either through reducing impact on that habitat, directly restoring habitat, or collecting resources for restoration projects
e. How frequently do you do the following activities?
   1. Donate to conservation organizations
   2. Fundraise for conservation organizations
   3. Volunteer for conservation organizations
f. Have you participated in professional development activities in the last 2 years?
g. Indicate agreement on a 5-point Likert scale
   i. I believe zookeepers should act to conserve the environment.
   ii. My relationships and experiences with animals at work motivate me to participate in conservation work.
   iii. My relationship and experiences with animals at work motivate me to participate in professional development activities.
   iv. I choose to support conservation projects based on their impact on animals I have formed relationships with at work.
   v. My opinions on participating in conservation projects have changed from when I started working as a zookeeper.
   vi. If my zoological facility offered opportunities to volunteer in field conservation projects, I would volunteer.
   vii. I participate in professional development opportunities offered by my zoological institution, or would if they were offered.
h. Would you like to add anything else about your relationships with zoo animals and/or your participation in conservation activities?
i. If you are not participating in conservation activities as much as you would like to, why not?

References

1. Carlstead, K. A comparative approach to the study of Keeper-Animal Relationships in the zoo. *Zoo Biol.* **2009**, *28*, 589–608. [CrossRef] [PubMed]
2. Hosey, G.; Melfi, V. Human-Animal Interactions, Relationships and Bonds: A Review and Analysis of the Literature. *Int. J. Comp. Psychol.* **2014**, *27*, 117–142. [CrossRef]
3. Cole, J.; Fraser, D. Zoo Animal Welfare: The Human Dimension. *J. Appl. Anim. Welf. Sci.* **2018**, *21*, 49–58. [CrossRef] [PubMed]
4. Hosey, G. A preliminary model of human-animal relationships in the zoo. *Appl. Anim. Behav. Sci.* **2007**, *109*, 105–127. [CrossRef]
5. Hosey, G.; Melfi, V. Human-Animal Bonds Between Zoo Professionals and the Animals in Their Care. *Zoo Biol.* **2012**, *31*, 13–26. [CrossRef] [PubMed]
6. Beetz, A.; Uvnäs-Moberg, K.; Julius, H.; Kotrschal, K. Psychosocial and Psychophysiological Effects of Human-Animal Interactions: The Possible Role of Oxytocin. *Front. Psychol.* **2012**, *3*, 234. [CrossRef]
7. Virués-Ortega, J.; Buela-Casal, G. Psycholophysiological effects of human-animal interaction: Theoretical issues and long-term interaction effects. *J. Nerv. Ment. Dis.* **2006**, *194*, 52–57. [CrossRef]

8. Mellen, J.D. Factors influencing reproductive success in small captive exotic felids (*Felis* spp.): A multiple regression analysis. *Zoo Biol.* **1991**, *10*, 95–110. [CrossRef]
9. Wielebnowski, N.C.; Fletchall, N.; Carlstead, K.; Busso, J.M.; Brown, J.L. Noninvasive assessment of adrenal activity associated with husbandry and behavioral factors in the North American clouded leopard population. *Zoo Biol.* **2002**, *21*, 77–98. [CrossRef]
10. Carlstead, K.; Paris, S.; Brown, J.L. Good keeper-elephant relationships in North American zoos are mutually beneficial to welfare. *Appl. Anim. Behav. Sci.* **2019**, *211*, 103–111. [CrossRef]
11. Breuer, K.; Hemsworth, P.; Barnett, J.; Matthews, L.; Coleman, G. Behavioural response to humans and the productivity of commercial dairy cows. *Appl. Anim. Behav. Sci.* **2000**, *66*, 273–288. [CrossRef] [PubMed]
12. Hemsworth, P.; Barnett, J. The effects of aversively handling pigs, either individually or in groups, on their behaviour, growth and corticosteroids. *Appl. Anim. Behav. Sci.* **1991**, *30*, 61–72. [CrossRef]
13. Hosey, G.; Birke, L.; Shaw, W.S.; Melfi, V. Measuring the Strength of Human-Animal Bonds in Zoos. *Anthrozoös* **2018**, *31*, 273–281. [CrossRef]
14. Walsh, F. Human-Animal Bonds II: The Role of Pets in Family Systems and Family Therapy. *Fam. Process* **2009**, *48*, 481–499. [CrossRef] [PubMed]
15. Melfi, V.; Skyner, L.; Birke, L.; Ward, S.J.; Shaw, W.S.; Hosey, G. Furred and feathered friends: How attached are zookeepers to the animals in their care? *Zoo Biol.* **2021**, *41*, 122–129. [CrossRef] [PubMed]
16. Berenguer, J. The Effect of Empathy in Proenvironmental Attitudes and Behaviors. *Environ. Behav.* **2007**, *39*, 269–283. [CrossRef]
17. Clayton, S.; Fraser, J.; Saunders, C.D. Zoo experiences: Conversations, connections, and concern for animals. *Zoo Biol.* **2008**, *28*, 377–397. [CrossRef] [PubMed]
18. Young, A.; Khalil, K.A.; Wharton, J. Empathy for Animals: A Review of the Existing Literature. *Curator Mus. J.* **2018**, *61*, 327–343. [CrossRef]
19. Skibbins, J.C.; Powell, R.B. Conservation caring: Measuring the influence of zoo visitors' connection to wildlife on pro-conservation behaviors. *Zoo Biol.* **2013**, *32*, 528–540. [CrossRef]
20. Vining, J. The connection to other animals and caring for nature. *Hum. Ecol. Rev.* **2003**, *10*, 87–99.
21. Stern, P.C. Toward a coherent theory of environmentally significant behavior. *J. Soc. Issues* **2000**, *56*, 407–424. [CrossRef]
22. Maynard, L.; Monroe, M.C.; Jacobson, S.K.; Savage, A. Maximizing biodiversity conservation through behavior change strategies. *Conserv. Sci. Pr.* **2020**, *2*, e193. [CrossRef]
23. Kollmuss, A.; Agyeman, J. Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environ. Educ. Res.* **2002**, *8*, 239–260. [CrossRef]
24. WAZA Executive Office. *Committing to Conservation: The World Zoo and Aquarium Conservation Strategy*; Barongi, R., Fisken, F.A., Parker, M., Gusset, M., Eds.; World Association of Zoos and Aquariums (WAZA) Executive Office: Gland, Switzerland, 2015.
25. Heimlich, J.E.; Ardoin, N.M. Understanding behavior to understand behavior change: A literature review. *Environ. Educ. Res.* **2008**, *14*, 215–237. [CrossRef]
26. Schultz, P.W. Strategies for promoting pro environmental behavior: Lots of tools but few instructions. *Eur. Psychol.* **2014**, *19*, 107–117. [CrossRef]
27. Rhoades, T. Tracking Conservation Culture at the Houston Zoo. Available online: https://www.aza.org/connect-stories/stories/conservation-culture-at-the-houston-zoo?locale=en (accessed on 15 November 2021).
28. Grazian, D. *American Zoo: A Sociological Safari*; Princeton University Press: Princeton, NJ, USA, 2015.