Canid Biology & Conservation

 ISSN 1478-2677

Research report

Implications of teenagers' attitudes toward maned wolf conservation in Brazil

Adriana Consorte-McCrea[1*], Dennis Nigbur[2] and Alistair J. Bath[3]

[1] Wildlife and People Research Group-ERG, School of Human and Life Sciences, Canterbury Christ Church University, Canterbury, Kent CT1 1QU, UK. Email: adriana.consorte-mccrea@canterbury.ac.uk.

[2] School of Psychology, Politics and Sociology, Canterbury Christ Church University, Canterbury, Kent CT1 1QU, UK. Email: dennis.nigbur@canterbury.ac.uk.

[3] Geography Department, Memorial University of Newfoundland, St. John's, NL A1B 3X9, Canada. Email: abath@mun.ca.

[*] Correspondence author

Keywords: awareness, carnivore conservation, Cerrado biome, human dimensions, human-wildlife conflict.

Abstract

The relationships between people and wild canids are a widespread concern for the conservation of species and habitats. The maned wolf *Chrysocyon brachyurus* is a Near Threatened species inhabiting South America. Strategies to conserve this keystone species may benefit the also-declining Cerrado biome. The attitudes of teenagers toward wild carnivores are also of worldwide interest as these youth are the future decision makers. We investigated selected attitudes, beliefs and knowledge in relation to the maned wolf of two age groups (12-13 and 16-17), using questionnaires delivered in three urban areas of the São Paulo state, a region highly populated and rich in biodiversity and endemism. Responses were analysed according to age groups, gender, location and experiences concerning the maned wolf. Results suggest that positive attitudes declined with age; gender has very little effect on attitudes; seeing the maned wolf in nature and zoos may increase support for the conservation and may facilitate learning about the species, while identification with some maned wolf attributes amongst older teens in the most urbanised areas may foster sympathy toward the species. Conservation strategies and environmental education can help to provide early positive experiences of contact with the maned wolf and the Cerrado, especially if they are tailored to address the variation we found in attitudes between different age groups.

Introduction

The relationship between people and wild animals is multifaceted and pervaded by feelings of both antagonism and attachment (Bjerke, Odegardstuen and Kaltenborn 1998b; Clayton and Myers 2009). How people relate to wild carnivores is of particular interest to conservation due to their outstanding role in the dynamics of ecosystems and biodiversity (Sergio et al. 2006). An understanding of this relationship, of how it develops from early years to adulthood, and of the factors affecting it is necessary to inform effective decision-making in wildlife conservation.

Maned wolf *Chrysocyon brachyurus* (Figure 1) populations are in decline mainly due to anthropogenic actions. Habitat loss and associated reduction of the carrying capacity, isolation of sub-populations and loss of genetic variability have been identified as the main reasons for the decline of maned wolf populations in Brazil (Paula et al. 2008; Paula and Desbiez 2014). Most of its favoured primary habitat, the Cerrado, has been heavily modified (between 50% and 92%), and only 2.2% is protected (Klink and Machado 2005; Klink 2014). Maned wolves are also subject to threats directly or indirectly related to human impact, such as vehicle collisions, feral dogs (that may transmit diseases, attack pups and compete for food), climate change and retaliations due to alleged attacks on poultry (Dietz 1984; Anic 2002; Rodrigues 2002; Muir and Emmons 2012; Emmons 2014). Killing and mutilation of maned wolves due to popular beliefs may be added reasons for their decline (Puglia 1978; Silva 2000; Silva and Nicola 1999; Anic 2002; Soler et al. 2005).

The maned wolf is a 'keystone' species and plays an important role in ecosystem dynamics (Sergio et al. 2006; Sillero-Zubiri 2014); it contributes to the dispersal of various species of fruit in the Cerrado, and also

The following is the established format for referencing this article:

Consorte-McCrea, A., Nigbur, D. and Bath, A.J. 2017. Implication of teenagers' attitudes toward maned wolf conservation in Brazil. *Canid Biology & Conservation* 20(5):16-24. URL: http://www.canids.org/CBC/20/attitudes_toward_maned_wolf_conservation.pdf.

feeds on insects and rats that are carriers of diseases such as hantavirus and leptospirosis (Dietz 1984; Motta-Junior 2000; Anic 2002). Although predation on hen houses has been mentioned as a source of conflict, evidence from research suggests otherwise, with poultry remains only found in 0.3-1.5% of analysed scat samples or not at all (see Motta-Junior, Queirolo and Bueno 2014 for a review of the feeding ecology of the maned wolf). On the other hand, the association with the grey wolf *Canis lupus* through its name, its large frame and stand out features, coupled with the rare but dramatic occurrence of attacks on chicken pens, may have helped to inspire negative attitudes and fear within minority groups (Mishra 1997, in Knight 2000; Hill 2004).

Figure 1. The maned wolf (©Edu Fortes).

São Paulo is the most populated state in Brazil, of high political and economic importance in the national context and arguably over the whole of the maned wolf's distribution. In São Paulo state the highest concentration of people meet some of the largest remaining areas of Brazil's biodiversity and endemism. The Cerrado savannah, a biodiversity "hotspot", is home to the most diverse savannah floras in the world (Klink and Machado 2005; Mittermeier et al. 2005). It also produces 50% of Brazil's soybean and beef, mostly for export. The remaining natural areas are highly fragmented and subject to anthropogenic pressures, such as the invasion of exotic animals and plants, hunting, and fire near urban areas (Rodrigues 2002; Klink 2014).

Research suggests that although the development of concern for wildlife conservation may be inherited, it is also shaped by learning, culture and experience, emerging at different ages as the child grows (Keliher 1997; Bjerke, Odegardstuen and Kaltenborn 1998a and b; Kellert 2002). Misconceptions and negative messages about wildlife can foster negative perceptions and limit people's interest in relation to wildlife (Velsor and Nilon 2006). The transition from pre-adolescence to adolescence is a crucial time for the formation of attitudes toward wildlife conservation. Citizens in development and future decision-makers, teenagers are an important component in any community, at an age when their attitudes and values toward the environment and wildlife are being formed and consolidated (Bath and Farmer 2000; Velsor and Nilon 2006).

Studies suggest that variables such as gender, age, knowledge and regional differences and variables related to place of residence may affect the development of attitudes toward carnivores (Kellert et al. 1996; Bjerk, Ødegardstuen and Kaltenborn 1998a, b; Karlsson and Sjostrom 2007; Roskaft et al. 2007; Thornton and Quinn 2009; Torkar 2010; Bath 2014; Consorte-McCrea 2014). These variables are the focus of our present investigation.

Specifically, the present study aims to investigate the attitudes (a general feeling toward an object, Roskeach 1968) of two age groups (12-13 and 16-17) of students living in three urban areas within the maned wolf range in Brazil toward the species and its conservation, and how they are affected by variables such as age, gender, location of residence and experiences in relation to the species in question. Within an educational context, this study could be instrumental in directing decisions about curriculum for these age groups and in the planning of environmental educational strategies.

Methods

A total of 808 questionnaires were completed in 2007 and 2008, focused upon attitudes toward the maned wolf and its conservation in the southeast of Brazil (for the full study see Consorte-McCrea 2011). Questionnaires aimed to identify selected attitudes, beliefs and knowledge of locals in relation to the maned wolf in urban and rural areas of three locations in São Paulo state. From this sample, data from student respondents aged 12-13 (n=140) and 16-17 (n=124) residing in urban areas, who were able to identify the maned wolf by looking at a photo, were selected for further investigation (see Table 1. below).

Table 1. Target groups by research location

		Research locations			Total
		Greater São Paulo	Low Mogiana region	São Carlos	
Target groups	Students year 8	21	69	50	140
	Students sixth-form	23	32	69	124
Total		44	101	119	264

The three research sites (Figure 2) selected for the study were:

Greater São Paulo (GSP): an area of 7,944km², including the cities of São Paulo and Franco da Rocha amongst others, and is inhabited by 19,616,060 people (IBGE 2008). Questionnaires were administered to pre-booked visiting schools in São Paulo Zoo Park Foundation (which houses maned wolves) and Juquery State Park, in Franco da Rocha, considered the last remaining fragment of Cerrado in the metropolitan region of São Paulo city (maned wolves are absent).

São Carlos city (SC) has a total population of 220,425 inhabitants occupying an area of 1,132km² (IBGE 2009). The maned wolf is present in remnants of the local Cerrado, preserved within conservation units. Questionnaires were distributed to three different local schools. The main revenue is produced by services and industry followed by agriculture. Prestigious universities and research centres are based in SC (one PhD per 180 inhabitants, 30 times above the national average).

Low Mogiana region (LM) comprises the municipalities of Mogi Mirim (87,800 inhabitants occupying an area of 499km²) and Mogi Guaçu (138,494 inhabitants over an area of 813km²) (IBGE 2008). Questionnaires were distributed to two local schools. The maned wolf inhabits the local Cerrado. Services provide the largest revenue, followed by industry and agriculture.

Student age groups were chosen according to their 'readiness' in terms of developmental stage (following Jean Piaget Cognitive Theory; Huitt and Hummel, 2003). Children aged 11-15 have already developed the ability to elaborate abstract concepts based on formal logic (Formal Operational stage) though their cognitive development is not fully complete, and from 16 onwards they are already capable of reasoning as adults as their development matures.

Based on the Theory of Planned Behaviour attitudes, beliefs, and knowledge concerning the maned wolf and its conservation were measured in the questionnaire as they strongly influence behavioural choices (Ajzen 1991; Manstead 1996). The questions of interest here were in a closed format to yield quantitative data for statistical analysis. Some items (for example, those assessing factual knowledge about the

maned wolf) were in a binary-choice or multiple-response format. Responses to these items were coded as 0 (incorrect) or 1 (correct). Other items used a semantic differential scale, where participants were invited to rate characteristics of the maned wolf on a seven-point scale between two semantic extremes (e.g. dangerous – harmless). These responses were coded by the position of the scale point selected by respondents (i.e. as 1-7). Due to sample sizes, we grouped experiences into first and second hand (i.e. in the absence of actual physical contact), but direct experiences observing the maned wolf in nature have also been examined.

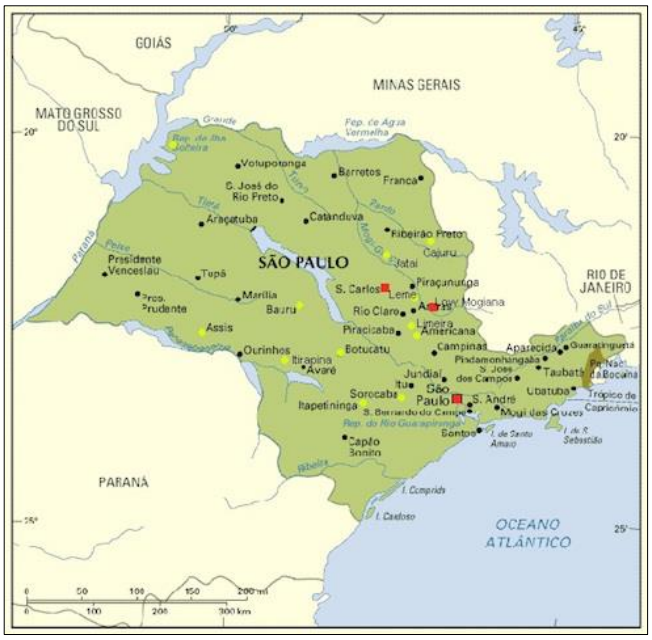

Figure 2. Map of São Paulo state showing the three key research areas (red squares), and further research areas covered by extended study (yellow spots) (Consorte-McCrea 2011).

Data analysis

Knowledge about the maned wolf was coded in a single variable. Participants gained one point on this variable for each correct factual answer about the maned wolf, and lost one point for each incorrect answer. The result was a normally distributed variable on a scale ranging from -5 to +5. The attitude items were subjected to a principal components analysis (PCA), for the purposes of exploration and data reduction. Based on the point of inflection in the scree plot, four components were extracted. These were then rotated orthogonally (with the Varimax method) for ease of interpretation. Component scores for each participant were calculated according to the regression method.

Attitudes of the 12-13 and 16-17 age groups were compared across gender and research locations to explore the influence of variables such as the size of the city and the presence of the maned wolf on attitudes toward the species. To compare outcome variables by age groups, location, and gender, univariate analyses of variance (ANOVA) were performed. Where necessary, pairwise comparisons were adjusted using the conservative Bonferroni procedure. Multiple t-tests were used to explore the effect of socio-demographic variables (residence, gender) amongst interest groups across components, knowledge, exposure to, and intentions to help the maned wolf.

Results

Attitudinal components

PCA component I collated positive beliefs related to sympathy and feelings that the maned wolf is unthreatening; Component II corresponded to a charismatic, even heroic, image of the maned wolf; Component III to positive attitudes toward the conservation of the maned wolf; and component IV to negative beliefs, fear and potential conflict with the species (Table 2).

Table 2. Rotated Component Matrix of beliefs and attitudes toward the maned wolf. Only the highest component loadings are listed.

Component 1	
Ferocious or *Tame*	.833
Dangerous or *Harmless*	.806
Aggressive or *Defensive*	.795
Good or *Bad*	.608
The maned wolf does not harm anyone	.574
Component 2	
Strong or *Weak*	.726
Brave or *Cowardly*	.673
Valuable or *Worthless*	.643
Big or *Small*	.633
Powerful or *Powerless*	.623
Beautiful or *Ugly*	.538
Component 3	
The maned wolf needs to be protected	.739
Preserving the maned wolf helps to preserve the ecology	.739
The best place for the maned wolf is nature	.615
The maned wolf helps my country's tourism and culture	.417
Component 4	
The maned wolf scares and attacks people	.714
The maned wolf is useless	.681
I don't care about the maned wolf	.521
The maned wolf attacks chicken pens and livestock	.467

The between-groups ANOVA indicated significant effects of some of the predictor variables upon Component I scores (Table 3) suggesting that respondents in São Carlos found the maned wolf significantly more unthreatening and likable than Lower Mogiana residents ($p < 0.001$). The interaction between age group and location was also significant, indicating the positive beliefs about the maned wolf decline as children grow older in São Carlos ($t(74) = 5.11$, $p < 0.001$) and Lower Mogiana ($t(85) = 2.57$, $p = 0.012$), while for Greater São Paulo residents the trend appears to be reversed ($t(21) = -2.16$, $p = 0.042$), although this difference is not significant after application of the Bonferroni adjustment (Figure 3).

Table 3. Univariate tests for Component I

Dependent variable	df	F	p
Research location	2, 174	8.298	<0.001
Target groups by locations	2, 174	6.977	.001

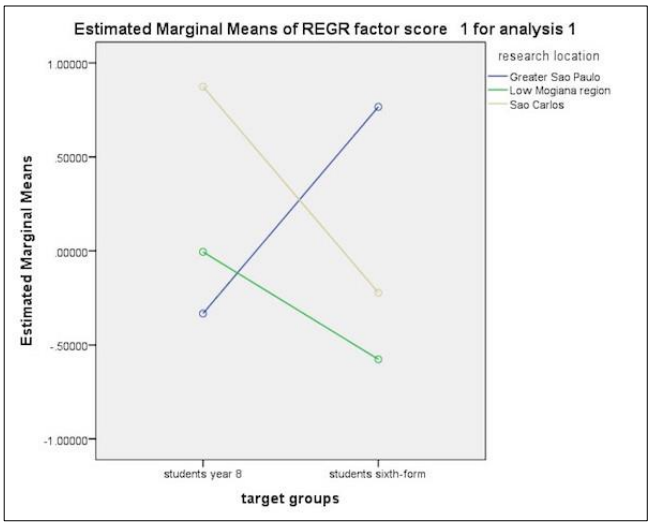

Figure 3. Profile plot for Component I by target groups, by research location.

Component II scores revealed a significant main effect of age group, and significant interactions between location and age group, and between location and gender (Table 4). Younger teens were positively impressed by the maned wolf's image. Such beliefs, as in Component I, seem to decline with age. Further investigation of the interaction between age group and location (Figure 4) showed that this trend is significant in São Carlos ($t(74) = 4.15$, $p < 0.001$) and Greater São Paulo ($t(21) = 2.49$, $p = 0.021$), but not in Low Mogiana ($t(85) = 0.71$, $p = 0.478$).

The interaction between location and gender suggests that boys found the maned wolf significantly less charismatic than girls only in São Carlos ($t(74) = -2.77$, $p < 0.01$), while no gender differences were significant in the other locations (p values > 0.6, see Figure 5).

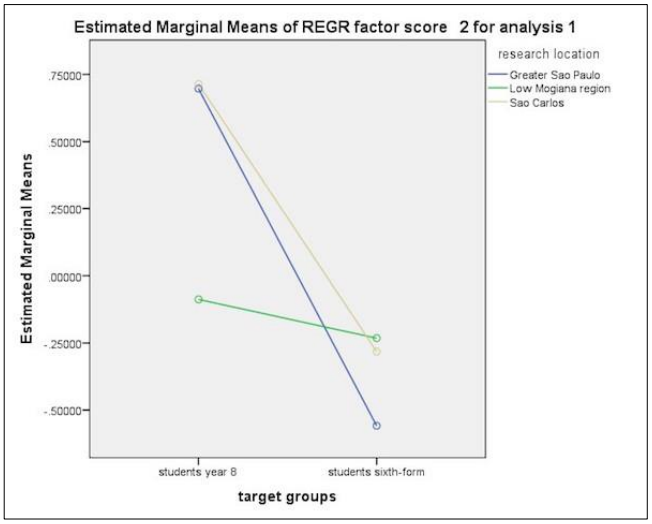

Figure 4. Profile plot for Component II by research locations and age group.

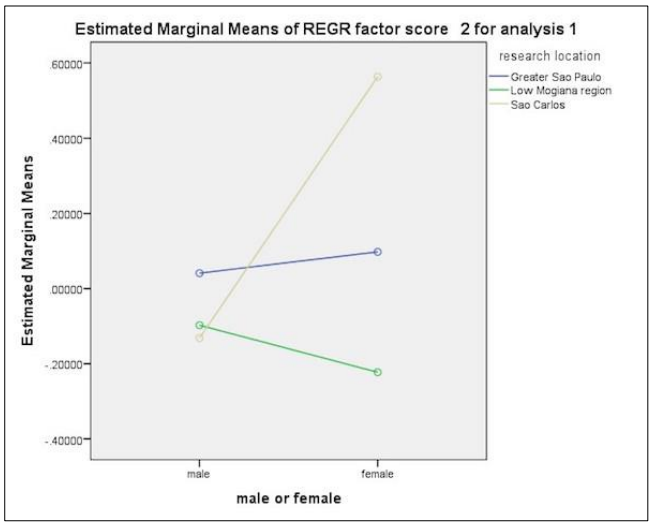

Figure 5. Profile plot for Component II by research locations and gender.

Table 4. Univariate tests for Component II.

Dependent Variable	df	F	p
Target groups	1, 174	13.760	<0.001
Target groups by location	2, 174	4.434	0.013
Location by gender	2, 174	3.484	0.033

Attitudes toward maned wolf conservation (Component III) did not seem to be associated to age group, location or gender (all p values were 0.25 or greater). There were strong associations between Component IV and age groups ($F(1, 174) = 7.74$, $p < 0.01$), showing that the younger participants scored higher on negative beliefs about the maned wolf.

Knowledge about the maned wolf

The Knowledge score corresponded to correct answers to questions about the maned wolf's feeding habits, declining number trend, and social organization. There was a strong association between Knowledge and research locations ($F(2, 251) = 30.29$, $p < 0.001$). Girls and boys of both age groups knew more about the maned wolf in São Carlos, followed by Greater São Paulo, with residents of Low Mogiana displaying significantly lower levels of knowledge (all p values < 0.015). The main effects of age group ($F(1, 251) = 0.23$, $p = .63$) and gender ($F(1, 251) = 0.06$, $p = 0.80$), as well as all interactions (p values > 0.25), were not significant.

Analysis of correlations between Knowledge scores and Component I showed that the more respondents knew about the maned wolf the higher they believed the maned wolf to be unthreatening and likable ($r = .36$, $p < 0.001$). We also found that the more students knew about the maned wolf the more positive their attitude toward its conservation ($r = .25$, $p = 0.001$). There was no correlation between Components II and IV and Knowledge (p values > 0.45).

Previous experience and sources of information

Respondents were asked about their exposure to the maned wolf, and if they had had a previous contact with the maned wolf in nature, in a zoo, museum or conservation unit or had a second-hand contact with the species via papers, books, magazines; school, environmental education, information from parents, family or friends, or the internet.

Chi-squared test indicated a significant association between exposure and research locations. Residents of Lower Mogiana had seen the maned wolf live in nature more than teens in other locations (Figure 6, $\chi^2(2) = 16.78$, $p < 0.001$). Second hand exposure is similar in all locations, while first hand (live, zoos, museum, CU) depends on location ($\chi(2) = 7.43$, $p = 0.024$). Since Lower Mogiana residents reported more experience in seeing the maned wolf in nature, it is possible that the high first-hand experience with maned wolves amongst São Carlos residents refers to encounters with them at the local zoo. 92.4% of participants in São Carlos knew the local zoo, compared with 70.3% in Low Mogiana and 65.9% in Greater São Paulo.

Teens who had seen the maned wolf first hand in nature or in the zoo rather than second-hand through the media or others were more supportive of maned wolf conservation ($t(184) = 2.73$, $p < 0.01$). This effect held when exposure to the maned wolf was differentiated between those who had seen the animal live in nature and those who had experienced it by any other means ($t(184) = 2.17$, $p < .05$). All other effects relating exposure to attitude components were not significant. Participants with first-hand experience of the maned wolf ($M = 1.54$, $s = 1.81$) displayed greater knowledge of the animal than those with only second-hand experience ($M = 0.98$, $s = 1.95$), $t(262) = 1.97$, $p = 0.05$.

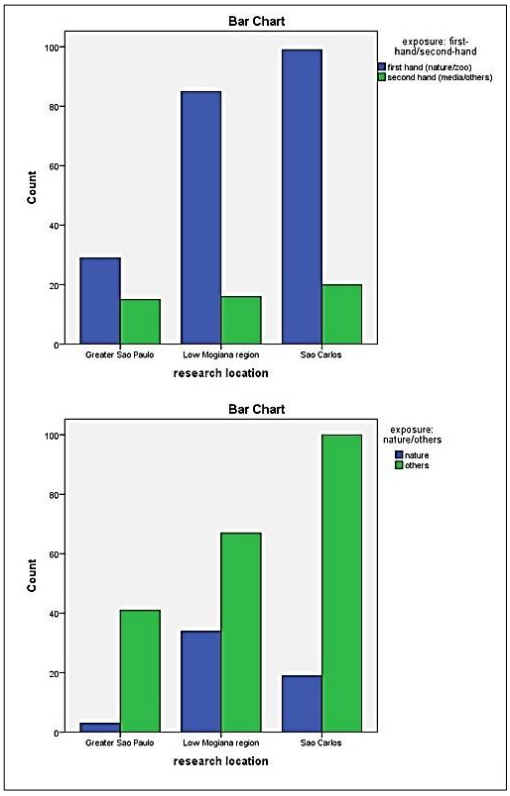

Figure 6. Exposure to nature/others, and exposure to first/second hand sources of information about the maned wolf, by location.

Intentions

Univariate analysis of variance indicated strong associations between intentions to help the maned wolf and age groups ($F(1, 249) = 19.82$, $p < 0.001$). Younger boys and girls ($M = 2.37$, $s = 0.84$) demonstrated more intention to help maned wolf conservation than the older group ($M = 1.74$, $s = 0.87$). The other main effects were not significant (p values > 0.46). A significant Interaction between age groups and locations (see Figure 7; $F(2, 249) = 3.59$, $p = 0.029$) was investigated further. Intentions to help the maned wolf were significantly higher among younger participants in both Low Mogiana ($t(99) = 4.96$, $p < 0.001$) and São Carlos ($t(115) = 3.31$, $p = 0.001$), but not in Greater São Paulo ($t(41) = 0.48$, $p = 0.635$).

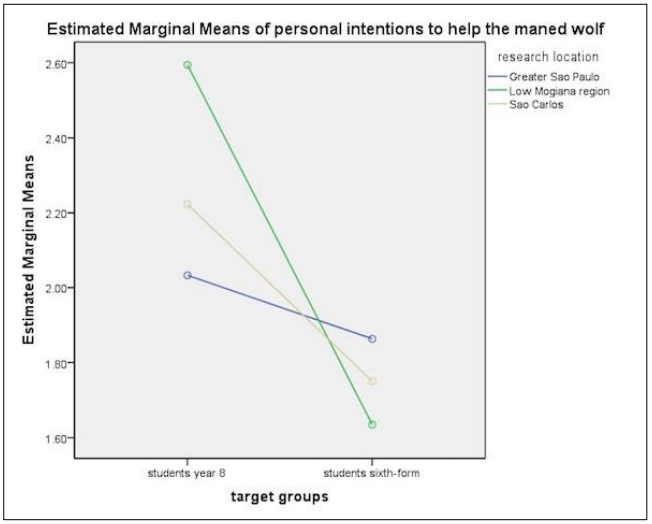

Figure 7. Intentions to help the maned wolf by research locations and age groups.

A multiple regression analysis was conducted to determine whether personal intentions to help the maned wolf could be predicted from the attitude components, knowledge, and first- or second-hand exposure. The model explained a significant amount of variance in intentions ($R = .50$, $R^2 = .25$, $F(6, 179) = 9.96$, $p < 0.001$). Significant predictors (all coefficients standardised) were Component I, characterised by sympathy ($\beta = 0.26$, $p < 0.001$), Component II, characterised by a charismatic and heroic image ($\beta = 0.31$, $p < 0.001$), Component III, the positive conservation attitude ($\beta = 0.27$, $p < 0.001$), lower knowledge of the maned wolf ($\beta = -0.19$, $p = 0.01$), and first-hand exposure ($\beta = -0.22$, $p = 0.001$). Attitude component IV, comprising negative beliefs, was not a significant predictor ($\beta = 0.03$, $p = 0.64$). It should be noted that the bivariate correlation between knowledge of the maned wolf and personal intentions to help was not significant ($r = -0.03$, $p = 0.68$).

Discussion

Attitudes and variables

Our results suggest that overall attitudes were positive toward the maned wolf. Nevertheless, some variables had a negative influence on attitudes. The results from our research shed some light onto when attitudes toward the maned wolf are formed, and about the influence of variables in their development, and form a baseline for future investigations.

Age

Attitudes toward the maned wolf were highly influenced by developmental changes taking place between the ages of 12 and 17. Younger teens (12-13) were more positive toward the maned wolf and displayed more intention to help the species, though they also believed the maned wolf was more of a threat to people and livestock. This can be expected from this age group, possibly as an innate response to predators (Heerwagen and Orians 2002; Kellert 2002).

As in other studies about attitudes toward wild carnivores, there was a decline in positive attitudes toward the maned wolf with age in areas where the maned wolf is present. This may be the result of an overall decline in interest for interactions with nature, in favour of social interactions, but may also reflect negative values associated with the maned wolf in the vicinity of rural areas where the species occur (Bjerke, Odegardstuen, and Kaltenborn 1998b; Kaplan and Kaplan 2002; Clayton and Myers 2009). Where the maned wolf is not present however, older teenagers were more sympathetic and less fearful of the maned wolf, in a similar way that European teens relate to the image

and symbolism attached to the wolf *Canis lupus* (Bjerk, Ødegardstuen and Kaltenborn 1998a). This older group, less familiar with the maned wolf *per se*, may identify with the wild appeal that resonates with the changes they are going through as they approach adulthood (Thomashow 2002). Such identification should be useful informing conservation strategies.

Sustaining any level of interest toward maned wolf conservation amongst older teens may depend on combining conservation-related activities with a chance for them to interact with peers, within a stimulating context (Kaplan and Kaplan 2002; Velsor and Nilon 2006). It is precisely between the ages of 13 and 17 that the maturation of abstract thinking and ethical concerns facilitates an appreciation of the wider world and its ecosystems, and of the interconnectedness and interdependence between people and wildlife. Feelings of moral and environmental stewardship can be fostered at this point in time, while an inclination to explore and test their limits provides opportunities for engagement. Such opportunities can be maximized by environmental education and awareness campaigns within zoos and conservation units, where the animals are present.

Gender

There were no pronounced differences between girls' and boys' attitudes toward the maned wolf, knowledge or intention to help the species, suggesting that the relationship between gender and attitudes toward the maned wolf differ from the results of other studies of large carnivores (Bath and Farmer 2000; Roskaft, Handel, Bjerke and Kaltenborn 2007; Bath, Olszanska and Okarma 2008; Prokkop and Tunnicliffe 2008; Thornton and Quinn 2009).

Location, experience and knowledge

Location of residence accounted for most variability in attitudes toward the maned wolf amongst respondents. Our findings suggest that attitudes are affected by proximity to maned wolves' ranges as a result of livelihoods and related influences posed by family, friends and peers (Bjerk, Ødegardstuen and Kaltenborn 1998a; Roskaft et al. 2007; Skogen and Thrane 2008).

Positive attitudes in São Carlos may be associated with familiarity with wildlife combined with a stronger urban cultural heritage and economy (Bath and Farmer 2000; Bath, Olszanska and Okarma 2008; Siemer et al. 2009). São Carlos enjoys proximity to natural areas but has an economy where competition with wildlife has been replaced by services and industries and a thriving academic life, more so than LM. On the other hand, Low Mogiana respondents displayed, overall, less positive attitudes toward and knowledge about the maned wolf, although they were the most exposed to the maned wolf in nature. However, their familiarity with the maned wolf still translated into intentions to help the species, and positive attitudes amongst the younger teens. As suggested by Thornton and Quinn (2009), the proximity to experiences of conflict and depredation may bring increasing awareness of the need to protect the maned wolf, particularly amongst younger residents, as is the case in Low Mogiana. The negative attitudes amongst younger children here may relate to misconceptions about the feeding ecology of the maned wolf and alleged threat to henhouses, possibly passed down from parents with a rural background. Notwithstanding, the attitudes of the younger children here, where maned wolves are present, were less negative than the attitudes of children residing in GSP, were maned wolves are not found. These findings are in accordance with other research (Bath and Farmer 2000; Bath, Olszanska and Okarma 2008).

Residents of the most urban area (Greater São Paulo) displayed less intention to help the maned wolf and less positive attitudes toward the species, as suggested by other studies (Kellert 1984; Thornton and Quinn 2009), though general attitudes toward the maned wolf improved with age. Older teenagers were more sympathetic and less fearful of the maned wolf although they knew less about them. Therefore the sympathy toward the species amongst older GSP teens is not likely to be based on knowledge or protectionism. It may, however relate to an identification with heroic-related attributes of the maned wolf, and other wolf-related attributes which have been associated with age-linked changes (values, affective).

Although not rural residents themselves, teens in the Low Mogiana may be highly influenced by the local rural economy and family connections, which may affect their attitudes toward the maned wolf. This cultural heritage may also prejudice their trust on information from institutional sources, in favour of local informal sources, which deserves consideration when planning interventions (Skogen and Thrane 2008).

Knowledge about the maned wolf was directly associated with positive attitudes toward the species and its conservation, highlighting the importance of the cognitive element of attitude formation and justifying the need for investment in devising and disseminating accurate information as a means to raise support for the conservation of the maned wolf and possibly other endangered carnivores (Kellert et al. 1996; Roskaft et al. 2007). By contrast, knowledge was not associated with personal intentions to help, and even became a negative predictor of intentions to help when attitudes were also taken into account. This suggests that personal attitudes may be more influential than factual knowledge with respect to personal willingness to help.

On the other hand, findings also suggest that seeing the maned wolf in nature or in a zoo may facilitate learning about the species. Zoos (and conservation units) may wish to explore this potential to combine the development of both cognitive and affective messages through information and the use of positive interactions with the maned wolf (Tunnicliffe, Lucas and Osborne 1997; Myers and Saunders 2002; Clayton and Myers 2009; Clayton et al. 2013; Moss, Jensen and Gusset 2014; Consorte-McCrea at al. 2017). Furthermore, zoos can influence children's experiences from an early age when attitudes toward wildlife are being formed, and help to develop active environmental concerns for life (Keliher 1997; Biaggio et al. 1999). While the conservation of wild habitats benefits both the maned wolf and the local people, the development of connections between the maned wolf and people in zoos can also be important to promote concern for the species and the natural environment as a whole.

Nevertheless our finding that teenagers attitudes were affected by seeing the maned wolf live in nature support suggestions that the expectation as well as the experience of encounters may relate to an awareness of conservation issues, interest in wild animals, reduction of fear, and beliefs that their presence enhances the quality of life (Bath and Farmer 2000; Bath 2014; Roskaft, Handel, Bjerke and Kaltenborn 2007; Bath, Olszanska and Okarma 2008; Thornton and Quinn 2009; Torkar et al. 2010). The emergence of positive attitudes may result from the fact that the experience provides an opportunity to combine affective and cognitive elements, when the excitement of seeing the maned wolf is supported by accompanying adults who reinforce positive attitudes and followed up by finding out more about the species (Millar and Millar 1996; Clayton and Myers 2009; Clayton, Luebke, Saunders, Matiasek and Grajal 2013).

Conclusions

The development of values regarding wildlife conservation, parallel to children's emotional and intellectual development, is particularly sensitive during middle childhood and early adolescence when it can benefit greatly from stimulation provided by nature and wildlife, from a mixture of direct, indirect and symbolic experiences. Understanding how this development may affect attitudes is relevant to the planning of effective conservation strategies for wildlife.

It is possible that in the most rural areas within the maned wolf range, teens between the ages of 13 and 16, as they prepare to take on their adult role in society, become more aware of negative attitudes toward this canid amongst their family and peers, identify themselves more with them, or begin to associate the maned wolf more with financial loss and danger for themselves and their family. Many negative attitudes, though, may relate to misconceptions about the feeding ecology of the maned wolf and alleged threat to henhouses and require investments in activities aiming to promote knowledge and mitigation. However, historical antipathies and mistrust of governmental institutions

may predispose local people against institutional sources of information. It becomes even more important to involve local conservationists and sympathetic leads in conservation strategies, who may inspire trust and be adopted as role models by the teens.

Consistent exposure to positive experiences in nature from an early age should help to shape values and affect the persistence of positive attitudes toward wildlife throughout life. In urban centres, positive personal experiences with maned wolves in captivity and in the wild can be managed to promote and strengthen positive values, to benefit their conservation and that of their habitat. Near rural areas, even if children are influenced by negative attitudes toward maned wolf eventual predation events, children's innate affinity with biodiversity and care for animal species before the age of 13 can be reinforced by the social environment, positive experiences and by quality information (Bjerke, Odegardstuen and Kaltenborn 1998a and b; Kellert 2002). Early investment seems crucial to help promote long term support for the conservation of the maned wolf and its environment.

It is important to consider that positive attitudes may decline as maned wolf populations recover and experiences of conflict and predation move closer to their place of residence. Thus, efforts toward recovery should be accompanied by monitoring human attitudes so that potential problems may be identified and addressed.

The charismatic maned wolf has a role to fulfil in raising awareness for the conservation of the Cerrado habitat on which its survival depends. The present research suggests that the maned wolf generates curiosity and intention to help conserve it among teenagers, the future decision makers. The maned wolf offers an entry point to discuss ecological interactions in the Cerrado habitat, and values related to the conservation of its biodiversity that should be explored for the benefit of generations to come.

Acknowledgements

Many thanks to Mike Nicholls and Rona Hodgens, and to Catherine Hill, David Ponsonby and Peter Vujakovic for their valued input and feedback; our gratitude to the Forestry Institute of São Paulo, São Paulo Zoo, Juquery State Park, UFSCar, and all schools, staff and students who contributed to the research. Many thanks to Alan Bainbridge and Ana Fernandez, who contributed with their insightful revisions of the manuscript.

References

Ajzen, I. 1991. The theory of planned behavior. *Organizational Behaviour and Human Decision Processes* 50: 179-211.

Anic, C.C. 2002. *Conhecimentos e crenças de algumas populacões rurais no sudeste do Brasil frente ao lobo-guará Chrysocyon brachyurus, Illiger, 1815 (Mammalia; Canidae)*. MSc. University of São Paulo, Brazil.

Bath, A. 2014. Introduction to the human dimension: a valuable research tool to achieve wildlife conservation objectives and maned wolf conservation. Pp. 265-282 in A.G. Consorte-McCrea and E.F. Santos (eds.)., *Ecology and Conservation of the Maned Wolf: Multidisciplinary Perspectives*. CRC Press, London, UK.

Bath, A. and Farmer, L. 2000. *Europe's carnivores: a survey of children's attitudes toward wolves, bears and otters.* WWFund-UK, Godalming, UK.

Bath, A., Olszanska, A. and Okarma, H. 2008. From a human dimensions perspective, the unknown large carnivore: public attitudes toward Eurasian lynx in Poland. *Human Dimensions of Wildlife* 13: 31-46.

Biaggio, A.M., Vargas, G.A., Monteiro, J.K., de Souza, L.K. and Tesche, S.L. 1999. Promoção de atitudes ambientais favoráveis através de debates de dilemas ecológicos. *Estudos de Psicologia* 4: 221-238.

Bjerk, T., Ødegardstuen, T.S. and Kaltenborn, B.P. 1998a. Attitudes toward animals among Norwegian children and adolescents: species preferences. *Anthrozoös* 4: 227-235.

Bjerke, T., Odegardstuen, T.S. and Kaltenborn, B.P. 1998b. Attitudes toward animals among Norwegian adolescents. *Anthrozoös* 2: 79-86.

Clayton, S. and Myers, G. 2009. *Conservation Psychology: Understanding and Promoting Human Care for Nature*. Wiley-Blackwell, Chichester, UK.

Clayton, S., Luebke, J., Saunders, C., Matiasek, J. and Grajal, A. 2013. Connecting to nature at the zoo: implications for responding to climate change. *Environmental Education Research* 20: 460-475.

Consorte-McCrea, A.G. 2011. *Conservation of the maned wolf (Chrysocyon brachyurus): carnivore and people relationships in the southeast of Brazil*. PhD. University of Kent/Canterbury Christ Church University, UK.

Consorte-McCrea, A.G. 2014. Relationships between the maned wolf and people. Pp. 35-52 in A.G. Consorte-McCrea and E.F. Santos (eds.)., *Ecology and Conservation of the Maned Wolf: Multidisciplinary Perspectives*. CRC Press, London, UK.

Consorte-McCrea, A.G. and Santos, E.F. (eds.) 2014. *Ecology and Conservation of the Maned Wolf: Multidisciplinary Perspectives*. CRC Press, London, UK.

Consorte-McCrea, A., Bainbridge, A., Fernandez, A., Nigbur, D., McDonnell, S., Morin, A. and Grente, O., 2017. Understanding attitudes toward native wildlife and biodiversity in the UK: the role of zoos. In *Sustainable Development Research at Universities in the United Kingdom* (pp. 295-311). Springer International Publishing.

Dietz, J.M. 1984. Ecology and social organization of the maned wolf (*Chrysocyon brachyurus*). *Smithsonian Contributions to Zoology* 392: 1-51.

Driscoll, J.W. (1995). Attitudes toward animals: species ratings. *Society and Animals* 3: 139-150.

Emmons, L.H. 2014. Environmental influences on maned wolf ecology in Bolivia. Pp. 221-234 in A.G. Consorte-McCrea and E.F. Santos (eds.). *Ecology and Conservation of the Maned Wolf: Multidisciplinary Perspectives*. CRC Press, London, UK.

Heerwagen, J.H. and Orians, G.H. 2002. The ecological world of children. Pp. 29-64 in P.H. Kahn and S.R. Kellert (eds.), *Children and Nature: Psychological, Sociocultural and Evolutionary Investigations*. The MIT Press, London, UK.

Hill, C. 2004. Farmers' perspectives of conflict at the wildlife-agriculture boundary: some lessons learned from African subsistence farmers. *Human Dimensions of Wildlife* 9: 279-286.

Huitt, W. and Hummel, J. 2003. *Piaget's theory of cognitive development.* [online] Educational Psychology Interactive. Available at: www.edpsycinteractive.org/topics/cognition/piaget.html [Accessed 25 April 2017].

IBGE 2008. Produção da Extração Vegetal e da Silvicultura, 2006; Senso Agropecuário, 2006; PIB, 2005. Available at: http://www.ibge.gov.br/cidadesat/topwindow.htm?1 [Accessed 19 October 2016].

IBGE 2009. Instituto Brasileiro de Geografia e Estatística. Available at: www.ibge.gov.br/ [Accessed 19 October 2016].

Kahn, P.H. and Kellert, S.R. 2002. *Children and Nature: Psychological, Sociocultural and Evolutionary Investigations*. The MIT Press, London, UK.

Kaplan, R. and Kaplan, S. 2002. Adolescents and the natural environment: a time out? Pp. 227-258 in P. Kahn and S.R. Kellert (eds.),

Children and Nature: Psychological, Sociocultural and Evolutionary Investigations. The MIT Press, London, UK.

Karlsson, J. and Sjostrom, M. 2007. Human attitudes toward wolves, a matter of distance. *Biological Conservation* 137: 610-616.

Keliher, V. 1997. Children's perceptions of nature. *International Research in Geographical and Environmental Education* 6: 240-243.

Kellert, S.R. 1984. Urban American perceptions of animals and the natural environment. *Urban Ecology* 8: 209-228.

Kellert, S.R. 2002. Experiencing nature: affective, cognitive, and evaluative development in children. Pp. 117-151 in P. Kahn and S.R. Kellert (eds.), *Children and Nature: Psychological, Sociocultural and Evolutionary Investigations*. The MIT Press, London, UK.

Kellert, S.R., Black, M., Rush, C.R. and Bath, A.J. 1996. Human culture and large carnivore conservation in North America. *Conservation Biology* 10: 977-990.

Klink, C.A. 2014. Policy intervention in the Cerrado savannas of Brazil: changes in the land use and effects on conservation. Pp. 293-308 in A.G. Consorte-McCrea and E.F. Santos (eds.). *Ecology and Conservation of the Maned Wolf: Multidisciplinary Perspectives*. CRC Press, London, UK.

Klink, C.A. and Machado, R.B. 2005. Conservation of the Brazilian Cerrado. *Conservation Biology* 19: 707-713.

Knight, J. 2000. *Natural Enemies: People-Wildlife Conflicts in Anthropological Perspective*. Routledge, London, UK.

Manstead, A.S.R., 1996. Attitudes and behaviour. Pp. 3-29 in G.R. Semin and K. Fiedler (eds.), *Applied Social Psychology*. Sage Publications, London, UK.

Millar, M.G. and Millar, K.U. 1996. The effects of direct and indirect experience on affective and cognitive responses and the attitude-behaviour relation. *Journal of Experimental Social Psychology* 32: 561-579.

Mittermeier, R.A., da Fonseca, G.A.B., Rylands, A.B. and Brandon, K. 2005. A brief history of biodiversity conservation in Brazil. *Conservation Biology* 19: 601-607.

Moss, A., Jensen, E. and Gusset, M. 2015. Evaluating the contribution of zoos and aquariums to Aichi Biodiversity Target 1. *Conservation Biology* 29: 537-544.

Motta-Junior, J.C. 2000. Variação temporal e seleção de presas na dieta do lobo guará, *Chrysocyon brachyurus* (Mammalia: Canidae), na Estação Ecológica de Jataí, Luiz Antônio, SP. Pp. 331-346 in J.E. Santos and J.S.R. Pires (eds.), *Estudos integrados em ecossistemas, volume 1*. Rima Editora, São Carlos, Brazil.

Motta-Junior, J.C., Queirolo, D. and de Arruda Bueno, A. 2014. Feeding Ecology. Pp. 87-98 in A.G. Consorte-McCrea and E.F. Santos (eds.)., *Ecology and Conservation of the Maned Wolf: Multidisciplinary Perspectives*. CRC Press, London, UK.

Muir, M.J. and Emmons, L.H. 2012. Conservation. In L.H. Emmons (ed.), *The Maned Wolves of Noel Kempff Mercado National Park*. *Smithsonian Contributions to Zoology* 639: 91-115.

Myers, O.E. and Saunders, C.D. 2002. Animals as links toward developing caring relationships with the natural world. Pp. 153-178 in P. Kahn and S.R. Kellert (eds.), *Children and Nature: Psychological, Sociocultural and Evolutionary Investigations*. The MIT Press, London, UK.

Paula, R.C. and Desbiez, A.L. 2014. Maned wolf population viability. Pp. 15-34 in A.G. Consorte-McCrea and E.F. Santos (eds.)., *Ecology and Conservation of the Maned Wolf: Multidisciplinary Perspectives*. CRC Press, London, UK.

Paula, R.C., Medici, P. and Morato, R.G. 2008. *Plano de Ação para a Conservação do Lobo-Guará -Análise de Viabilidade Populacional e de Habitat*. Centro Nacional de Pesquisas para Conservação dos Predadores Naturais-CENAP/ICMBio, Brasília, Brazil: P. 158.

Prokop, P. and Tunnicliffe, S.D. 2008. "Disgusting" animals: Primary school children's attitudes and myths of bats and spiders. *Eurasia Journal of Mathematics, Science & Technology Education* 4: 87-97.

Puglia, L.R.R. 1978. O lobo guará em cativeiro. *Revista de Zoológico*. 1: 6.

Rodrigues, F.H.G. 2002. *Biologia e conservação do lobo-guará na Estação Ecológica de Águas Emendadas, DF*. PhD. University of Campinas Institute of Biology, Brazil.

Roskaft, E., Handel, B., Bjerke, T. and Kaltenborn, B.P. 2007. Human attitudes toward large carnivores in Norway. *Wildlife Biology* 13: 172-185.

Rokeach, M. 1968: The nature of attitudes. Pp. 449-458 in D.L. Sills (ed.), *International Encyclopedia of the Social Sciences, Vol. 1*. Macmillan, New York, USA.

Sergio, F., Newton, I., Marchesi, L. and Pedrini, P. 2006. Ecologically justified charisma: preservation of top predators delivers biodiversity conservation. *Journal of Applied Ecology* 43: 1049-1055.

Siemer, W.F., Hart, P.S., Decker, D.J. and Shanahan, J.E. 2009. Factors that influence concern about human–black bear interactions in residential settings. *Human Dimensions of Wildlife* 14: 185-197.

Sillero-Zubiri, C. 2014. The Canidae family: setting the scene for maned wolf conservation. Pp. 3-14 in A.G. Consorte-McCrea and E.F. Santos (eds.)., *Ecology and Conservation of the Maned Wolf: Multidisciplinary Perspectives*. CRC Press, London, UK.

Silva, C.B.X. 2000. Projeto lobo guará – uma contribuição à conservação dos Campos Gerais no Paraná, Brasil. Pp. 43-49 in *Protocolo de manejo do lobo guará mantidos em cativeiro*. Sociedade de Zoológicos do Brasil, Sorocaba, Brazil.

Silva, C.B.X. and Nicola, P.A. 1999. Observações sobre o lobo guará no Parque Estadual de Vila Velha, Ponta Grossa, Paraná, Brasil. Congresso Brasileiro de Conservação e Manejo da Biodiversidade: P .23. Ribeirão Preto, Brazil.

Skogen, K. and Thrane, C. 2008. Wolves in context: using survey data to situate attitudes within a wider cultural framework. *Society and Natural Resources* 21: 17-33.

Soler G.L., Carenton J.M., Birochio D., Salvatori V., Orozco M.M., Rosso M.S., Carpinetto M., Heinonen Fortabat, S., Steiman, L., Díaz, M.L., Pino, M.C., Chávez Calvimontes, V., Kina, A.M., Torres Jiménez, G., Prates, P. and Solís, G. 2005. Problems and recommendations for the conservation of maned wolf in Argentina. Results from the First Workshop of *Chrysocyon brachyurus* in Argentina and surrounding countries: Conservation *in situ* and *ex situ*. *Endangered Species UPDATE*, 22: 1–9.

Thornton, C. and Quinn, M. 2009. Coexisting with cougars: public perceptions, attitudes, and awareness of cougars on the urban-rural fringe of Calgary, Alberta, Canada. *Human-Wildlife Conflicts* 3: 282-295.

Thomashow, C. 2002. Adolescents and ecological identity: attending to wild nature. Pp. 259-278 in P. Kahn and S.R. Kellert (eds.), *Children and Nature: Psychological, Sociocultural and Evolutionary Investigations*. The MIT Press, London, UK.

Torkar, G.M. 2010. The conservation knowledge and attitudes of teenagers in Slovenia toward the Eurasian otter. *International Journal of Environmental and Science Education* 5: 341-352.

Tunnicliffe, S.D., Lucas, A.M. and Osborne, J. 1997. School visits to zoos and museums: a missed educational opportunity? *International Journal of Science Education* 19: 1039-1056.

Velsor, S.W. and Nilon, C.H. 2006. A qualitative investigation of the urban African-American and Latino adolescent experience with wildlife. *Human Dimensions of Wildlife* 11: 359-370.

Biographical sketch

Adriana Consorte-McCrea has an MSc in Conservation Biology from the Durrell Institute of Conservation and Ecology (DICE, UKC) and a PhD in Ecology from the University of Kent. She has worked in the conservation of wild canids for 30 years with zoos both in Brazil and in the UK, and has co-edited a book on the ecology and conservation of the maned wolf. She is particularly interested in the human dimensions of wildlife conservation. In 2006, she created the Wildlife and People Research Group, which she chairs (as part of the Ecology Research Group) at Canterbury Christ Church University, where she has taught undergraduate students since 2004 and also works as an Education for Sustainable Development Lead (Futures Initiative). She has been a member of the IUCN SSC Reintroduction Specialist Group since 1997.

Dennis Nigbur is a senior lecturer in psychology and the Chair of the Faculty Ethics and Governance Committee at Canterbury Christ Church University, with particular interests in the social psychology of culture and sustainability. He graduated from the University of Kent with a BSc in Social Psychology in 1999, and conducted his doctoral studies on national identity, receiving a PhD from Royal Holloway, London in 2004. He conducted post-doctoral research at the University of Surrey on predictors of kerb-side waste recycling, and at the University of Sussex on children's acculturation orientations. He took up his lectureship at Canterbury Christ Church University in 2007.

Alistair Bath is a full professor in the human dimensions (HD) in natural resource management field within the geography department at Memorial University, with particular interests in conflict resolution and strategic planning using his applied HD facilitated workshop approach that has proven successful 100% of the time over his 25 year career. He graduated with geography degrees from Wilfrid Laurier University with an honors BA in 1985, a MA from University of Wyoming in 1987, and a PhD from University of Calgary in 1993. Much of his research has focused on large carnivore-human interaction issues in Europe, North America, India and Brazil but he has also worked in protected areas management issues in Romania, USA and Canada. He began his career at Memorial University in 1991.