

# Does people's knowledge about an endangered bird species differ between rural and urban communities? The case of the Greater Rhea (*Rhea americana*, Rheidae) in Minas Gerais, Brazil

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**RESUMO: O conhecimento das pessoas acerca de uma espécie de ave ameaçada de extinção difere entre comunidades rurais e urbanas? O caso da ema (*Rhea americana*, Rheidae) em Minas Gerais, Brasil.** Emas são aves sul-americanas ameaçadas de extinção; a perda de habitat, a predação e a caça são os principais fatores responsáveis pelo declínio da espécie. Populações dessa espécie estão sendo mantidas em cativeiro para futuros programas conservacionistas. Entretanto, para um programa conservacionista obter sucesso, é necessário que a comunidade humana se envolva. Então, as percepções da comunidade humana precisam ser avaliadas e incorporadas aos planos de conservação. Espera-se que as comunidades humanas inseridas no ambiente onde a espécie ameaçada ocorre deem mais importância à sua conservação do que comunidades humanas não inseridas no ambiente de ocorrência da espécie. O objetivo deste estudo foi avaliar se as percepções de comunidades urbanas e rurais sobre as emas diferem devido à proximidade ao problema. O estudo foi conduzido em São José do Buriti (comunidade rural; emas ocorrem no local) e no zoológico de Belo Horizonte (comunidade urbana), ambas localizadas no Estado de Minas Gerais, sudeste do Brasil. Cento e trinta e cinco questionários foram aplicados nas duas áreas. Pessoas da área rural reconheceram melhor as emas se comparadas às pessoas da área urbana. O conhecimento sobre os riscos de extinção das emas diferiu em alguns aspectos entre as duas comunidades, mas ambas concordaram que a extinção da espécie traria problemas ecológicos. Programas de educação ambiental devem ser implementados em ambas as áreas a fim de maximizar os efeitos das ações conservacionistas.

**PALAVRAS-CHAVE:** Conservação, educação ambiental, ratitas, extinção, zoo.

**ABSTRACT: Does people's knowledge about an endangered bird species differ between rural and urban communities? The case of the Greater Rhea (*Rhea americana*, Rheidae) in Minas Gerais, Brazil.** Greater Rheas are threatened South American birds; habitat loss, predation and hunting are the main factors responsible for population declines. Populations of this species are now held in captivity for future conservation programmes. Meanwhile, for a conservation program to succeed, it is necessary that the human community close to an *in-situ* conservation project be involved. Thus, the perceptions of the human community must be evaluated and incorporated into the conservation activities planned. It is expected that the human communities that are inserted in the environment where the endangered species occur will give more importance to its conservation than human communities that live far from the problem. The aim of this study was to evaluate whether perceptions of rural and urban communities about Greater Rheas are different due to experience and proximity with the problem. The study was conducted in São José do Buriti (rural community; wild Greater Rheas occur in this area) and at the BH Zoo (urban community), both in Minas Gerais state, southeastern Brazil. One-hundred and thirty-five questionnaires were given to people in both areas. Rural people were better able to recognize Greater Rheas than the urban community. People's knowledge about the Greater Rheas' risk of extinction differed in some aspects between rural communities and urban communities, but both communities agreed that the local extinction of Greater Rheas would bring ecological problems. Rural communities related local environmental problems (*e.g.*, silvicultural activities) as one of the main reasons for Greater Rheas' declining populations while urban communities related more general reasons (*e.g.*, trafficking and hunting). Environmental education programs should be implemented in both areas to maximize conservation actions.

**KEY-WORDS:** Conservation, environmental education, extinction, ratites, zoo.

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More than 13% of the world's bird species are threatened by extinction to some degree (IUCN 2011). In Brazil, 25.5% of the birds species are considered threatened according to the National Red List (Machado *et al.* 2008) and 6.7% according to the IUCN's red list (IUCN 2011). Differences between the two lists are generated mainly due to criteria used by each institution for classification of species in threat categories (*e.g.*, the Yellow-nosed Albatross *Thalassarche chlororhynchos* is classified as endangered by IUCN and as vulnerable by the National Red List of Brazil; Rodriguez *et al.* 2000, Rodrigues *et al.* 2005, Marini and Garcia 2006, Milner-Gulland 2006).

Greater Rheas *Rhea americana* (Linnaeus 1857) (Rheiformes, Rheidae, Aves) are the largest birds of South America, occurring from the north of Brazil to the south of Argentina (Sick 1997, Davies 2002), and it is one of the bird species that differed between the two red lists cited earlier. Although Greater Rheas are not present in the Brazilian National Red List (Machado *et al.* 2008), their populations are declining in several Brazilian states (Minas Gerais included) due to habitat loss, hunting, feral dog predation, crop burning, and egg losses caused by agricultural machinery (Dani 1993, Sick 1997, Machado *et al.* 1998, Navarro and Martella 1998, Fernández and Reboreda 2000, Di Giacomo and Krapovickas 2005). According to the IUCN, Greater Rheas are classified as 'near threatened', a species that does not fulfil the requirements for being classified as vulnerable, endangered or critically endangered, but there are signs that it will be threatened in the near future (IUCN 2011).

Conservation efforts are therefore necessary to reduce the impacts of human activities upon wild populations of Greater Rheas. One of the most indicated actions to protect any threatened species is the implementation of environmental education activities (Feinsinger 2004, Padua *et al.* 2004). It is known that there exists a correlation between people's behaviour and how they perceive the environment (Fishbein 1967). An investigation about what people know about threatened species could affect species conservation (Ruiz-Mallen and Barraza 2008), since it could indicate actions to be implemented using environmental education; thereby, enhancing the effectiveness of these actions through the insertion of the community (Campbell *et al.* 2010).

Depending on the conflicting demands of local and regional communities, desires about the conservation of a certain endangered species may change (Jobes 1991, Power 1991, Rasker *et al.* 1992, Reading *et al.* 1994). It is expected that human communities inserted in the environment where endangered species occur will give more importance to their conservation than human communities that live far from the problem, especially communities who exploit those species to some degree (Gadgil *et al.* 1993, Berkes *et al.* 2000).

The aim of this study was to investigate the level of knowledge and interest about Greater Rheas of people in a community at the Felixlândia Municipality (north-western Minas Gerais, Brazil), and compare them to an urban community far from the Greater Rheas' natural environment.

## MATERIAL AND METHODS

### Study areas

The study was conducted in two distinct areas, one rural and one urban. The rural area was located at São José do Buriti (local population: 1,390), a district of the Felixlândia municipality, northwestern Minas Gerais state, south-eastern Brazil (18°S; 45°W). The region is inserted in the *Cerrado* biome *latu sensu* (Velooso and Goés-Filho 1982), and declining wild Greater Rhea populations were observed locally (Azevedo *et al.* 2006). The economy of São José do Buriti is based on silvicultural activities (*Eucalyptus* plantation) and cattle farming (the area was a matrix of *Eucalyptus* forests, native *Cerrado* vegetation and pasture lands), being the district formed by human houses and farms sparsely distributed. Native Greater Rhea populations were observed in the area, with birds found both near and far from the human houses (no detailed estimate of the Greater Rheas' population size in the District of São José do Buriti was obtained, but a two-year round study conducted by the authors counted at least 30 individuals).

The urban area, a zoological garden (the Belo Horizonte Zoo, hereafter BH Zoo), is located in the Belo Horizonte municipality, capital city of the Minas Gerais state (19°S; 44°W). This area is the second largest park of Belo Horizonte (1,450,000 m<sup>2</sup>), with elements of the *Cerrado* and Atlantic Forest vegetation (Silva *et al.* 2006); there were seven Greater Rheas on-exhibit to the visitors of the zoo. The BH Zoo receives 1.2 million visitors annually. The rural area and the urban area were separated by 225 km.

### Data collection and analysis

Two similar semi-structured questionnaires (Appendices 1 and 2) were applied in both areas; in the rural area, it was applied to the local population of the São José do Buriti. In the urban area, the questionnaire was applied to the visitors at the Greater Rheas' enclosure at the BH Zoo. In total, we randomly applied 270 questionnaires, being 135 in each area. Informal conversations were conducted after the fulfillment of the questionnaires; this intended to investigate the degree of honesty of the answers. Some questions of the questionnaires were not answered

by the interviewees, which explain different samples sizes obtained in the result section (e.g., only 124 people in the rural community answered their gender, while 11 people did not answer this question).

The questionnaires intended to evaluate the knowledge and the perceptions of the populations about the conservation of the Greater Rheas. We collected general demographic information about the interviewed public such as gender, age, schooling (level), profession and birthplace, and specific information, such as the role of introduced predators (e.g., feral dogs) and zoos in the conservation of Greater Rheas. The schooling categories followed the Brazilian educational system: fundamental level (seven to 14 years old), secondary level (15 to 18 years old), technical school (15 to 18 years old school), and college level (19 to 23 years old). Data were summarized and analyzed statistically using the Chi-square test. All tests were run using MINITAB v.12 (1998) with a confidence level of 95% ( $\alpha = 0.05$ , Zar 1999).

## RESULTS

The chi-squared test showed that the interviewees opinions differed significantly between rural and urban populations for the sightings of Greater Rheas in the wild, with rural communities seeing more birds than urban ones ( $X^2 = 143.41$ ,  $DF = 1$ ,  $p < 0.01$ ). In terms

**TABLE 1:** Age and schooling of the rural and urban interviewees questioned in this study on Greater Rheas (N = absolute number; % = relative number).

Rural Community (São José do Buriti)					
Schooling	N	%	Age	N	%
Incomplete fundamental	45	33.34	10-19	61	45.19
Complete fundamental	9	6.67	20-29	23	17.04
Incomplete secondary	43	31.85	30-39	8	5.93
Complete secondary	13	9.63	40-49	14	10.37
Incomplete university	0	0.00	50-59	9	6.67
Complete university	2	1.48	60-69	6	4.44
Technical	4	2.96	70-79	5	3.70
Not answered	19	14.07	Not answered	9	6.67
Total	135	100	Total	135	100
Urban community (Zoo visitors)					
Schooling	N	%	Age	N	%
Incomplete fundamental	1	0.74	10-19	10	7.41
Complete fundamental	24	17.78	20-29	48	35.56
Incomplete secondary	20	14.81	30-39	37	27.41
Complete secondary	60	44.44	40-49	22	16.30
Incomplete university	7	5.19	50-59	15	11.11
Complete university	15	11.11	60-69	1	0.74
Technical	0	0.00	70-79	2	1.48
Not answered	6	4.44	Not answered	0	0.00
Total	135	100	Total	135	100

of recognition of the Greater Rheas, rural communities identified these birds more correctly than urban communities ( $X^2 = 18.24$ ,  $DF = 1$ ,  $p < 0.01$ ). In terms of opinion about Greater Rheas' risk of extinction, the rural community believed that Greater Rheas are in Greater risk of extinction than urban communities ( $X^2 = 8.60$ ,  $DF = 1$ ,  $p < 0.05$ ), and as for the causes of Greater Rheas' population decrease, urban people suggested more causes than the rural community ( $X^2 = 37.09$ ,  $DF = 1$ ,  $p < 0.01$ ).

In the rural community, we interviewed 84 men and 40 women. The majority of people aged between 10 and 19 years old (45.19%,  $N = 61$ ), the next highest category was of 20-29 years old (17.04%,  $N = 23$ , Table 1). Most of the interviewees had incomplete primary school (seven to 14 years old, 33.34%,  $N = 45$ ) or incomplete secondary school (15 to 18 years old, 31.85%,  $N = 43$ , Table 1). Students ( $N = 26$ ), farm-hands ( $N = 14$ ) and forestry assistants ( $N = 11$ ) were the most encountered professions.

In the urban community, we interviewed 62 men and 73 women. The majority of people had an age varying between 20 and 29 years old (35.56%), the next most prominent category being of 30-39 years old (27.41%, Table 1). Schooling varied from a complete fundamental level (seven to 14 years old, 17.78%,  $N = 23$ ) to complete secondary school (15 to 18 years old, 44.44%,  $N = 60$ , Table 1). Students ( $N = 13$ ), drivers ( $N = 9$ ) and teachers ( $N = 6$ ) were the most encountered occupations.

Most of the rural interviewees recognized the Greater Rhea photograph ( $N = 120$ , 88.89%). One-hundred and two people said that they had seen the birds in the study region, while 10 people had never seen them. Most of the interviewees ( $N = 96$ , 71.11%) reported seeing Greater Rheas only in open habitats, such as grasslands and open *Cerrado*; 2.22% ( $N = 3$ ) reported seeing the birds in forests and 8.89% ( $N = 12$ ) saw them inside *Eucalyptus* forests; the same percentage of people saw Rheas in both open and forest areas. One interviewee (0.74%) told that he saw one individual locked inside a pen, and one interviewee (0.74%) saw the birds in all habitats.

Many of the urban interviewees recognized the Greater Rhea (67.41%,  $N = 91$ ), but 44 (32.59%) individuals confused Rheas with ostriches or did not recognize the bird. One-hundred and fourteen (84.44%) persons said that they had not seen Greater Rheas in the wild; 19 (14.07%) people had seen wild Greater Rheas at least once in their lifetimes.

More than 85% of the rural interviewees ( $N = 115$ ) believed that Greater Rheas' local populations were vanishing, and 12% ( $N = 16$ ) did not believe that Greater Rhea populations were reducing. When questioned about the possible causes of decline in the local populations, people answered: habitat loss (22%,  $N = 30$ ), poisoning from pesticides (19%,  $N = 26$ ), hunting (7%,  $N = 10$ ), and other reasons not listed in the questionnaire, such as the increased transit of people and cars in the region,

drying of water resources, and the establishment of *Eucalyptus* plantations in the area, were cited by 17% (N = 24) of the interviewees (Figure 1).

More than 71% of the urban interviewees (N = 97) believed that Rheas populations are in risk of extinction, and almost 26% believed that they are not. When questioned about the possible causes of decline in Greater Rheas' populations, people answered that habitat loss (28.15%, N = 38), hunting (14.81%, N = 20) and these two causes acting together (8.89%, N = 11) were the main reasons (Figure 1).

Only three rural interviewees had the habit of collecting Greater Rheas' eggs to eat, but when asked if this habit could cause any risks to the birds, only one individual answered yes; one answered no and the other did not answer this question. Three questions evaluated the degree of knowledge of the role of feral dogs in Greater Rhea population decline: more than a half of the interviewees had a dog (59%), 28% allowed their dogs to run free through the vicinities of their houses, and 37% thought that this habit did not bring any risk to Greater Rhea populations (Figure 2).

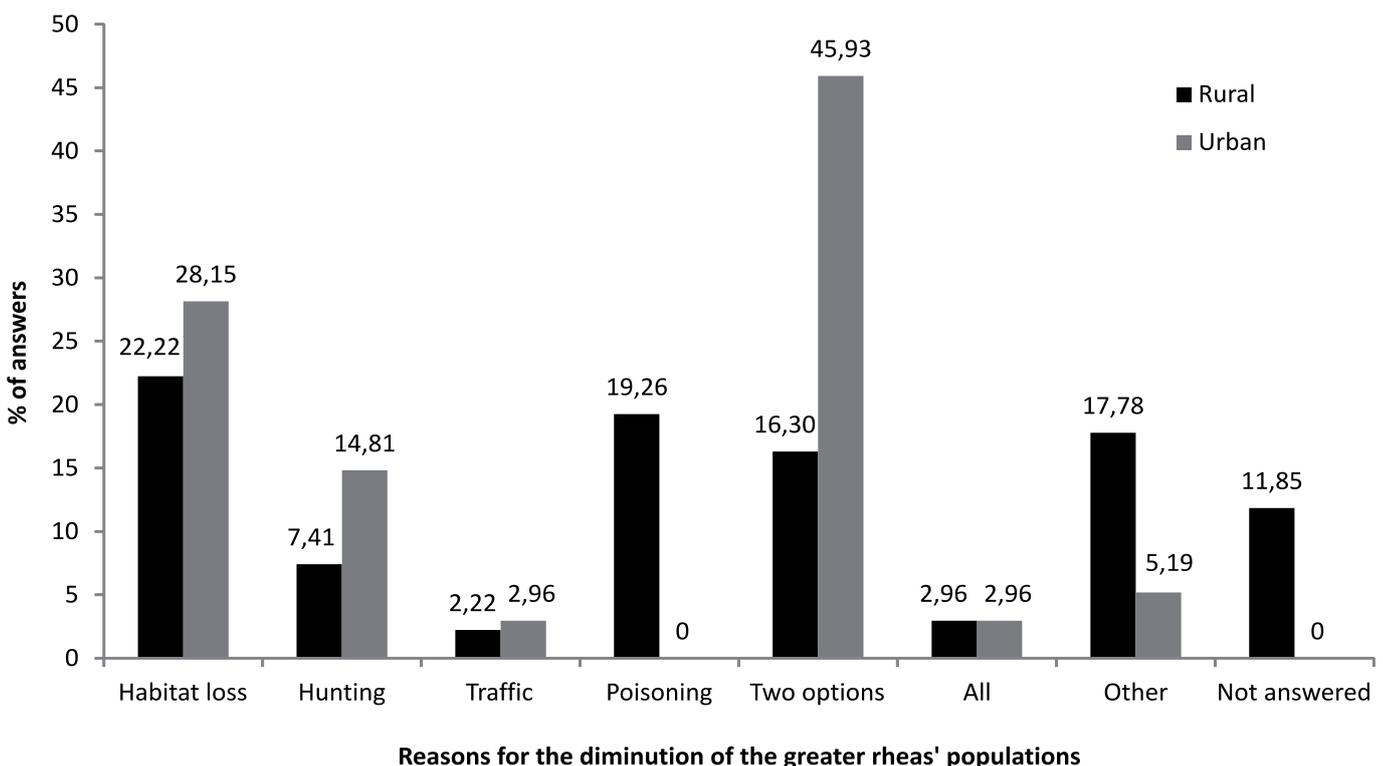
Nearly all urban interviewees (97.7%; N = 132) thought that it is important to conserve Greater Rheas, and 83.70% (N = 112) thought that the maintenance of specimens in zoos could be a good strategy to conserve this species. When asked why we should conserve Greater Rheas, many of the interviewees (40%, N = 54) answered that the birds have as much right to live as any other living creature, 22.96% (N = 30) answered that ecological

problems due to their extinction could be difficult to manage, and 13.33% (N = 18) thought that it is important to conserve Rheas due to their aesthetics, since they are beautiful birds to watch (Figure 3). The main reasons given by interviewees on the role of zoos in a conservation strategy for Greater Rheas were protection (53.91%, N = 61), educational opportunities (20%, N = 23), and reintroduction stocks (19.13%, N = 22); 5% (N = 11) did not answer this question, and 1.74% (N = 2) said that zoos should be the last alternative to conservation of Greater Rheas or any other species.

Ninety-six rural interviewees thought that it was important to conserve Greater Rheas locally, and 87% would like to participate in a conservation program if implemented in the region.

## DISCUSSION

In this study, the human communities inserted in the environment where the Greater Rhea occurs had in general more knowledge about the species than the human communities that live far from the problem, but both communities (rural and urban) gave the same level of importance to its conservation. The communities differed in some important aspects: (1) people from rural community had more chance to observe the birds in their natural habitat than people living in the city, an expected result; since most of the city's citizens did not have any opportunity to watch wildlife unless they went to a zoo



**FIGURE 1:** Reasons pointed out by the interviewees from rural (São José do Buriti) and urban (Belo Horizonte) communities for the decline of Greater Rheas' populations (results presented in percentages; both communities from the state of Minas Gerais, Brazil).

(Young 2003); (2) people from rural community recognized more frequently Greater Rheas than city people; and (3) habitat loss was the main reason cited as being responsible for the decline of Greater Rheas by both communities, but the other reasons differed significantly between them, with urban people relating trafficking and hunting, and rural people relating poisoning by pesticides as important factors.

Most rural people already knew or had seen wild Greater Rheas in the study area; most of them made sightings in opened areas, which was expected since Greater Rheas inhabit grasslands and opened *Cerrados* (Del Royo *et al.* 1992, Sick 1997, Davies 2002). Few interviewees

made sightings of Greater Rheas in forests or inside the *Eucalyptus* plantations. Although uncommon, Greater Rheas can use such habitats (Martella *et al.* 1996, Bazzano *et al.* 2002, Bellis *et al.* 2004, Giordano *et al.* 2008), but the low detectability of birds inside forests (Martella and Navarro 1992, Donatelli *et al.* 2004) may have influenced this results.

Most of the urban interviewees had not seen Greater Rheas in the wild; from the interviewees that had already seen Greater Rheas in the wild, most were from other Brazilian states, such as Mato Grosso and Maranhão; these states are in concordance with Greater Rheas' known distribution (Sick 1997). Some of the interviewees reported

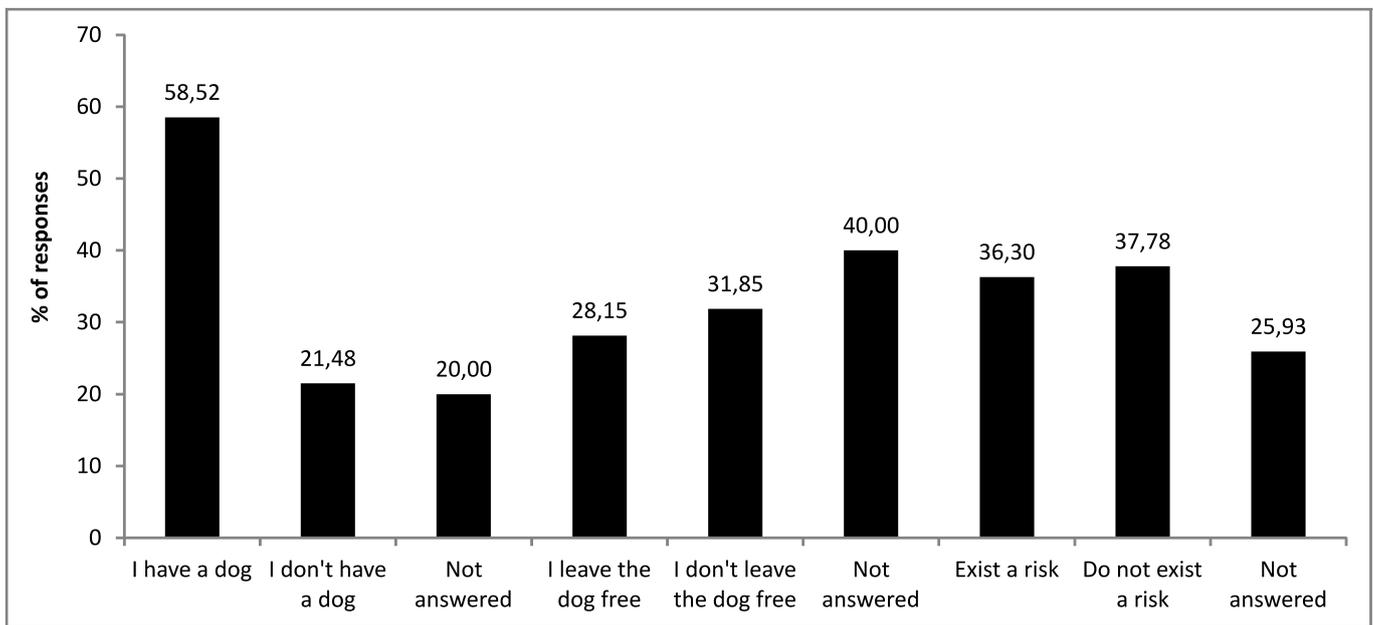


FIGURE 2: Perceptions of the rural community (São José do Buriti, Minas Gerais state, Brazil) about the role of domestic dogs in the risk of extinction faced by Greater Rheas (results presented in percentages).

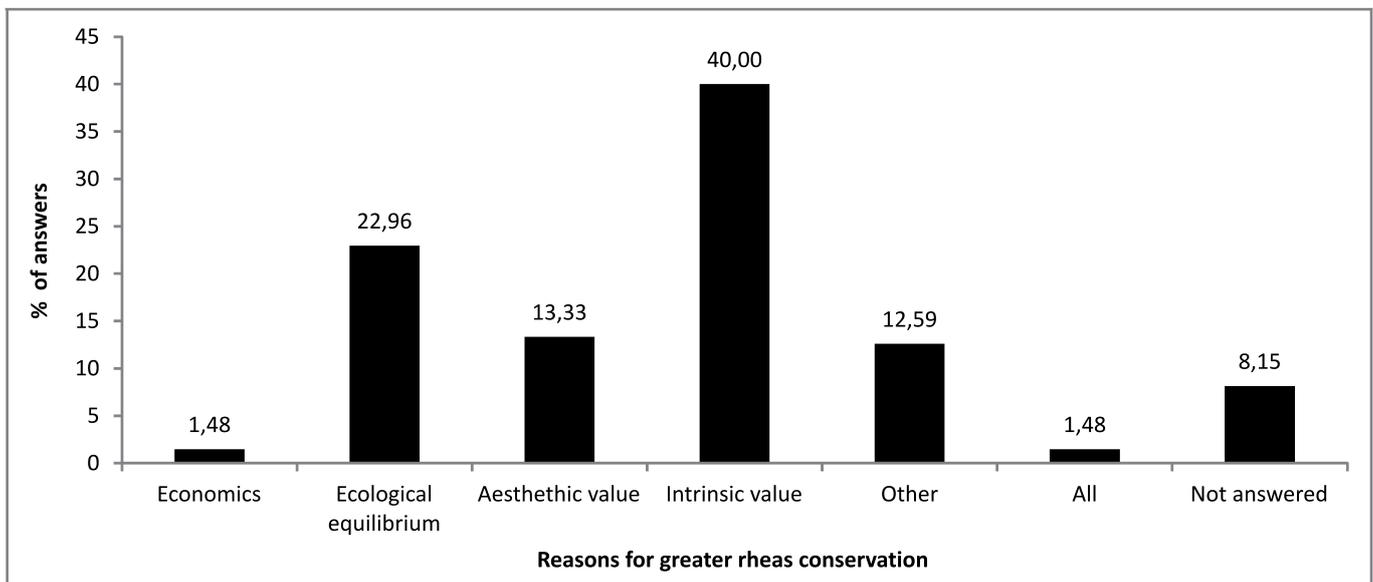


FIGURE 3: Reasons pointed out by the urban people community (Belo Horizonte zoo visitors, Minas Gerais state, Brazil) for the conservation of Greater Rheas (results presented in percentages)

that although they had seen Greater Rheas in the wild, there had been a while since their last sightings, which is in accordance to the studies that showed that Greater Rheas have declining populations all over their distribution area (Dani 1993, Sick 1997, Machado *et al.* 1998, Navarro and Martella 1998, Fernández and Rebores 2000, Di Giacomo and Krapovickas 2005).

Most people recognized Greater Rheas, but a large sample of urban people did not know the bird or confused it with the ostrich (*Struthio camelus*); people have a need to name the animals and they allocate a name of nearest fit according to their knowledge (Bruner *et al.* 1966). In this study, some people thought that Greater Rheas were ostriches; ostriches are the closest genetic relative to Greater Rheas depending on the methods used to infer phylogenies (Sibley and Alquist 1990, Del Hoyo *et al.* 1992, Van Tuinen 1998, Davies 2002). The Ostrich is the African ratite and, as other large animals of African savannas, it appears more frequently on TV documentaries, cartoons and even in children books. This fact could be responsible for the confusion of the zoo visitors, since they rarely go to the zoo to see native fauna, but often to see the African fauna, a phenomenon that occurs in most zoos of the world (Auricchio 1999, Achutti 2003).

The great majority of rural interviewees believed that the number of local Greater Rheas had diminished, and that the habitat loss and poisoning by pesticides were the main reasons. Both reasons were linked by the population to the silvicultural activities in the study area (growth of *Eucalyptus* forests); the use of pesticides inside the plantations was pointed out as one of the greatest problems of such silviculture. Few interviewees believed that Greater Rheas migrated from *Eucalyptus* forests to the opened areas in the vicinity.

Although the rural community had reported great mortality of Rheas after the implementation of the silvicultural farms in the region, especially due to poisoning by pesticides, this hypothesis is not supported by previous studies on environmental impacts conducted in the area (Del Rey Engenharia 2000). According to this study, although *Eucalyptus* forests had been treated with pesticides to eliminate weeds, which could cause the death of Rheas due to bioaccumulation, only two Rheas were found dead in the plantations and none of them died by poisoning, as confirmed by toxicological exams. According to the Monsanto do Brasil Company, the manufacturer of the pesticide used in the *Eucalyptus* forests (Scout®), the possible bioaccumulation of the pesticide is virtually inexistent, since it acts only on weeds and is soon degraded in the environment (Monsanto 2004). This idea was passed on to the local population by local environmental activists and even by some schoolteachers, as observed by us. This could explain the great number of interviewees suggesting this reason. If so, it demonstrates the great power of schools in teaching notions of environmental impacts

and education (Vaughan *et al.* 2003) and, obviously, the need to do this with correct information.

The hypothesis of migration of Greater Rheas to the vicinity of *Eucalyptus* forests seemed more plausible than the hypothesis of poisoning. The *Eucalyptus* silviculture was planted over human-altered areas, covered by exotic grasses used for cattle production (Del Rey Engenharia 2000). Thus, *Eucalyptus* forests did not destroy native forests or *Cerrados*, but grasslands instead, areas frequently used by Greater Rheas, displacing the birds to nearby areas. During this displacement, many birds could have died, since they become more susceptible to hunting, capture, predation and accidents with cars (Lank *et al.* 2003).

The great majority of urban interviewees also believed that the number of Greater Rheas is diminishing, and that habitat loss was the main reason. However, hunting and trafficking were also cited instead of poisoning as the other reasons accounting to Greater Rheas population decline. The increase of human populations was cited by many as the reason behind habitat loss. Hunting and trafficking may have been cited as reasons due to the recent boom of reports on these themes on Brazilian TV, but no programs focusing specifically on Greater Rheas have been made.

It is important to emphasize that the rural community believes that the conservation of Greater Rheas' populations would help in the maintenance of some ecological equilibrium in the region, and that they want to participate in conservation programs for the species.

The desire of the local community to participate in the conservation of local Greater Rheas populations is also positive. Padua *et al.* (2004) suggested that a key-element for an environmental education program is to develop mechanisms to promote the participation of the local communities in conservation actions. The individual's strength and its sense of identity are essential for environmental education, and need to emerge from inside each person (Glazer 1999). The community's participation in all solutions and decisions in a conservation program should be guaranteed; in this way, the feelings of "to conserve what matters to me" could blossom and dominate their actions. Zoo visitors believed that it was important to conserve Greater Rhea populations due to their intrinsic right to live and their contribution in the maintenance of some ecological equilibrium in nature.

The majority of the rural interviewees had dogs, and more than a half allowed their dogs free access to explore the surrounding areas (grasslands, *Cerrados*, forests, etc.). The opinions about the possible problems of this habit were equally divided, with half of the persons thinking that dogs bring problems to Greater Rheas and half of the persons thinking that this was not a problem to Greater Rheas. The domestic dog is one of the most problematic animals in terms of wildlife predation, as it causes great

impacts not only on prey populations but also on native predator populations, since it competes with them for prey (Yanes and Suárez 1996, Manor and Saltz 2004). Two dog killed Rhea carcasses found in the study area by us and one video recording of a persecution and killing of a Greater Rhea by a dog proved that this was a real problem in this area. Besides, the majority of the dogs observed in the area were big enough to persecute and kill Greater Rheas.

One of the biggest problems faced by conservation researchers is the lack of knowledge that the owners of domestic animals have about their pets and the danger they can cause to native fauna if left to roam freely (Galetti and Sazima 2006). In the study area, owners that left their dogs free thought that they did not hunt Rheas, not believing that they can represent a real problem for Greater Rhea's conservation. Environmental education programs should be implemented in the region approaching the problem of dogs to wildlife conservation, especially for the Greater Rheas.

Many reports of people capturing Greater Rhea adults and chicks for consumption or trafficking in the rural area were collected in this study, although 97% (N = 131) of the rural interviewees said that this practice was not done. Many rural interviewees were concerned about the indiscriminate collection of eggs and the capture of Rhea chicks in the region, suggesting that if these practices do not stop, Greater Rheas would quickly disappear from the area. The rural population should understand that they play an important role in the conservation of Greater Rheas by teaching their children to respect this species or even participating in the vigilance of the area, protecting the birds from activities of persons from outside their community; environmental education is a valuable tool to achieve these goals (Baral *et al.* 2007).

More than 87% (N = 115) of the urban interviewees thought that zoos play an important role in conservation efforts for Greater Rheas, and for their protection from hunters and predators. It is important to highlight the educational opportunities that captive environments offer to the public, so long as the animals are experiencing good levels of welfare (Fernandez and Timberlake 2008). It is known, for example, that animals expressing a lot of abnormal behavior tend to generate pity rather than interest in the species (Swaigood 2007).

It is important to note that the interviewees' data were in general biologically accurate and therefore we can be confident that their responses were genuine/honest (informal conversations supported this conclusion).

The rural community had some knowledge about Greater Rheas' biology and their conservation status, although a few aspects of the birds' biology and population threats were apparently unknown to them (*e.g.*, most of the interviewees did not recognize that dogs could kill Greater Rheas). The urban community had less

knowledge about Greater Rheas and their conservation status, but had a more general knowledge about conservation problems than the local community; these results corroborate our initial hypothesis, that people who live far from the environment where endangered species occur will have less knowledge about them than people who live near the problem.

The knowledge about animal extinction and wildlife trafficking increased with schooling level. Urban people had more formal knowledge than rural people and this could be decisive to explain this difference. Tunnicliffe (2006) stated that the most important work that biology education researchers can do is to identify starting points for teaching from and then stimulate the manner in which new biological knowledge is built upon the learner's existing knowledge. This creates a challenge in the educational activities, especially at zoos, since it needs to be able to reach people practically from illiterate to post-graduated educational levels. Urban people generally have the opportunity to acquire information about the animals using more sources than rural people; books, museums, higher education schools, and TV documentaries are easily accessed by urban people. Parents, relatives, friends, and personal experiences are the main sources of information of rural people (traditional knowledge, Kemper *et al.* 2008). Both publics have some degree of knowledge, even though this knowledge can be far from scientific terms or not necessarily correct (Birney 1995).

People fight for what they care about, and what they care about is strongly linked to what they know (Brewer 2006). The affective domain seems to be crucial in the development of attitudes towards nature conservancy (Moyer 1975, Ruiz-Mallen and Barraza 2008). It is important to evaluate the feelings of rural and city people about Greater Rheas, and, based on the results of such an evaluation, create an environmental education program, especially for children. It is easier to implement environmental education programs for children to change habits and concepts about the role of humankind in the protection of the planet and its wildlife (Strong 1998). It has been shown that children have the power to change their parent's habits, increasing the net of nature's conservancy (Vaughan *et al.* 2003).

Environmental education activities should be implemented in both rural and urban areas. For rural communities, who have the chance to observe wild Greater Rheas, activities such as bird watching, habitat characterization by guided walking, school activities concerning the Greater Rhea biology (such as painting and writing contests) are plausible examples, especially for the children. Besides, a citizen-science strategy is strongly suggested for the case of the Greater Rheas in rural areas; it consists in connecting conservation biologists with members of the public, who will help with data collection and research. This would increase their knowledge

about nature and the role of humans in shaping the environment, demystifying and increasing appreciation of science (Brewer 2006).

For the urban communities, environmental activities such as interpretative trails, photo contests, exhibits on the species, and lectures about the importance of zoo activities for the conservation of Greater Rheas could be implemented.

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## APPENDIX 1

Questionnaire applied to the rural community of São José do Buriti, Minas Gerais State, southeastern Brazil, to determine their knowledge about the biology and conservation of the Greater Rhea (*Rhea americana*, Rheidae, Aves).

Date: \_\_\_\_\_ Local: \_\_\_\_\_ Gender: M ( ) F ( )  
Age: \_\_\_\_\_ Schooling: \_\_\_\_\_ Profession: \_\_\_\_\_

1 – Mark the Greater Rhea photograph.



( )



( )



( )

2 – Have you seen Greater Rheas in your region? ( ) Yes ( ) No

3 – If yes, in what habitat? ( ) Open (grasslands and *cerrados*) ( ) Forest ( ) *Eucaliptus* forest

4 – Do you think that the Greater Rheas' populations are declining in your region? ( ) Yes ( ) No

5 – If yes, what are the causes? ( ) Habitat loss ( ) Hunting ( ) Trafficking ( ) Poisoning ( ) Other

6 – Do you have the habit of eating Greater Rheas' eggs or hunting Greater Rheas for food? ( ) Yes ( ) No

7 – If yes, do you think that these activities could represent a risk for the Greater Rhea's population in the region?  
( ) Yes ( ) No

8 – Do you think that it is important to conserve Greater Rheas in the region? ( ) Yes ( ) No

9 – Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

10 – Would you like to participate in a conservation programme for the Greater Rheas in the region? ( ) Yes ( ) No

11 – Do you have dogs? ( ) Yes ( ) No

12 – Do you leave your dog to run free in natural areas? ( ) Yes ( ) No

13 – Do you think that allowing your dog to run freely through such area represents a risk to the Greater Rheas of the region? ( ) Yes ( ) No

14 – Why? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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**APPENDIX 2**


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Questionnaire applied to the urban community of Belo Horizonte, Minas Gerais State, southeastern Brazil, to determine their knowledge about the biology and conservation of the Greater Rhea (*Rhea americana*, Rheidae, Aves).

Date: \_\_\_\_\_ Local: \_\_\_\_\_ Gender: M ( ) F ( )  
 Age: \_\_\_\_\_ Schooling: \_\_\_\_\_ Profession: \_\_\_\_\_

1 – What is the bird you are looking at? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

2 – Have you seen this bird in your region? ( ) Yes ( ) No

3 – Do you think that this species is in risk of extinction? ( ) Yes ( ) No

4 – If yes, what are the causes? ( ) Habitat loss ( ) Hunting ( ) Trafficking ( ) Poisoning ( ) Other

5 – Do you think that it is important to conserve Greater Rheas in the region? ( ) Yes ( ) No

6 – Why? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

7 – Do you believe that is a good conservation measure to maintain Greater Rheas in captivity? ( ) Yes ( ) No

8 – Why? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_