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The welfare of an unwanted guest in an urban environment: the case of the white-eared opossum (Didelphis albiventris)

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Abstract

*One major problem facing wildlife is urbanisation, and the increasing contact between human city dwellers and animals. In this study, we investigated the problems of urban opossums (*Didelphis albiventris*), through the analysis involving responses to call-outs (n = 500) made by the environmental police of Belo Horizonte, Minas Gerais, Brazil (2002 to 2007). Our objective was to characterise the problems faced by opossums and use this information to suggest how their welfare and urban management could be improved. Two types of call-outs were made: (i) solicitation whereby a person called them to report a problem; and (ii) the report of an injured animal. On average, one call-out was made every four days. There were no 'time of year' effects in relation to call-outs, or any effect of gender or age of the person making the call-out. Furthermore, we found no environmental (eg percentage of 'green area') or socio-economic variables (eg salary levels) associated with call-out frequency. The majority of call-outs resulted in the attempt to capture opossums, and usually only one animal was captured. Many of these animals were released into city forest fragments at a mean (± SEM) distance of 8,285 (± 727) m; (n = 312) from their point of capture. Injured animals were sent to veterinary clinics or to the Government's wildlife processing centre. From these data we were able to make recommendations regarding the welfare and management of urban opossums.*

Keywords: *animal welfare, human-wildlife conflicts, marsupials, translocations, urban wildlife, white-eared opossums*

Introduction

The scale of the welfare problems of wildlife and, especially urban wildlife, can be enormous (eg Teixeira *et al* 2007; Wimberger & Downs 2010; Wimberger *et al* 2010). These problems often derive from human-animal conflict situations (eg accidents involving traffic; Goulart *et al* 2010). The solutions to such problems may be simple, but the causes of such problems need to be understood first. In many countries in the world, wildlife problems are dealt with by dedicated rescue centres (see Wimberger *et al* 2010), which may or may not be run by Government agencies. In Brazil, for example, urban wildlife problems are first dealt with by the environmental police (a division of the military police) who may, depending on the circumstances, pass on their cases (ie rescued animals) to Government rescue centres, which may in turn pass animals on to Non-Governmental Organisation (NGO) run rescue centres (Goulart *et al* 2010). We estimate that annually in Brazil hundreds of thousands of urban animals are rescued by the environmental police.

Urban wildlife may be classified as: urban avoiders (species which live at lower than wild-conspecific densities); urban adapters (species which live at the same density as wild-conspecifics); and urban exploiters (species which live at higher densities than wild-conspecifics) (McKinney 2006). The occupation of cities by urban wildlife may be seen by human dwellers as positive, neutral or negative (Leite *et al* 2011). In many European cities, the presence of birds, and even meso-predators such as red foxes (*Vulpes vulpes*), are viewed positively; whereas, in the same cities the presence of urban exploiters such as pigeons (*Columba livia domestica*) are viewed negatively (Keeling & Gilligan 2000; Piasecki 2006; Shartz *et al* 2008). It is often with some justification that certain species are seen as unwelcome guests in cities, for example, raccoons (*Procyon lotor*) in the USA are associated with the creation of mess through their behaviour of searching through human rubbish for food (Rosatte & MacInnes 1989), and rats (*Rattus* spp) and pigeons are, for example, associated with the spreading of diseases (Keeling & Gilligan 2000; Piasecki 2006).

Due to the increasing urbanisation, contact between wildlife and city dwellers is increasing: this reflects both the fact that cities swallow-up green areas creating 'green islands' where species become stranded and certain species learn to adapt to the urban environment. A number of research projects have shown that this contact can be beneficial to both the psychological and physical well-being of city dwellers (Maller *et al* 2005; Fuller *et al* 2007). It is not clear if these benefits would be affected adversely by the presence of 'pest' species or

species that are viewed negatively by the public, such as bats. A number of species, due to their physical appearance, may be sources of distress to humans without necessarily causing any real problem; such fear can be reduced by environmental education (Prokop *et al* 2009).

A number of environmental and socio-economical factors are known to affect how urban dwellers interact with urban wildlife. Housing density has been shown to be a principal factor affecting the rate at which people and urban wildlife interact: interactions increasing as housing density decreases (ie, more green space [natural habitat or human-cultivated vegetation]; Krester *et al* 2008). Human tolerance of these interactions depends on factors beyond how 'cute' or 'endangered' a species is (Gunnthorsdottir 2001; Maresova & Frynta 2008). Studies have consistently shown that more affluent people tend to complain more about annoyances or irregular situations, as do people with higher levels of education (Kolodinsky & Aleong 1990). Finally, studies have shown that, in general, women are more tolerant than men in questions relating to animals and the problems they cause (Herzog 2007; Ogra & Ruchi- Badola 2008).

In this study, our principal objective was to characterise the welfare situation of the opossum (*Didelphis albiventris*) in a large Latin American city through analysis of call-outs made to the environmental police. The opossum was chosen as it is a frequent subject of call-outs and it is generally not considered to be a cute species by humans. Furthermore, we were interested in how factors such as the profile of the caller (eg age and gender) and profile of the city's administrative regions (environmental and socio-economic) affected call-outs. Our final objective was to use this information to make recommendations about the welfare and management of urban opossums.

Materials and methods

Study area

Belo Horizonte city has a population of 2.238 million inhabitants in an area of 330.9 km^2. The city is located in the state of Minas Gerais, Brazil delineated by the latitudes 19º46´35´´ and 20º03´34´´ south and by longitudes 43º51`27´´ and 44º03´47´´ west of Greenwich (PMBH 2003). It is divided into nine administrative regions, each one of which has unique socio-economic (eg salary levels) and environmental characteristics (eg percentage of 'green area') (Goulart *et al* 2010).

Belo Horizonte has many small 'green areas' (ie natural habitat or human-cultivated vegetation) distributed throughout the city (150 of these areas being greater than two hectares in size; Goulart *et al* 2010) and many tree-lined avenues. It is in these areas where our study species *D. albiventris* may occur.

The Brazilian Institute of Environment and Renewable Natural Resources (in Portuguese, 'IBAMA') is the executive organ of the Federal Government responsible for the management of Brazilian wildlife. The environmental police, which is a division of the military police, is responsible for the apprehension of illegal trafficking of wild animals, data concerning the capture of animals that are in conflict with the human population and aiding injured or sick animals. Since most of the attention in Brazil has focused on the illegal trafficking of wild animals, data concerning animals collected by the environmental police have not been analysed; despite, the fact that these data, when analysed, could form the basis of an urban management plan for opossums.

Study species

The white-eared opossum is a medium-sized marsupial species, which can be easily identified by its white ears, black body, long tapering nose and naked tail (Emmons & Feer 1997). It is one of the most common and widespread marsupial species of Latin America (Cerqueira 1985); it is also ecologically one of the most successful species due to its ability to survive in many habitat types including impacted environments such as urban ones (Fonseca *et al* 1982; Cáceres 2000; Teixeira *et al* 2006). In general, males are heavier than females and weigh around 800 g. Their ecological success is due in part to their varied diet and high reproductive rate (a female may have 6 to 7 pups per litter (Talamoni & Dias 1999). In terms of the behaviour, the species is thought to be solitary and largely nocturnal with the breeding season in south-central Brazil being from October to March, which coincides with the wet season (Talamoni & Dias 1999). Studies have shown that adults of this species in urban forests have home-range sizes of 600 to 1,600 m^2 and daily ranges of 115 to 125 m^2 (Almeida *et al* 2008); the limited data available from natural environments indicate a home-range size of approximately 4,000 m^2 (Teixeira *et al* 2006).

As a species, it tends not to be popular with humans due to its reputation for having a strong pungent smell, and although it is a potential reservoir of infectious diseases (eg Ramirez *et al* 2002), this fact is not widely known by the general public. Furthermore, its physical characteristics do not make it a 'cute' or 'important' animal in the eyes of the public, as it is neither human-like or an endangered species (Tisdell *et al* 2007). Therefore, it is an animal widely regarded as unwelcome by city dwellers; although it is eaten in some areas (C Teixeira, personal observation 2011).

Environmental police reports

In Belo Horizonte, the public may call out the environmental police to deal with any concern or problem that they have regarding urban wildlife. In response to such call-outs, the environmental police send out officers to evaluate and resolve any situation encountered. At the end of a call-out, details are typed onto a standardised report form.

Five hundred environmental police reports, from 2002 to 2007, relating to call-outs to deal with *D. Albiventris* were available for analysis. These reports contained the following information: date; gender and age of the person who made the call-out (age was divided into four categories for analyses: ≤ 20, 21–40, 41–60 and > 60 years old); why the call-out was made (eg conflict or to deal with an injured animal); location (with geographic co-ordinates marked by a GPS device); the action undertaken by the environment police (eg capture of the animals); number, age and sex of animals (eg adult, juvenile, infant, male or female); the physical condition of the animals as assessed by the police officer; and, if appropriate, where the animals were released (ie translocation of the animals; the co-ordinates being noted).

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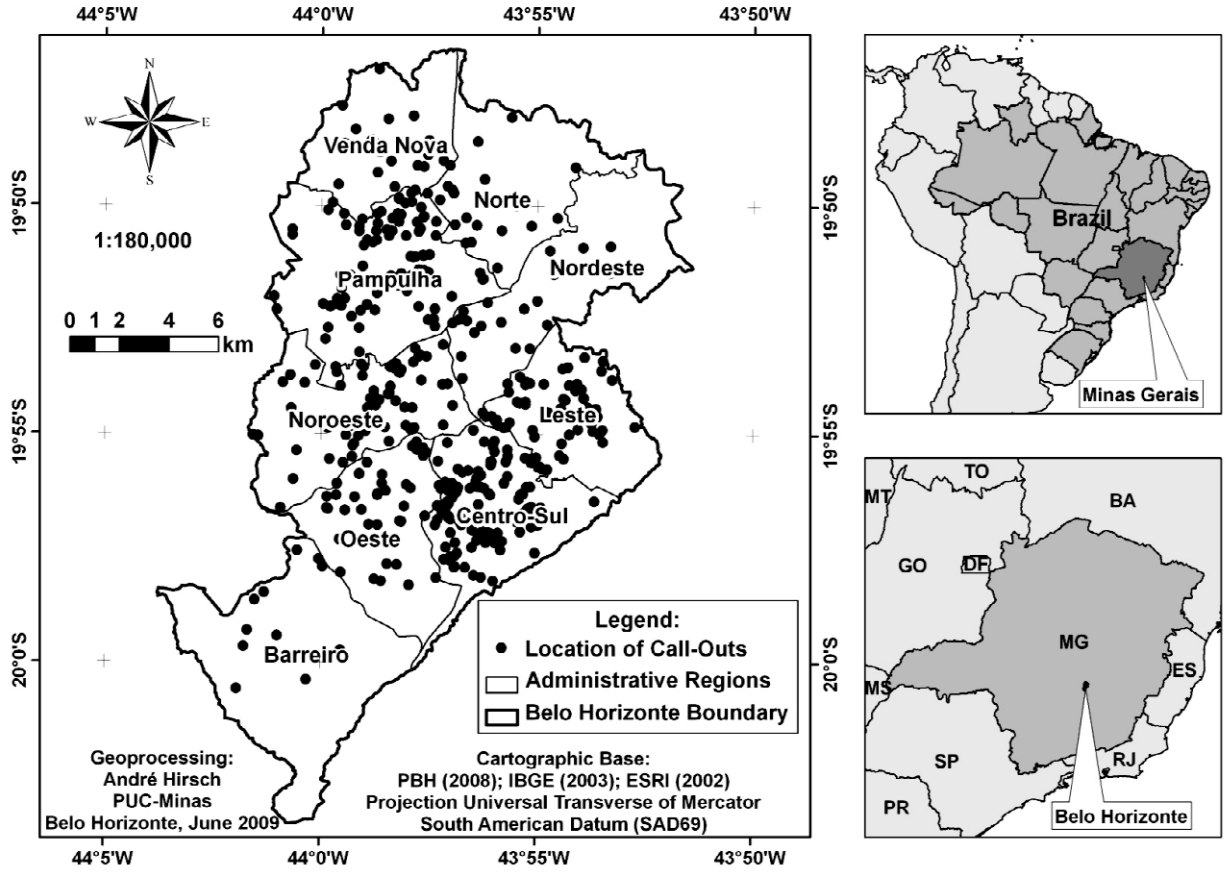
Figure 1



The geographic distribution of call-outs (n = 500) for the white-eared opossum (*Didelphis albiventris*) in relation to the nine administrative regions of Belo Horizonte, Minas Gerais, Brazil (2002 to 2007).

The environmental police responded to two types of call-outs: (i) solicitation when the person asked the environmental police to capture opossums that appeared close to a residence; or (ii) injured animal when the opossum was visually suffering from a problem (eg attacked by an animal). The action undertaken by the environmental police was characterised as: (i) release, when the opossums were released (ie translocated) by the environmental police; (ii) sent to the wildlife processing centre (CETAS, IBAMA); (iii) escape, when at the time of the operation the opossum escaped capture; and (iv) veterinary care, when the opossums were sent to a veterinary clinic by the environmental police. To clarify a number of points regarding the actions of the environmental police and their reports, we interviewed a number of officers.

Statistical analysis

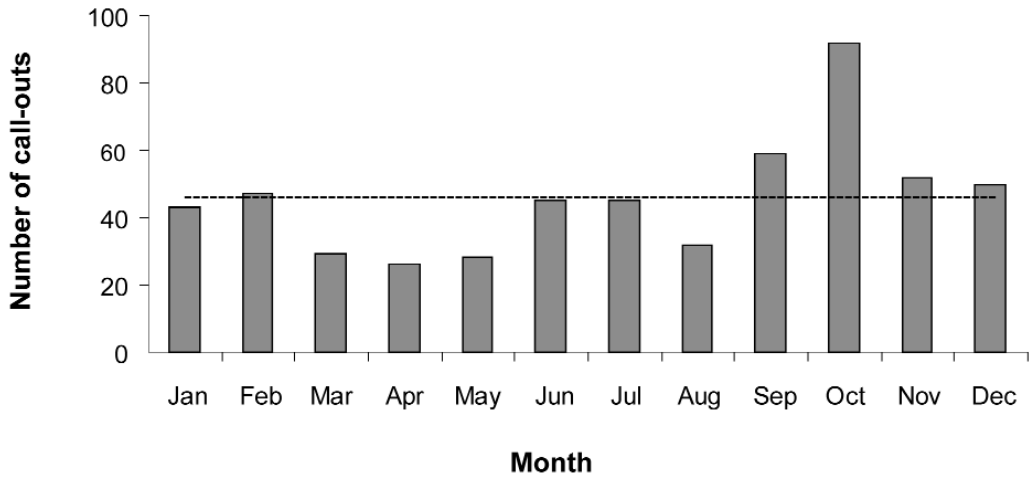
Data were tested to see whether they met the requirements for parametric statistics, using the Anderson-Darling test, which they did not; therefore, non-parametric statistical tests were used throughout. The nine administrative regions of Belo Horizonte were treated as separate sample points in analyses since each has unique socio-economic and environmental characteristics (PMBH 2003; Goulart *et al* 2010). Spearman rank correlation tests were used to verify the relationships between: the size of the green area in a city region and the number of call-outs; the human population density in a city region and the number of call-outs; and salary level by city region and the number of call-outs. The data relating to the size of the green area in the region, human population density, and salary levels were obtained from IBGE (Brazilian Institute of Geography and Statistics: http://www.ibge.gov.br/home/).

We used Chi-squared or Fisher's exact tests to analyse the nature of call-outs and the gender or age of the caller. The Mann-Whitney *U* test was used to evaluate the difference between the number of call-outs in the wet and dry seasons. All tests were performed using the statistical software MINITAB 15 (State College, PA, USA).

Results

In total, 500 call-outs were made in relation to opossums in Belo Horizonte, involving a total of 774 animals or a mean (± SEM) of 1.56 (± 0.073) animals per call-out. The mean monthly call-out rate was 6.94 (± 0.537). The distribution of call-outs in the nine administrative regions of Belo Horizonte is shown in Figure 1.

Figure 2



The monthly frequency of call-outs regarding the white-eared opossum (*Didelphis albiventris*) in Belo Horizonte, Minas Gerais, Brazil (2002 to 2007) (the dashed line shows overall mean monthly value).

The majority of call-outs were solicitations by the public to remove opossums (93.2%; n = 466), with only 32 (6.4%) of call-outs concerning injured animals, one animal was collected during a patrol and in one report the reason why the animal was captured was not stated. In 81.6% (n = 408) of call-outs the animals were translocated and released into another green area. Of the remaining animals: 10.8% (n = 54) were sent to wildlife processing centres (CETAS, IBAMA); 6.2% (n = 31) escaped capture; 1.2% (n = 6) were sent to veterinary clinics for treatment; and one case was not registered. For 14 of the injured animals the cause of their injury was unknown, a further ten were encountered dead (again cause of death unknown), seven had been run-over by vehicles, four had been attacked by dogs, one had been attacked by a person, one had been electrocuted and one had suffered a physical trauma of unknown origin.

The correlation between the size of the green area in administrative regions and the number of call-outs was not significant (r_S = –0.550, n = 9; P = 0.125). The comparison between the number of call-outs in the wet (October to March) and dry seasons (April to September) was not significant (W = 46.5, $n_1 = n_2 = 6$, P = 0.2607) (Figure 2). The 99.9% confidence interval for monthly totals of call-outs was from 21.74 to 61.59, which meant that only the value (80) for the month of October was outside the confidence interval range (Figure 2).

Both genders were equally as likely to make a call-out with 52.53 and 47.47% for men and women, respectively. The mean (± SEM) age of a person making a call-out was 41.44 (± 0.647) years of age. There was no interaction between the variables age category and gender of the person making the call-out (χ^2 = 4.255, df = 3; P = 0.235). We found no effect of age (χ^2 = 2.203, df = 3; P = 0.531) or gender on the reason why people made call-outs (eg nuisance animal or injured animal) (χ^2 = 2.366, df = 1; P = 0.267).

Similarly, the association between human population density in administrative regions of Belo Horizonte and the number of call-outs was not significant (r_S = –0.117, n = 9; P = 0.765). The association between mean salary level per administrative region of Belo Horizonte and the number of call-outs was not significant (r_S = –0.367, n = 9; P = 0.322).

In the majority of call-outs (85.51%; n = 425) only one individual was captured. From all the call-out reports, only 15.8% (n = 79) described the age or sex of the captured animal of which: 7.2% (n = 36) were infants; 6.4% (n = 32) were females with infants; four were juveniles; three were adults, three were adults with infants; and one was a pregnant female. Of the call-outs that resulted in animals being translocated (n = 408), animals were released into 69 different green areas with a further 44 places not identified in reports. However, the number of translocations in a specific area during our six-year study period varied from 1 to 85 (this location involved 138 animals) with a mean (± SEM) of 6.61 (± 1.85). Opossums were translocated a mean distance of 8,285 (± 727) m (n = 312) from their point of capture, and there was no evidence of animals returning to their point of capture.

Discussion

Once every four days, on average, the environmental police were called out to deal with a situation involving *D. albiventris*, and in most cases these call-outs were to solve a perceived conflict. This being that an animal was seen close to a human residence. This high frequency of call-outs shows that this species can be considered problematic by the human inhabitants of Belo Horizonte.

The majority of call-outs regarding *D. albiventris* were to request its removal, when it was observed close to a human habitation. This no doubt reflects the poor reputation that the

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species has in the eyes of city dwellers. Unlike urban marmosets (*Callithrix penicillata*), problems with opossums were not caused by deliberate public feeding (see Goulart *et al* 2010). Furthermore, we observed that few call-outs were made in relation to injuries, which may reflect the reality of the situation that few animals of this species were injured or that people were less inclined to call out the environmental police to help this species. Unfortunately, we have no way, at present, of distinguishing between these two hypotheses. The only data we have, which can elucidate the situation, is that the percentage of call-outs concerning injured urban marmosets in the same city was much higher (36.49% of call-outs; Goulart *et al* 2010), but, obviously behavioural differences between the species may explain this difference. Interestingly, our interviews with the environmental police officers suggested that people complained about the presence of opossums, but rarely had a 'real' problem. In the majority of cases people said they were 'scared' of the animal, but this was not based on any specific event. For example, complaints about urban marmosets were related normally to aggressive behaviour or the invasion of houses to look for food (Goulart *et al* 2010).

The principal environmental factor that affected the number of call-outs related to opossums was time of year, and more specifically the month of October. It is at this time of year that *D. albiventris* starts its reproductive activity (Talamoni & Dias 1999), and it would seem that these two events are linked. Most probably through changes in behaviour, either the production of pungent scents to attract mates or increase in movements to search for mates. This question deserves further investigation as it could suggest a strategy to deal with this peak in call-outs.

The percentage of green area within a city region did not have an impact on the number of call-outs. However, it may be that we need to analyse data on a smaller/finer scale, such as that of neighbourhoods, which are only one factor larger than the home-range sizes of opossums (Almeida *et al* 2008) rather than administrative regions which are two to three factors larger than home-range sizes. It should also be noted that administrative regions are made up of many neighbourhoods, which can vary greatly in their socio-economic and environmental characteristics (Goulart *et al* 2010).

We found that neither age nor gender affected whether a person would make a call-out about opossums; this is not surprising given that *D. albiventris* are, probably, universally disliked by urban dwellers. It is perhaps surprising that people actually make any call-outs about injured animals. Despite this situation, we only found one record of an animal that had been attacked by a human, perhaps suggesting that urban dwellers were quick to call the environmental police rather than take matters into their own hands. This may be related to the fact that many people in Brazil, wrongly, believe that opossums have the same ability as skunks (family Mephitidae) to spray their pungent smell on a person when attacked or disturbed. The origin of this misconception is that in Portuguese the generic name for skunks and opossums is the same — *gambá* — and this story of spraying a foul smell has been reinforced in Brazil by the cartoon character *Pepé Le Pew* (Warner Bros©). Obviously, an environmental education programme could be used to reduce or eliminate this misconception about opossums, although it could be argued that this misconception provides opossums with a certain degree of protection.

We found no impact of socio-economic factors on call-outs, we had expected more call-outs in wealthier regions of the city or in regions with greater percentages of 'green areas', but we did not find this to be the case. Again, we suspect that as soon as an opossum was observed by a human it was reported to the environmental police as a problem, and duly removed (translocated). As previously discussed, this may also be related to the scale of analysis (administrative region rather than neighbourhood): an administrative region could have a few rich and many poor neighbourhoods (Goulart *et al* 2010). The behaviour of people in the rich neighbourhoods, in this case, was perhaps being masked by that of people in the poorer neighbourhoods.

One worrying aspect of the data analysed was the number of translocations made to a specific location; for example, one location received more than one translocated animal per month, however, in this case the receiving site was large (> 2,000 hectares). Some relatively small sites also received high numbers of translocated animals. Data suggest that opossum males are territorial (Talamoni & Dias 1999) and therefore, indiscriminate translocation is unlikely to be in this species' best interest as, frequently, animals would have been released into the territories of resident males. Unfortunately, we do not have data concerning the carrying capacity of urban environments for our study species nor whether places used for translocations were likely to be at carrying capacity. The assumption that translocating problem individuals was in their best welfare interest can also be questioned as many studies have found high mortality rates in such animals (Teixeira *et al* 2007).

On average, opossums were translocated a distance of 8 km, despite the recommendation of IBAMA to release individuals in the nearest green area to the point of capture (Daniel Vilela, IBAMA, personal communication 2011). In the wild, opossums of this bodyweight have home-ranges of 4,000 m^2 (Teixeira *et al* 2006), and in urban forest fragments have daily ranges of less than 150 m^2 (Almeida *et al* 2008). Therefore, it is highly unlikely that translocated individuals returned to their point of capture, especially when to do so would mean navigating through highways of a highly urbanised area. An observation further supported by the fact that only seven individuals were reported to have had collisions with vehicles. Our study has shown that our study species is common in the city of Belo Horizonte and it has a high reproductive rate: both of these facts suggest that a systematic plan for the translocation of individuals needs to be developed based on the species biology, giving due consideration to animal welfare. These recommendations are important, because improved management and welfare of urban animals should decrease problems caused by these animals in the city. The main point of this study is try create a public policy to determine what kind of management is appropriate for each species (eg if we translocate marmosets

there is a high risk that they would be separated from their social group, implying a need to know about species' biology; Goulart *et al* 2010).

Animal welfare implications

Here, we can make a series of recommendations about the welfare and management of urban white-eared opossums, (we believe that some recommendations could apply to other unwanted urban wildlife): (i) given that opossums were not causing any 'real' problems to the public an environmental education programme could help in reducing human-animal conflicts about this species (ie often needless capture and translocation); (ii) areas where opossums can be translocated to without causing conflict with resident individuals need to be identified, especially in the case of males; (iii) translocated opossums should be marked and ideally their survival rate monitored; (iv) the health status of opossums should be evaluated before translocation; (v) the environmental police need to receive training courses about the biology of the species that they commonly deal with (eg how to sex animals and identify age-categories); and (vi) better data collection is needed by the environmental police.

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