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Annual intake trends of a large urban animal rehabilitation centre in South Africa: a case study

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Abstract

Each year, worldwide, large numbers of wild animals are taken to rehabilitation centres for treatment, care and release. Although analysis of intake records may provide valuable insight into the threats and impacts to wildlife, there are few such published reports. Four years of intake records from a large urban rehabilitation centre in South Africa were examined for trends. Animal intake rate was high (2,701 [± 94] per annum). Most of the intake (90%) was birds, with few mammals (8%) and reptiles (2%), and most of these were of locally common species (eg doves, pigeons). This reflects the findings of other studies, namely that species living in close association with humans are the most frequently admitted to rehabilitation centres. In total, most of the animals admitted (43%) were juveniles, which were assumed to be abandoned or orphaned. The implications of then rehabilitating these juveniles, which were largely uninjured, are three-fold: should humans be interfering with nature if the cause was not human-related, can each juvenile (especially in these large numbers) be adequately prepared to survive and thrive when released into the wild, and is there space in the environment for them, without causing harm to others already in the environment. This study suggests that the large numbers of animals currently being admitted to the centre may be reduced, possibly through increased public education; in particular to leave uninjured juveniles in the wild. Furthermore, improvements in the centre's recording system may allow for use in funding requests and various research opportunities.

Keywords: *animal welfare, intake records, rehabilitation, South Africa, trends, urban*

Introduction

Worldwide, there are thousands of wild animal rehabilitation centres; for instance, there are 5,000 registered rehabilitators in the USA (Jacobs 1998), 650–800 in the UK (Kelly & Bland 2006; Leighton *et al* 2008), and 63 in South Africa (SA) (Wimberger 2009). Some are specialised, such as the 65 bird of prey centres in Spain (Fajardo *et al* 2000), and approximately 100 centres in 16 countries dealing only with marine mammals (Measures 2004). Rehabilitation centres provide treatment to injured, ill and orphaned wild animals, under temporary care, with the goal of releasing them back into their natural habitat once recovered or treated (Anon 2008).

Analyses of the intake records at these rehabilitation centres may provide a valuable insight into the threats to wildlife (Fix & Barrows 1990; Hartup 1996; Aitken 2004). For instance, birds and mammals appear to be more vulnerable as juveniles, being orphaned or abandoned (Dubois 2003), while reptiles and amphibians are mainly brought in because of vehicle collisions (Hartup 1996). Furthermore, intake records provide an insight into the variety of species and the number of individuals that are vulnerable in the local area or region (Harden *et al* 2006), and whether this trend has a seasonal component (Hartup 1996; Kelly & Bland 2006) or is occurring as a result of other factors, such as human population growth (Neese *et al* 2008). Knowledge about such factors affecting wildlife would allow for preventative measures to be implemented (Harden *et al* 2006; Drake & Fraser 2008). Rehabilitation centres could benefit from analysing their own records; by determining whether changes made to their rehabilitation methods had an improvement on decreased intake (Hartup 1996) and increased release rates (Parsons & Underhill 2005; Kelly *et al* 2008).

The few published inventories of intake trends, across species and time, have been for rehabilitation centres in developed countries of temperate zones (UK: Molony *et al* 2007; USA: Hartup 1996; Harden *et al* 2006; Neese *et al* 2008; Canada: Dubois 2003), while studies in Africa have been carried out in Uganda (Kampala: Azikuru & Angubo 2007), and in South Africa (Nama Karoo: Visagie 2008; Cape Town: Parsons & Underhill 2005). Kampala and Nama Karoo are both rural areas, and the rehabilitation centres admit only birds (Azikuru & Angubo 2007) and raptors (Visagie 2008), respectively. The rehabilitation centre in Cape Town is in an urban context, but only admits marine birds (Parsons & Underhill 2005). No comprehensive studies have been conducted in the developed African urban context. We, therefore, investigated animal intake trends over four years at one of the largest urban wildlife rehabilitation centres in South Africa. This centre has been in existence for at least 25 years, and is situated in a suburb of Durban in the KwaZulu-Natal Province, near urban parks, industrial areas and the sea. It predominantly receives animals from the Durban metropolis, but occasionally from further afield in South Africa. The only animals not rehabilitated are large ones (eg rhinoceros, elephants), or those in need of specialised care (eg seals, penguins, bats). We expected there to be no difference in the general trends of intake rates, and causes for intake, observed here, to those published elsewhere for centres within suburban and urban environments. We predicted greater species diversity here, than those reported internationally, as a result of being in a different biogeographical realm, with relatively high biodiversity.

Materials and methods

Wild animal intake records at the rehabilitation centre were collated for four years (January 2004–December 2007). All the data from records were analysed, as all the information recorded by the staff at the rehabilitation centre was seen to be potentially useful. For ease of analysis and interpretation, data were categorised into three sections, namely: identification of the animal and information about the rescuer; causes for the intake; and condition and immediate fate (eg at clinic, euthanased) of the animal.

The first section included the following information: date; species; number of individuals; their age and sex; information on the person or organisation uplifting the animal (the 'rescuer'); and the type (eg given food, drink) and duration of initial treatment administered prior to release to the rehabilitation centre (ie < 1 day, < week, < 1 month, > 1 month). Species data were further classified. Each animal was placed into an animal class (ie bird, mammal, reptile). For each class, animals were placed into a category. Categories for mammals (Appendix 2) and reptiles (Appendix 3) were derived from orders or sub-orders, whereas bird categories (Appendix 1) were derived subjectively either from their regional habitat (eg water habitat) (Hockey *et al* 2005), or if a habitat generalist, were grouped according to their niche, namely feeding (eg aerial insectivore, raptor), and activity patterns (eg diurnal/nocturnal). This categorical difference was due to the higher number of bird orders and sub-orders compared with those of mammals and reptiles. A context-driven category would therefore result in smaller groupings, as well as provide insight into the habitat where birds were most vulnerable. For each category, depending on the number of individuals, animals were referred to by their species name (eg hadeda ibis [*Bostrychia hagedash*]) or were placed into their common name grouping (eg laughing dove [*Streptopelia senegalensis*] is placed into 'dove') (Appendix 1). Often, the admittance staff at the centre would only record common names. Those common name groupings with few individuals were placed within a larger group (eg 'Marine group'). Several sources were used to identify order, family, and species names for birds (Newman 2002; Hockey *et al* 2005), mammals (Skinner & Chimimba 2005), reptiles (Alexander & Marais 2007) and non-indigenous fauna (best available source for particular taxon).

The second section dealt with information relating to the reason(s) for the animal being brought to the rehabilitation centre (Table 1). When no cause was given by the rescuer, probable causes were inferred by examining the records that gave the condition of the individual as well as other notes (eg an identification ring on a bird that might indicate a 'probable pet' [Table 1]).

The third section described the condition of the animal as determined by a brief examination undertaken by the admittance staff soon after arrival. Conditions were grouped into six categories (Table 1) to enable meaningful comparisons. Since it was only the immediate fate of the individual (eg dead on arrival, placed in clinic) recorded by the staff at the centre, the data shown in this category do not show the actual numbers of animals that died, were released or euthanased each month or year at the centre.

For each section, there was a category for when no information was provided. Terms used to define the causes and conditions were taken largely from the inventory described by Dubois (2003).

Data analysis

Since most individuals were brought in singly (91%), in all subsequent analyses the number of cases and not the actual number of individuals was used. Proportions were used to compare the relative contributions made by each group in a category (eg proportion of juveniles contributing to an overall age class). However, where appropriate and depending on normality, significant difference was determined using an unpaired Students' *t*-test, analysis of variance (ANOVA) or Kruskal-Wallis ANOVA, and a Scheffé *post hoc* test when significant. All statistical analyses were performed using Statistica 7 (StatSoft Inc, Tulsa, OK, USA).

Results

Trends in numbers of individuals and age groups admitted

Over four years, a minimum of 10,802 intake cases representing 12,948 individuals were admitted to the Durban rehabilitation centre. The average number of individuals admitted each year was 2,701 (± 94) and this did not differ significantly between years (ANOVA: $F_{3,44} = 0.28$; $P = 0.838$). Monthly average intake was 255 (± 14), with a significant difference between months (ANOVA: $F_{11,36} = 15.33$; $P < 0.001$) (Figure 1). Over the four years, the highest monthly intake was consistently seen in November. Grouping the months into seasons showed a significant seasonal trend in intake rates (ANOVA: $F_{3,44} = 25.26$; $P < 0.001$). Intake of individuals was generally higher in both summer (December–February: 322 [± 19]) and spring (September–November: 280 [± 24]) compared with both autumn (March–May: 167 [± 18]), and winter (June–August: 131 [± 8]) (Scheffé *post hoc*: $P < 0.001$). No difference in intake rate between spring and summer (Scheffé *post hoc*: $P = 0.441$), or winter and autumn (Scheffé *post hoc*: $P = 0.572$), were observed.

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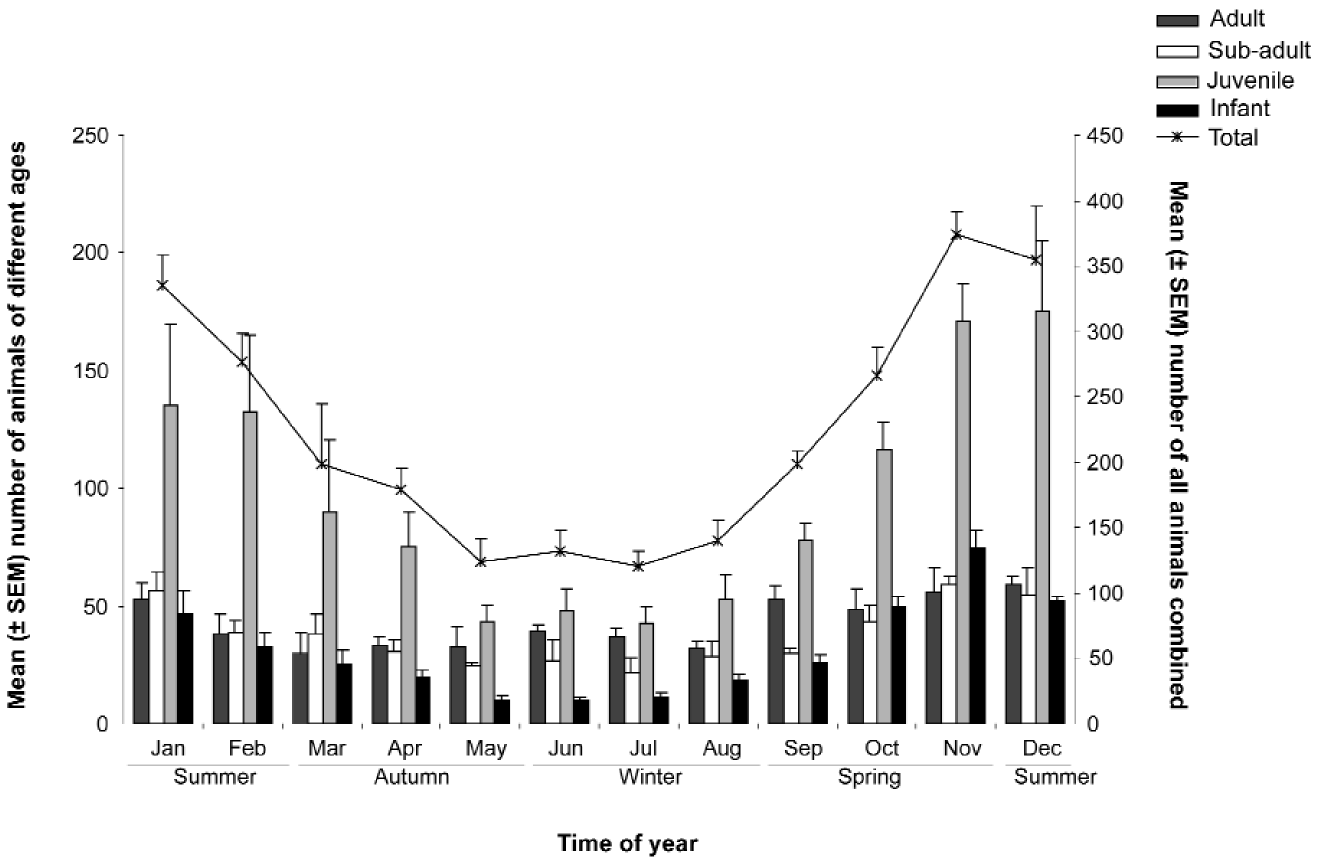
Table 1 List and descriptions of causes and conditions affecting animals admitted to the rehabilitation centre. Note that 'probable' indicates these causes were inferred.

Factors	Description
Cause	
Unknown	Nothing was written in the records
Young	Orphaned, abandoned, fell from nest, fledgling
Probable young	Infant or juvenile with no visible injuries (NVI), excluding reptiles
Hand-raised	Hand-raised animal > 1 week but < 1 month
Ex-pet	Pet handed in by owners
Probable ex-pet	Pet not handed in by owners (ie was released/escaped), eg exotic tortoise, bird has identification ring
Removed animal	Included if the animal was found tied up, being sold; confiscated by nature conservation
Dog/cat attack	Attack by dog or cat
Other animal attack	Includes attack by non-domestic animal, eg vervet monkey
Human attack	Includes intentional (eg hit with sticks/bricks, shot, beaten, poisoned, in snare) and accidental (eg driven over by lawn mower)
Vehicle impact	Hit or driven over by car, tractor, plane, train
Probable vehicle impact	Found in road and injured and/or concussed (excluding infant/juvenile birds)
Other impact	Flew into window, wall or door
Probable other impact	If concussed (excluding infant/juvenile birds), or if bird was released immediately after admission
Adhesive	Covered in adhesive, including glue, tar, oil
Entangled	Entangled in string, plastic, hair, barbed wire, fishing line
Wrong place: water bodies	Found in the pool, dam, other water bodies
Wrong place: other	Found in car, building, garden, roof; stuck in hedge; nest intentionally removed
Wrong place: road	Found in the road, parking lot, railway line
Probable wrong place (water bodies, other, road)	Animals with NVI or if released immediately: includes reptiles, adult/sub-adult mammals, groups of adult/sub-adult with juveniles/infant birds)
Other	If electrocuted, burnt in fire
Condition	
Unknown	No condition recorded
No visible injuries (NVI)	No visible injuries, includes if weak, dehydrated, exhausted, lethargic and in poor condition
Possibly diseased/injured	Includes if the animal is thin, full of fly eggs, has fever, diarrhoea, vomiting, and if not standing/walking/flying properly (but NVI)
Diseased	Includes avian pox, trichomoniasis, salmonellosis, chlamydiosis, rabies, distemper, mange, tetanus (even if also injured/concussed)
Injured	Injuries include wounds, broken bones, paralysed, blind and concussed (includes if disorientated, neurological symptoms)
Dying/DOA	Individuals dying and dead on arrival

Seasonal changes in numbers of individuals were also observed within each age group (Figure 1), namely adults (ANOVA: $F_{3,12} = 5.67$; $P = 0.012$), sub-adults (ANOVA: $F_{3,12} = 6.92$; $P = 0.006$), juveniles (ANOVA: $F_{3,12} = 15.50$; $P < 0.001$) and infants (ANOVA: $F_{3,12} = 20.45$; $P < 0.001$). Note that the groups with unknown ages or with multiple ages were excluded from this analysis. Adult numbers were significantly higher in spring compared with autumn (Scheffé *post hoc*: $P = 0.038$); while sub-adult numbers were significantly higher in summer compared with winter (Scheffé *post hoc*: $P = 0.014$). Both juveniles and infants showed a more pronounced seasonal difference in numbers. Juvenile numbers were significantly larger in summer compared with both autumn (Scheffé *post hoc*: $P = 0.004$) and winter (Scheffé *post hoc*: $P < 0.001$), as well as being significantly greater in spring compared with winter (Scheffé *post hoc*: $P = 0.007$); while infant numbers were also significantly larger in summer compared with both autumn (Scheffé *post hoc*: $P = 0.007$) and winter (Scheffé *post hoc*: $P = 0.002$), and significantly larger in spring compared with both autumn (Scheffé *post hoc*: $P = 0.001$) and winter (Scheffé *post hoc*: $P < 0.001$). In total, over four

Figure 1



Mean (± SEM) number of individuals of different age classes admitted each month (bars) to an urban SA rehabilitation centre and monthly mean for all ages combined over four years (2004–2007). Note that the monthly mean ('total') follows the second y-axis.

years, juveniles contributed the most to all animal intake to the centre (46%, n = 4,640 in total; 1,160 [± 105] per annum), followed by adults (20%, n = 2,048 in total; 512 [± 38] per annum), sub-adults (18%, n = 1,817 in total; 454 [± 29] per annum) and infants (15%, n = 1,506 in total; 377 [± 43] per annum). This trend was similar in each animal class, with juveniles contributing 48% (n = 4,338), 30% (n = 229) and 36% (n = 64) of four years of bird, mammal and reptile intakes, respectively.

Trends in animal class and species

Most of the intake at the rehabilitation centre were birds (90%, n = 9,700 in total; 2,425 [± 72] per annum), followed by mammals (8%, n = 823; 206 [± 23]) and reptiles (2%, n = 228; 57 [± 9]). A total of 51 (13 [± 5]) intake records did not state the type of animal. In total, there were 208 species, including 151 bird species from 20 orders and 69 families (Appendix 1); 41 mammal species from 11 orders and 23 families (Appendix 2); and 16 reptile species from 3 orders and 9 families (Appendix 3).

The most common bird category were those that occurred commensally with humans in urban or suburban areas, hereafter referred to as 'urban habitat' (82%, n = 7,915 in total, 1,979 [± 53] per annum), while the other categories contributed less than 5% each (Figure 2), including an 'other' category, with two chickens (order Galliformes, *Gallus gallus*) and one cockatiel (order Psittaciformes, *Nymphicus hollandicus*) (refer to Appendix 1 for the species listed in each category). The most common bird species were those that occurred in the urban habitat, especially doves (order Columbiformes, 27%, n = 2,653 in total), hadeda ibis (order Ciconiiformes, *Bostrychia hagedash*, 10%, n = 967 in total), and pigeons (order Columbiformes, 9%, n = 861 in total) (Figure 2).

Those mammals belonging to the order Primates were the most prevalent of mammalian categories (47%, n = 384 in total, 96 [± 17] per annum). This was followed by order Carnivora (14%, n = 117, 29 [± 3]), and order Ruminantia (16%, n = 133, 33 [± 4]), while the other categories contributed less than 5% each (Figure 3). The two most common mammalian species were vervet monkeys (order Primates, *Cercopithecus/Chlorocebus aethiops*, 44%, n = 365 in total) and blue duiker (order Ruminantia, *Philantomba monticola*, 10%, n = 84 in total) (Figure 3).

The most common reptile category was order Chelonia (80%, n = 182 in total, 46 [± 7] per annum), followed by order Squamata, sub-order Sauria (12%, n = 28; 7 [± 2]),

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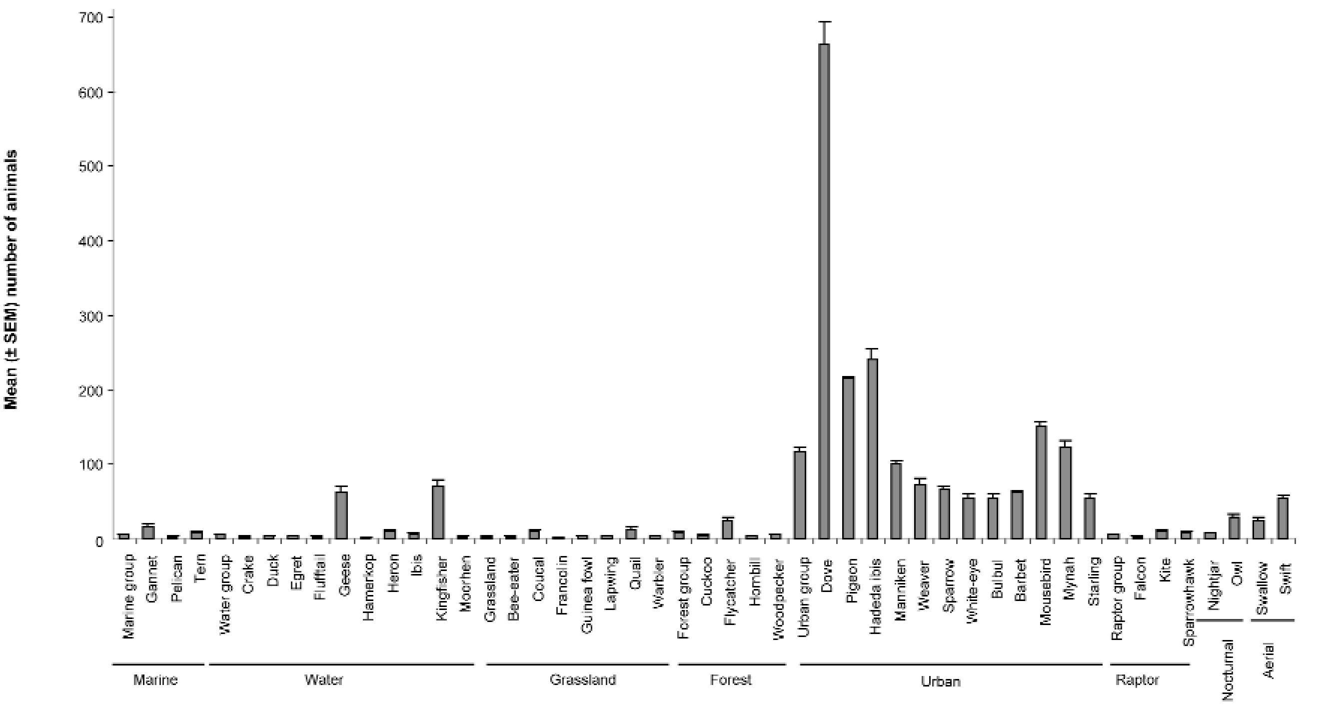
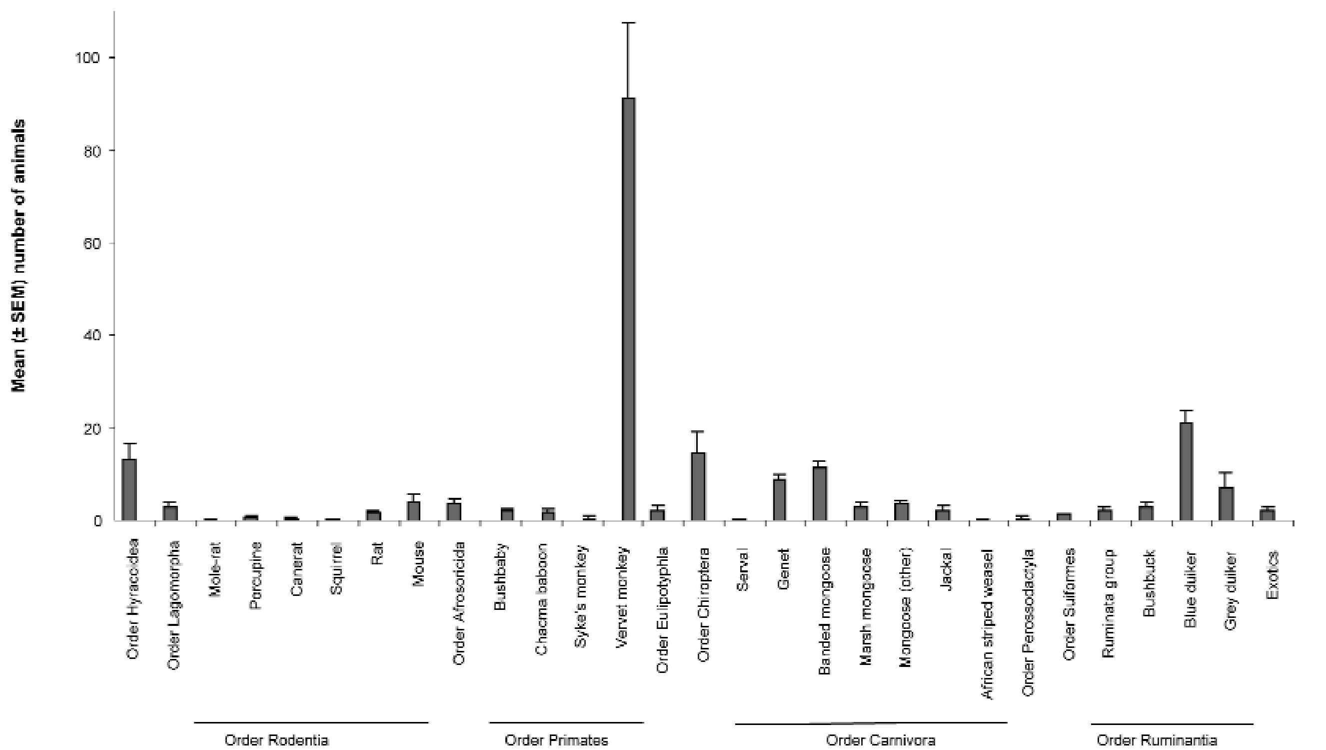
Figure 2



Mean (± SEM) number of each group within eight different bird categories (excluding 'other' category) admitted each year to an urban SA rehabilitation centre. (See Appendix 1 for a list of species abbreviations and family names).

Figure 3



Mean (± SEM) number of each group within 11 different mammal orders and one group of exotics admitted each year to an urban SA rehabilitation centre. (See Appendix 2 for a list of species abbreviations and family names).

order Squamata, sub-order Serpentes (7%, n = 17; 4 [± 2]), and order Crocodylia (< 1%, n = 1). The two most common reptile species were the leopard tortoise (order Chelonia, *Stigmochelys pardalis*, 34%, n = 78 in total, 20 [± 3] per annum), and hinged tortoise (order Chelonia, *Kinixys* spp, 16%, n = 36 in total, 9 [± 2] per annum).

Rescuer and whether animals were treated before intake at the rehabilitation centre

Most animals were brought to the rehabilitation centre by private individuals (66%, n = 7,148 in total, 1,787 [± 53] per annum) and a nearby bird park (21%, n = 2,289, 572 [± 25]), while others were brought in by a group consisting of other rehabilitators and the local nature conservation authority (4%, n = 427, 107 [± 19]), left in the after-hours box at the centre (3%, n = 326, 82 [± 20]), brought in by an animal welfare organisation (SPCA) (3%, n = 290, 73 [± 10]) or rescued by the rehabilitation centre itself (2%, n = 4,173, 3 [± 22]). A total of 149 records (1%, 37 [± 8]) did not state who admitted the animal to the rehabilitation centre.

Excluding those records without data on whether or not animals had been treated prior to admittance (40%, n = 4,304 in total, 1,076 [± 33] per annum), there was no significant difference (*t*-test: $t = 0.71$, df = 6, $P = 0.505$) between whether the animal had been treated (31%, n = 3,314, 829 [± 30]), or not (29%, n = 3,184, 796 [± 35]). Most treated the animal for only one day (81%, n = 2,689, 672 [± 16]), while there were relatively equal numbers of those treated for less than 1 week (10%, n = 340, 85 [± 26]), treated for less than 1 month (4%, n = 145, 36 [± 6]) and those treated for more than 1 month (4%, n = 140, 35 [± 6]). The animals that were treated for 2–29 days prior to placement at the rehabilitation centre were generally without injuries (45%, n = 220), but 28% (n = 137) were injured. Some of the animals that had been treated had to be euthanased as a result of their injuries (15%, n = 73 in total), suggesting that a delay in bringing an animal to the centre may have either lead to injuries being caused by and/or compounded by the care they received from the person who found them.

Causes

An explanation of the respective terms that were used to describe the causes for rescue are shown in Table 1. Besides the large number of 'unknown' cases (31%), the four main overall causes for birds being brought to the rehabilitation centre were probable young (when cause was inferred, 20%), young (17%), dog/cat attack (13%) and 'wrong place: other' (4%, eg found in car) (Table 2). Similarly, for each bird category, the highest proportion was usually listed as 'unknown' (29–39%). If this cause was excluded, the most common cause was 'young', except for marine birds, which were mainly found entangled, and raptors, which were mainly involved in vehicle collisions (Table 2). For mammals, besides the large number with an unknown history (18%), the main causes were dog/cat attack (13%), wrong place (12%), vehicle impact (12%) and young (11%) (Table 2). Similarly, for each mammalian category, the main cause was generally dog/cat attack (Table 2). Reptiles were mostly admitted to the rehabilitation centre because they were found in the wrong place, which included the sub-categories 'other' (20%), on road (16%) and 'probable' (when cause was inferred, 14%); or because they were ex-pets ('probable': 11%, known: 10%) (Table 2). Most ex-pets were leopard tortoises (70%, n = 16). For each reptile category, the main cause for admission was being found in the wrong place (Table 2).

Condition and immediate fate

Most of the birds and mammals with an unknown history for cause of admission were injured (59%, n = 1,759 in total; 59%, n = 86 in total, respectively), while those that were young were mostly uninjured (71%, n = 1,158, 56%, n = 49, respectively). In general, birds and reptiles admitted did not have any visible injuries (44%, n = 4,246 in total, 1,062 [± 107] per annum; 63%, n = 144 in total, respectively), while mammals were mostly injured (48%, n = 393 in total). Although it was not a common condition, 236 animals were diseased, namely birds (2% of all animal types, n = 217, 54 [± 7] per annum), especially pigeons and doves; and mammals (2% of all animal types, n = 19), especially banded mongoose (*Mungos mungo*) and vervet monkey. Most of the diseased animals were immediately euthansed (66%, n = 155).

Over the four years, out of all the animal classes, most of the individuals brought to the centre were placed into the clinic (70%, n = 7,546). Some (18%, n = 1,911), were immediately euthanased, while others (7%, n = 759) had unknown placements and almost equal proportions (1–2%) were dead on arrival (n = 107), died soon after arrival (n = 231), were released (n = 147), given to another rehabilitator for care (n = 43) or were in a group where individuals had different fates recorded (n = 24).

Discussion

The large numbers and regularity of animal intake at this rehabilitation centre over the years allowed for consistent trends to emerge. The annual average intake of 2,701 animals was similar to that recorded at a centre in Canada (over 2,000 animals: Dubois & Fraser 2003). Diversity of bird species was similar (151 over four years) to that found in one study in USA (199 over 15 years; Harden *et al* 2006), but higher than in Uganda (32 over four years; Azikuru & Angubo 2007). Furthermore, the variety of reptiles (16 species, one centre, four years) was greater than that documented in Canada (six species, 11 centres, 12 years) (Dubois & Fraser 2003) but lower than another study in the USA (20 species, one centre, 14 years) (Hartup 1996). The relatively high species diversity in the South African rehabilitation centre may be the result of the greater diversity of the Afrotropical region compared with countries in the Nearctic (USA, Canada) and Palaeartic (UK) regions (Newton 2003). The low species diversity of animals admitted for rehabilitation in Uganda is perhaps due to socio-economic and cultural differences, rural people perhaps being less likely to bring wild animals to rehabilitation centres (Kellert 1991 in Measures 2004).

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Table 2 Main causes (%, total, mean [± SEM]) resulting in animals admitted to the rehabilitation centre for each category within bird, mammal and reptile classes (refer to Appendices for description of categories, and refer to Table 1 for description of causes and conditions).

Class	Category	Cause	%	Total	Mean (± SEM)
Bird	All	Unknown	31	2,964	741 (± 17)
		Probable young	20	1,977	494 (± 58)
		Young	17	1,607	402 (± 21)
		Dog/cat attack	13	1,221	305 (± 23)
		Wrong place: other	4	351	88 (± 20)
	Marine	Entangled	12	17	4 (± 1)
	Water	Probable young	26	109	27 (± 4)
	Raptors	Vehicle impact	17	16	4 (± 1)
	Grassland	Probable young	15	17	4 (± 2)
	Nocturnal	Probable young	12	18	5 (± 1)
	Aerial insectivores	Probable young	24	79	20 (± 5)
	Specialist	Dog/cat attack	15	79	20 (± 2)
	Urban habitat	Probable young	21	1,691	423 (± 45)
	Other	Wrong place: other	67	2	–
Mammal	All	Unknown	18	147	–
		Dog/cat attack	13	110	–
		Wrong place: other	12	98	–
		Vehicle impact	12	97	–
		Young	11	87	–
	Primates	Vehicle impact	20	76	–
	Carnivora	Young	20	23	–
	Ruminata	Wrong place: other	29	38	–
	Chiroptera	Dog/cat attack (besides uknown)	28	16	–
	Hyracoidea	Dog/cat attack	30	7	–
	Rodentia	Probable young	42	5	–
	Afrocoricida	Dog/cat attack	43	6	–
	Lagomorpha	Dog/cat attack	28	8	–
	Eulipotyphla	Dog/cat attack	75	6	–
	Suiformes	Various (eg young)	20	1	–
	Exotics	Removed animal	25	2	–
Reptile	All	Wrong place: other	20	45	–
		Wrong place: road	16	36	–
		Probable wrong place	14	32	–
		Probable ex-pet	11	24	–
		Ex-pet	10	23	–
	Chelonia	Wrong place: other	20	37	–
	Crocodylia	Man-made attack	100	1	–
	Squamata: Sauria	Wrong place: other	14	4	–
	Squamata: Serpentes	Wrong place: other	24	4	–
		Dog/cat attack	24	4	–

A trend seen throughout the world is that the common species living in close association with humans are those most frequently admitted to rehabilitation centres (Deem *et al* 1998), because of the increased probability of injury and of subsequent detection (du Toit 1999; Reeve & Huijser 1999; Barnett & Westcott 2001). Sometimes these species have grown in numbers and spread into previously unoccupied areas, because they are able to successfully adapt to man-made changes in the environment (Hockey *et al* 2005). They are also often tolerant of humans (Hockey *et al* 2005; Drake & Fraser 2008). The three most common bird species admitted to the rehabilitation centre in this study have all benefited from increased roost and nesting sites, when trees were planted in previously open areas (hadeda ibis: Macdonald *et al* 1986; doves: Rowan 1983) or suitable man-made structures (eg roofs) exist (pigeons: Rowan 1983). They have also benefited from increased foraging sites, for instance where cities and agricultural farming provide food for pigeons and doves (Rowan 1983). The increased number of artificial water bodies and areas under irrigation (eg suburban gardens) also benefit birds, such as the hadeda ibis (Macdonald *et al* 1986). Meanwhile the vervet monkey, the mammal most commonly admitted to the rehabilitation centre, is common in KwaZulu-Natal suburbia (Skinner & Chimimba 2005), largely due to a decrease in natural habitat and/or increased foraging opportunities around suburban houses and gardens (Henzi 1979). Leopard tortoises are the most common reptile admitted, probably on account of it being the most widely distributed tortoise in South Africa and a common choice of reptilian pet (Boycott & Bourquin 2000). Commonly admitted species listed in other studies, such as mallard ducks (*Anus platyrhynchos*) in Canada (Dubois & Fraser 2003; Drake & Fraser 2008) and hedgehogs (*Erinaceus europaeus*) in the UK (Kirkwood & Best 1998), are likely also as a result of successfully adapting to human changes to environment.

Wildlife rehabilitation centres are generally established to deal with casualties or consequences from man-made hazards or developments (Trendler 1995a; MWAC 2009). Common causes of admittance of birds and mammals in Canada include orphaned or abandoned young (25 and 66%, respectively), cat attack (23 and 13%, respectively) and vehicle impact (9 and 8%, respectively) (Dubois 2003). A similar analysis in the UK echoed this, where 25% of all animals admitted were abandoned young, while 8% were due to cat attack (Kirkwood & Best 1998). The main causes in this study were similar, but varied between animal classes. The main cause of admittance in birds was being found young, for mammals it was dog or cat attack, and for reptiles, being found in a 'wrong' place. This is almost certainly a result of birds being able to live and breed in close proximity to humans, and thus their juveniles are readily found and easily picked up, while mammals generally avoid humans and only tend to be encountered when in conflict with humans. Reptiles, especially snakes, are generally regarded with fear (Marais 2004), and are thus commonly found where they are not wanted. Causes also varied for different taxa, related perhaps to foraging methods (Kelly & Bland 2006), where raptors are particularly vulnerable to collisions (Deem *et al* 1998; Kelly & Bland 2006; Visagie 2008), or due to their habitat, where marine birds are vulnerable to oil spills (Carter 2003; Barham *et al* 2006), and entanglement in fishing lines (Trendler 1995a; Jacobs 1998).

Including all animal classes, juveniles contributed the most to the total animal intake at the Durban rehabilitation centre. In addition, the seasonal increase in the number of animals was linked directly to an increase in numbers of juveniles in spring and summer, similarly documented in hedgehogs (Reeve & Huijser 1999) and in seals (Barnett & Westcott 2001). In our study, this was a time when there was an overlap between bird and mammal species in their peak-breeding season in southern Africa (Hockey *et al* 2005; Skinner & Chimimba 2005). These juveniles were assumed to have been abandoned or orphaned (Jacobs 1998; Beringer *et al* 2004), and thus were taken to the centre for hand-rearing. Despite the fact that there are genuine instances when juveniles probably do need help (eg orphaned bears: Clark *et al* 2002; and abandoned ducklings: Drake & Fraser 2008), various authors have documented that they are picked up unnecessarily (eg deer fawns: Beringer *et al* 2004; von Klemperer 2008; seal pups: Measures 2004; and owl chicks: Leighton *et al* 2008), as their mothers are merely feeding close by. Not only does this have ethical consequences, but when examining the natural mortality for infants and juveniles from the most commonly admitted bird group (doves), nesting success (survival until fledging) has been estimated to only be 40% for red-eyed doves (*Streptopelia semitorquata*), 38% for cape turtle doves (*S. capicola*) and 46% for laughing doves (*S. senegalensis*); largely due to predation, desertion and inclement weather (Rowan 1983). This raises two important issues with rehabilitating juveniles: should humans be interfering with nature if the cause was not human-related (Kirkwood 1992), and is there space in the environment for them, without causing harm to those already in the environment (Caldecott & Kavanagh 1983). Furthermore, in the rehabilitation process, there is the likelihood of juveniles becoming human-imprinted, habituated or tame (Aitken 2004; Sleeman 2007), with human-imprinted individuals far more likely to become aggressive or a nuisance by approaching humans for food and/or companionship (Alt & Beecham 1984; Beringer *et al* 1994). Similarly, hand-raising songbirds without conspecifics and/or in close association with heterospecifics, has been shown to negatively influence their song development, subsequently affecting their ability to find a mate or defend a territory (Spencer *et al* 2007). A third issue with rehabilitating juveniles is thus whether juveniles can be adequately prepared to survive and thrive when released into the wild (Bennett 1992; Csermely 2000). As detailed by other authors (Trendler 1995a; Jacobs 1998), the public must be informed not to bring in juvenile birds if they have just fallen out of the nest or are fledglings.

Besides identifying the threats to wildlife (Fix & Barrows 1990; Reeve & Huijser 1999), analysis of intake records could be useful to rehabilitation and conservation. For instance, specific areas where animals frequently encounter harm may be identified from intake records (Curtis & Jenkins 2002; Harden *et al* 2006; Drake & Fraser 2008). This information may then be used to place preventative measures at these sites (Drake & Fraser 2008), such as tunnels and culverts to help with tortoise road crossings (Guyot & Clobert 1997). Intake records may also be used to monitor diseases affecting wild animals (Kirkwood 1992; Measures 2004; Harden *et al* 2006), such as sarcoptic mange, canine distemper and rabies in foxes (Kelly & Sleeman 2003) and suspected in animals at the rehabilitation centre in this study. Additional uses include monitoring population trends in an area, to pick up an expansion of a native range or if a decrease is noticed, it could be an early warning signal of an environmental change (Harden *et al* 2006; Neese *et al* 2008). Generally, these have been underutilised and so may have resulted in poor completion of intake records at this centre, and elsewhere; as those completing them did not realise its importance (Italy: Fajardo *et al* 2000; Canada: Dubois & Fraser 2003; USA: Kelly & Sleeman 2003; Harden *et al* 2006).

Additionally, intake records should be analysed by the rehabilitation centres themselves to learn from their successes and failures (Trendler 1995b). One centre noticed that release rates of African penguins (*Spheniscus demersus*), had improved over the years as a result of refinements to rehabilitation techniques (Parsons & Underhill 2005). In addition, an accurate record of where an animal was found enables it to be released back into the appropriate habitat (Harden *et al* 2006). Furthermore, studies have shown that intake records can be used to identify individuals that are high risk, so that special care is provided to these individuals (eg ducklings with low body mass: Drake & Fraser 2008) or provided to those with less severe injuries (Molony *et al* 2007). The opportunities for research are numerous if all rehabilitators input their intake records into a centralised online database, such as the one set up by the British Wildlife Rehabilitation Council (Anon 2009). Furthermore, an automated recording system could help rehabilitation centres generate accurate trends for use in funding requests or in permit applications.

Animal welfare implications

The consistently large numbers of juveniles admitted in the current study reflects a need for greater public education at this centre to prevent such numbers in the future (Hartup 1996; Dubois & Fraser 2003). Money and resources may then be freed up for use on animals that genuinely need assistance, ie casualties resulting from man-made hazards (Trendler 1995a). Otherwise, the large numbers of juveniles limit the practicality of being able to provide adequate care to each individual and prepare them for release, and increase the possible negative impact of releasing these individuals on the environment. We suggest that intake records should be better utilised by rehabilitation centres as well as conservation authorities, where analyses could reveal, for example: the threats to wildlife and the specific areas where animals frequently encounter harm, so that preventative measures could be put in place at these sites; and they could reveal improvements in rehabilitation techniques.

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Appendix 1 List of species (if recorded by admittance staff) admitted to centre and their common and family names within each bird category (developed using habitat rather than taxonomic associations, to allow for more meaningful smaller groupings).

Bird category	Group	Group name (family name): species name
Marine habitat	*Marine group*	Cormorant (Phalacrocoracidae); Penguin (Spheniscidae): African; Petrel (Procellariidae); Shearwater (Procellariidae): Wedge-tailed; Skua (Laridae) Sub-antarctic
	Gannet	Sulidae: Cape
	Gull	Laridae
	Pelican	Pelecanidae
	Tern	Laridae: Little
Water habitat	*Water group*	Crane (Gruidae): Grey-crowned; Grebe (Podicipedidae): Little; Thick-knee (Burhinidae): Spotted; Painted-snipe (Rostratulidae): Greater; Sandpiper (Scolopacidae); Spoonbill (Threskiornithidae): African; Stork (Ciconiidae): Woolly-necked
	Crake	Rallidae: African, Black, Corn
	Duck	Anatidae: White-faced, Fulvous, Muscovy (exotic), Yellow-billed
	Egret	Ardeidae
	Fluff-tail	Rallidae: Buff-spotted
	Goose	Anatidae: Egyptian, Spur-winged, Domestic
	Hamerkop	Scopidae
	Heron	Ardeidae: Grey, Grey-backed, Goliath, Black-headed
	Ibis	Threskiornithidae: African sacred, Southern bald
	Moorhen	Rallidae
	Kingfisher	Alcedin idae: Malachite, African pygmy Dacelonidae: Brown-hooded, Mangrove Cerylidae: Giant, Pied
Grassland habitat	*Grassland group*	Bustard (Otididae): Black-bellied; Buttonquail (Turnicidae); Cisticola (Cisticolidae); Sparrowlark (Alaudidae); Lark (Alaudidae); Partridge (Phasianidae); Pheasant (Phasianidae: exotic)
	Bee-eater	Meropidae
	Francolin	Phasianidae: Crested francolin, Natal spurfowl
	Coucal	Centropodidae: Burchal's
	Guinea fowl	Numididae: Helmeted
	Lapwing	Charadriidae: Black-smith
	Quail	Phasianidae: Harlequin
	Warbler	Sylviidae
Forest habitat	*Forest group*	Babbler (Sylviidae); Chat (Muscicapidae); Honeyguide (Indicatoridae); Hoopoe (Upupidae), African; Roller (Coraciidae): European; Tchagra (Malaconotidae); Tit (Paridae); Trogon (Trogonidae): Narina; Twinspot (Estrildidae)
	Cuckoo	Cuculidae: Diederik, African emerald
	Flycatcher	Muscicapidae: Southern black, African dusky Monarchidae: African paradise-flycatcher
	Hornbill	Bucerotidae: Trumpeter Bucorvidae: Southern ground-hornbill
	Woodpecker	Picidae

Appendix 1 (cont)

Bird category	Group	Group name (family name): species name
Urban habitat (including suburban gardens)	*Urban group*	Raven (Corvidae): White-necked; Crow (Corvidae): House, Pied; Drongo (Dicrurida): Fork-tailed; Waxbill (Estrildidae): Common; Firefinch (Estrildidae); Canary (Fringillidae): Cape, Yellow-fronted; Shrike (Laniidae): Common fiscal: Puff-back (Malaconotidae): Black-backed; Wagtail (Motacillidae); Turaco (Musophagidae): Purple-crested, Grey go-away bird; Sunbird (Nectariniidae): Collared; Oriole (Orolidae); Bishop (Ploceidae): Southern red; Thrush (Muscicapidae): Olive, Spotted-ground; Robin (Muscicapidae): White-starred; Robin-chat (Muscicapidae): Cape, Red-capped; Whydah (Viduidae): Pin-tailed
	Dove	Columbidae: Cape turtle dove; Laughing, Red-eyed, Tambourine doves; Emerald-spotted wood dove
	Pigeon	Columbidae: Rock dove; Speckled pigeon; African green pigeon; African olive-pigeon
	Hadeda ibis	Threskiornithidae
	Mannikin	Estrildidae: Bronze
	Weaver	Ploceidae: Masked-weaver (lesser/southern): Spectacled, Thick-billed weavers
	Sparrow	Passeridae: House, Southern grey-headed
	White-eye	Zosteropidae: Cape
	Bulbul	Pycnonotidae: Dark-capped
	Barbet	Lybiidae: Black-collared, Crested, White-eared barbets; Tinkerbird
	Mousebird	Collidae: Speckled
	Mynah	Sturnidae: Common
	Starling	Sturnidae: Cape glossy, Violet-backed, Red-winged
Raptors	*Raptor group*	Accipitridae: Buzzard: Jackal, Steppe; Eagle: African crowned, Long-crested, Martial, Wahlberg's; Snake-eagle; African harrier hawk; Vulture; Unknown spp
	Falcon	Falconidae: Lanner, Peregrine
	Kite	Accipitridae: Black-shouldered, Black
	Sparrowhawk	Accipitridae: Black
Nocturnal	Nightjar	Caprimulgidae
	Owl	Tytonidae: Barn Strigidae: Marsh owl; Cape, Spotted and Verreaux eagle-owls; Southern white-faced scops-owl; African wood-owl
Aerial insectivores	Swallows	Hirundinidae: Barn, Striped (lesser/greater)
	Swifts	Apodidae: Common, White-rumped
Other	Chicken	Phaianidae: *Gallus gallus*
	Cockatiel	Psittacidae: *Nymphicus hollandicus*

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Appendix 2 List of species (if recorded by admittance staff) admitted to centre and their common and family names within each mammal category (developed according to taxonomic grouping and whether exotic to SA and/or KZN province).

Mammal category	Group	Family name: species name
Order Hyracoidea	Hyrax	Procaviidae: Rock, Tree hyrax
Order Lagomorpha	Scrub hare	Leporidae
Order Rodentia	Mole-rat	Bathyergidae
	Porcupine	Hystricidae
	Canerat	Thryonomyidae
	Squirrel	Sciuridae
	Rat	Muridae
	Mouse	Muridae
Order Afrosoricida	Golden mole	Chrysochloridae
Order Primates	Galago	Galagidae: Greater, South African
	Chacma baboon	Cercopithecidae
	Syke's monkey	Cercopithecidae
	Vervet monkey	Cercopithecidae
	Monkey (unknown)	Unknown
Order Eulipotyphla	Shrew	Soricidae
Order Chiroptera	Bat	Pteropodidae (fruit-eating); Molossidae (Free-tailed), Vespertilionidae (vesper)
Order Carnivora	Serval	Felidae
	Genet	Verridae: Spotted
	Banded mongoose	Herpestidae
	Marsh mongoose	Herpestidae
	Mongoose (other)	Herpestidae: Large grey, slender, yellow
	Jackal	Canidae; Black-backed
	African striped weasel	Mustelidae
Order Perossodactyla	Plains zebra	Equidae
Order Suiformes	Bushpig	Suidae
	Common warthog	Suidae
Order Ruminata (family Bovidea)	Bushbuck	Sub-family Bovinae
	Blue duiker	Sub-family Antilopinae
	Grey/common duiker	Sub-family Antilopinae
	Ruminata group	Sub-family Antilopinae: unknown duiker, red duiker, reedbuck, oribi, impala
Exotic	Suricate/meerkat	Order Carnivora, Family Herpestidae: *Suricata suricata*
	European rabbit	Order Lagomorpha, Family Leporidae, *Oryctolagus cuniculus*
	Marmoset	Order Primates, Family Callitrichidae: various spp

Appendix 3 List of species (if recorded by admittance staff) admitted to centre and their common and family names within each reptile category (developed according to taxonomic grouping).

Reptile category	Common	Family name: species name
Order Squamata	Snake (common)	Colubridae: House, Spotted bush, Eastern green snake, Herold
Sub-order Serpentes	Black mamba	Elapidae
	Night adder	Viperidae
	Snake (exotic)	Colubridae: Corn snake, *Elaphe guttata*
Sub-order Sauria	Southern tree agama	Agamidae
	Chameleon	Chamaeleonidae
	Water monitor	Varanidae
Order Crocodylia	Nile crocodile	Crocodylidae
Order Chelonia	Terrapin	Pelomedusidae
	Tortoise	Testudinidae: exotic to KwaZulu-Natal Province (Angulate tortoise, Parrot-beaked padloper); Hinged; Leopard; Unknown spp

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