

ARTICLE

Reasons why animals are admitted to wildlife rehabilitation centers in Canada

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Abstract

A retrospective analysis was performed using more than 21 000 patient records from three large centers across Canada in order to determine the reasons for the presentation and outcome of wildlife brought into wildlife rehabilitation centers in Canada. Results suggest that up to 97% of wild animals brought into wildlife rehabilitation centers are thought to be directly or indirectly linked to anthropogenic causes. Trauma was the leading reason recorded for 61% of all cases admitted to wildlife rehabilitation centers. Orphaned wildlife was also a key reason why animals were admitted to wildlife rehabilitation centers in Canada. This research will help wildlife rehabilitators and agencies be aware of the reasons for animal admission to rehabilitation centers and provide opportunities to develop mitigation strategies to potentially minimize human impact on indigenous wildlife.

BIO

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Introduction

Wildlife rehabilitation is the treatment and temporary care of injured, diseased, and displaced indigenous animals and the subsequent release of healthy animals into appropriate habitats in the wild (Miller 2012). The goal is not to rehabilitate every animal at any expense; rather, wildlife rehabilitation practices seek to return healthy animals to their appropriate habitat. This functionality includes being able to recognize and obtain the appropriate foods, select mates of their own species and reproduce, and display appropriate behavior, including fear of potential dangers (e.g., people, cars, cats, dogs, etc.) (Ministry of Natural Resources and Forestry 2020).

It is well known that wildlife are killed and injured due to anthropogenic activity. Vehicle collisions are thought to be the cause of an estimated 80 million avian fatalities every year and 976 million deaths per year due to collisions with windows (Erickson et al. 2005). In Canada, approximately 25 million birds are killed by collisions with windows every year (Machtans et al. 2013), and it is estimated that 13.8 million birds are killed by vehicles every year (Bishop & Brogan 2013). An estimated 2.5 to 25.6 million birds are killed every year by collisions with transmission lines in Canada (Rioux et al. 2013). In another study, more than 30% of snapping turtles (*Chelydra serpentina*) observed

Keywords

Wildlife rehabilitation; wildlife; rehabilitation; injured wildlife; anthropogenic

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Dates

Accepted: 13 February 2022
Published: 31 May 2022

on roads were killed by vehicles (Haxton 2000). Poaching and road mortalities could result in the population decline of snapping turtles and other chelonian species given the later age at which they can reproduce.

Other examples of anthropogenic problems include illegal hunting activities, rodenticide ingestion by raptors, lead toxicity from fishing or spent lead shot, wind turbines (affecting habitat destruction as well as direct mortality), and construction activities that displace animals (Miller 2012; Zimmerling et al. 2013).

The objective of this paper is to look at the role of wildlife rehabilitators in Canada and identify the direct and indirect human impacts on wildlife or the anthropogenic reasons why animals may be brought into a wildlife rehabilitation facility.

Wildlife rehabilitation in Canada is regulated on a provincial basis by various agencies, with many migratory birds regulated by the Canadian Wildlife Service. In other words, wildlife rehabilitators must be authorized to rehabilitate wild animals in their respective provinces and that authorization often dictates that species may be rehabilitated.

The field of wildfire rehabilitation has experienced rapid growth over the past 30 years. In the early 1980s, the International Wildlife Rehabilitation Council and the National Wildlife Rehabilitators Association Boards of

Directors established minimum standards for both individual rehabilitators and rehabilitation centers (Miller 2012). These standards have been widely adopted by many state and provincial wildlife agencies that regulate this field.

Wildlife rehabilitation centers take many forms: They may be large, multistaffed, or volunteer-based nonprofit organizations or individual wildlife rehabilitators caring for these animals in a small, self-funded operation. For the most part, wildlife rehabilitators in Canada receive no government funding to support ongoing operations. That is, wildlife rehabilitators must raise funds to support the nutritional, housing, medical, and surgical requirements of the animals in their care.

Wildlife rehabilitation primarily deals with individual wild animals. However, wildlife rehabilitation efforts can positively impact populations of animals in times of mass disaster, such as oil spill response activities (Barham et al. 2006), botulism outbreaks, or forest fire response as well as wildlife rehabilitation efforts in working with endangered species.

Wildlife rehabilitators can be considered on the “front line” of wildlife disease surveillance. In many cases, they act as the first point of contact for the public in answering questions regarding what to do if someone finds a sick, injured, or orphaned wild animal. With many diseases having a wild animal origin, wildlife rehabilitators find themselves submitting samples to veterinary laboratories and working with scientists to help disseminate knowledge regarding new and emerging diseases. Wildlife rehabilitators have played an important role in tracking the spread of disease or reporting new diseases. A skunk adenovirus was discovered in porcupines in Nova Scotia as a result of the rehabilitator and medical team working with researchers to identify an illness not encountered before (Bourque et al. 2019). One of the first outbreaks of the West Nile virus in waterfowl in Canada was reported at a wildlife rehabilitation center in Ontario (Cox et al. 2015). This is an area of further development and collaborative opportunity as we work through the One Health concept connecting the health of humans, animals, and the environment.

Furthermore, wildlife rehabilitators have been working together with the public and provincial agencies to help solve human-wildlife conflicts, such as providing resources to address injured animals, as well as providing educational information on how to cohabitate with urban wildlife. Wildlife rehabilitators have unique knowledge and expertise in many areas, such as capturing and stabilizing wildlife in the event of an oil spill response (Berg 2003).

Wildlife rehabilitators play an important role as the interface among sick, injured, or orphaned animals and a member of the general public. More often than not, a member of the public will take an orphaned animal into their own hands to rear if they cannot find a wildlife rehabilitator to admit that animal. While members of the public

have positive intentions, the outcomes can sometimes be catastrophic for wild animals. Problems such as nutritional metabolic bone disease that permanently alter bone growth (Fig. 1) or habituation can be a death sentence for that animal in terms of its ability to be released and survive in the wild. But the wildlife rehabilitator is often the help that the person is desperately seeking if they have found a sick, injured, or orphaned animal. Members of the public routinely call into the wildlife hotline of a center—many in tears—searching for someone to help the sick, injured, or orphaned wild animal.

While many orphaned animals are brought into wildlife rehabilitation centers, not all are without parents. Sometimes members of the public will bring in wild animals thinking that they are orphaned; however, they are not. This is particularly true in the case of young rabbits and fawns whereby the mother will leave the immature animal unattended for prolonged periods. Wildlife rehabilitators play an important role in helping to educate the public to best assess whether or not the animal is orphaned and should be brought to a wildlife rehabilitator.

In Canada, aggregate information regarding reasons why wild animals are admitted to rehabilitation centers is undocumented. To help answer this question, data from approximately 20 000 wildlife rehabilitation records were analyzed to determine the reason for admission to three wildlife centers spanning the country from British Columbia, Ontario, and Nova Scotia.

Materials and methods

Three authorized wildlife rehabilitation centers provided 3 years of data for analysis in this retrospective study. A center in British Columbia, Ontario, and Nova Scotia participated in the study.

Twenty-one categories were identified as reasons why animals were admitted to wildlife rehabilitation centers in Canada based on information contained in the medical record or as coded by the wildlife rehabilitation center (Table 1). These data were also sorted by species and final disposition results.

Given limited detailed information to further analyze the categories above, the following assumptions were made in terms of direct and indirect human involvement in the analyses.

- Assumption 1: Other predator attack (code 9), illness or emaciation (code 11), and environmental factors (code 18) are excluded from direct or indirect human involvement.
- Assumption 2: Cat and dog attack (codes 7 and 8), other predator attack (code 9), illness or emaciation (code 11), environmental factors (code 18), and other



Fig. 1 Radiograph of a Virginia opossum with severe nutritional metabolic bone disease from an improper diet. Note the two broken legs that have healed improperly. This baby opossum was fed watermelon as a diet for more than 2 months by a well-intentioned member of the public.

domestic animal interaction (code 19) are excluded from direct or indirect human involvement.

Results

A total of 21 157 animals were identified comprising 331 species; 573 animals were recorded as unknown species with 988 animals not identified or the species information recorded was illegible.

Several categories were combined where the reasons for admittance were thought to be similar in terms of etiology. For example, dog, cat, and other domestic animal attacks were combined.

Other predator attack (code 9), illness or emaciation (code 11), and environmental factors (code 18) were excluded from direct or indirect human involvement.

Cat and dog attack (codes 7 and 8), other predator attack (code 9), illness or emaciation (code 11), environmental factors (code 18), and other domestic animal interaction (code 19) were excluded from direct or indirect human involvement.

Table 1 Category definition and assignment of codes.

Code	Reason for admission identified
1	Hit a stationary object: wind turbine, window strike, fan
2	Vehicle collision (motorcycle, truck, car, watercraft, bicycle)
3	Electrocution
4	Hazardous noxious substance (oil, sticky traps, glue)
5	Entrapment (trap, entanglement—e.g., nets, fences, pipes, chimneys, fishing tackle)
6	Gardening, lawnmower, farm equipment accident
7	Cat attack
8	Dog attack
9	Other predator attack (conspecific, wild animal, nondomestic)
10	Projectile (shot—rifle, pellets, arrow)
11	Illness or emaciation (loss of body condition)
12	Trauma—unknown reason
13	Orphan
14	Kidnapped
15	Fall from nest
16	Human interference other than kidnapped (unauthorized to hold wildlife, construction/trapped at home)
17	Habitat destruction
18	Environmental factors (e.g., weather/storms)
19	Other domestic animal interaction
20	Toxicants

Table 2 Breakdown of a number of cases by category definition.

Code definitions	Total # recorded	% of total
1 Hit a stationary object or fan/wind turbine: window strike, walls, fan	1029	4.86%
2 Vehicle collision (motorcycle, truck, car, watercraft, bicycle)	1933	9.14%
3 Electrocution	43	0.20%
4 Hazardous noxious substance (oil, sticky traps, glue)	71	0.34%
5 Entrapment (trap, entanglement—e.g., nets, fences, pipes, chimneys, fishing tackle, string)	485	2.29%
6 Gardening, lawnmower, farm equipment accident	133	0.63%
7 Domestic cat attack	1416	6.69%
8 Domestic attack	316	1.49%
9 Other predator attack (conspecific, wild animal, non-domestic)	247	1.17%
10 Projectile (shot/rifle/pellets, arrow)	30	0.14%
11 Illness/emaciation (loss of body condition, illness)	698	3.30%
12 Trauma—unknown reason	6287	29.72%
13 Orphan	6134	28.99%
14 Kidnapped	432	2.04%
15 Fall from nest	175	0.83%
16 Human interference (unauthorized to hold wildlife, construction/trapped in homes, inappropriate human possession)	874	4.13%
17 Habitat destruction	96	0.45%
18 Environmental factors (e.g., weather/storms)	260	1.23%
19 Other domestic animal interaction	379	1.79%
20 Toxicants including lead toxicity	119	0.56%
Total	21 157	100%

Table 3 Combining similar categories.

Code definitions	Revised # recorded	Revised % of total
1 Hit a stationary object or fan/wind turbine: window strike, walls, fan	1029	4.86%
2 Vehicle collision (motorcycle, truck, car, watercraft, bicycle)	1933	9.14%
3 Electrocutation	43	0.20%
4 Hazardous noxious substance (oil, sticky traps, glue)	71	0.34%
5 Entrapment (trap, entanglement—e.g., nets, fences, pipes, chimneys, fishing tackle, string)	485	2.29%
6 Gardening, lawnmower, farm equipment accident	133	0.63%
7 Domestic cat, dog, or other domestic predator interaction	2111	9.98%
9 Other predator attack (conspecific, wild animal, nondomestic)	247	1.17%
10 Projectile (shot/rifle/pellets, arrow)	30	0.14%
11 Illness/emaciation (loss of body condition, illness) or trauma—unknown reason	6985	33.02%
13 Orphan or kidnapped (e.g., accidental orphan)	6566	31.03%
16 Human interference (unauthorized to hold wildlife, construction/trapped in homes, inappropriate human possession)	874	4.13%
17 Habitat destruction or fall from nest	271	1.28%
18 Environmental factors (e.g., weather/storms)	260	1.23%
20 Toxicants including lead toxicity	119	0.56%
Total	21 157	100%

Table 4 Cases with possible direct or indirect human involvement (Assumption 1).

Total cases	21 157
Codes where there may not be human involvement 9, 11, 18	507
Revised count with these 3 codes removed	20 650
% Human related (indirect or direct)	97.60% 20 650
% not human related	2.46% 507

Table 5 Cases with possible direct or human direct involvement (Assumption 2).

Total cases	21 157
Codes where there may not be human involvement 7, 8, 9, 11, 18, 19	3316
Revised count with these 6 codes removed	17 841
% Human related (indirect or direct)	84.33% 3316
% not human related	15.67% 886

The following groups of animals were compiled spanning seven categories. Birds represented the majority of animals brought into wildlife centers (55.5%) with terrestrial mammals being second (37.2%).

A number of species at risk in Canada were admitted to rehabilitation centers. These represented 341 animals spanning 14 species.

The following species are listed on Schedule 1 of the Canadian federal Species at Risk Act (SARA) and were treated at wildlife rehabilitation centers:

Special Concern

- Mole, eastern (*Scalopus aquaticus*)
- Vole, woodland (*Microtus pinetorum*)
- Grebe, horned (*Podiceps auritus*) Western population
- Grosbeak, evening (*Coccothraustes vespertinus*)
- Phalarope, red-necked (*Phalaropus lobatus*)
- Falcon anatum/tundrius, peregrine (*Falco peregrinus anatum/tundrius*)
- Snake, milk (*Lampropeltis triangulum*)
- Turtle, snapping (*Chelydra serpentina*)

Threatened

- Owl, barn (*Tyto alba*) western population
- Swallow, barn (*Hirundo rustica*)
- Swift, chimney (*Chaetura pelagica*)
- Nighthawk, common (*Chordeiles minor*)

Endangered

- Myotis, little brown (*Myotis lucifugus*)
- Flycatcher, Acadian (*Empidonax virescens*)

Approximately 46% (7171, 1190/18 202) were released, transferred, placed, or the outcome was pending.

Discussion

Based on more than 21 000 wild animals admitted to three wildlife rehabilitation centers across Canada, it is estimated that 84.3% (17 841/21 157) to 97.6% (20 650/21 157) of cases are likely a result of direct or indirect human involvement. The value of 84.3% excludes animals that were admitted due to attacks by domestic dogs, cats, or other domestic animals. While many animals are allowed outdoors, thousands of wild animals (particularly in the spring) are killed every year by domestic animals. Many animals admitted to rehabilitation centers are fledgling birds or baby rabbits, hares, or squirrels. Domestic house cats are likely responsible for the greatest number of bird mortalities in Canada (Loss et al. 2013). The higher value of 97.6% is attributed to owners being responsible for their pet's interactions and impact on wildlife. It is estimated that feral cats are also responsible for hundreds of millions of bird mortalities every year (Loss et al. 2013). A tiny fraction of the birds that survive these injuries are ever

Table 6 Types of animals admitted.

Type of animal	# of animals identified	# of animals of unknown species	Total	% of total
Terrestrial mammals	7747	126	7863	37.2%
Marine mammals	60	0	60	< 1%
Semi-aquatic mammals	61	0	61	< 1%
Aerial mammals (e.g., bats)	158	0	158	< 1%
Birds	11 264	485	11 749	55.5%
Reptiles	247	10	257	1.2%
Amphibians	11	0	11	< 1%
Not identified or missing on records			988	4.7%

Table 7 Number of species based on types of animals admitted.

Type of animal	# of species identified
Terrestrial mammals	31
Marine mammals	2
Semi-aquatic mammals	4
Aerial mammals (e.g., bats)	4
Birds	272
Reptiles	10
Amphibians	8

Table 8 Species at risk.

Risk classification	# of animals	# of species identified
Special concern	206	8
Threatened	111	4
Endangered	24	2
Total	341	14

Table 9 Disposition of Animals (where such values were recorded).

Disposition description	Total #	% of total
Total animals that were dead on arrival/never admitted	975	5%
Total animals that died in care	6073	32%
Total animals that were euthanized	3768	20%
Total animals that were placed or released or transferred	7171	39%
Total unknown outcomes or still pending	1190	7%
Total animals admitted	18 202	100%

admitted to wildlife rehabilitation centers. Furthermore, actions aimed to control populations of feral cats such as the Trap-Neuter-Return program do not alleviate the adverse effects that feral cats have on wildlife (Longcore et al. 2009).

Trauma for unknown reasons accounted for 29.7% (6287/21 127) of cases admitted to the rehabilitation centers. When trauma for unknown reasons was

combined with trauma from vehicle or stationary object collisions; cat, dog, predator, and other domestic animal attacks; electrocution; hazardous and noxious substance (e.g., glue traps); entrapment (e.g., fishing tackle, string, fences); gardening accidents; projectile; falls from nests; habitat destruction and weather events, the number of animals admitted for trauma reached 61% (12 900/21 157), with the majority of remaining cases being orphaned wild animals. Approximately 11% or about one in 10 trauma-related reasons for admittance was due to cat attacks (1416/12 900).

Collisions with vehicles cause morbidity and mortality for wildlife. According to the Traffic Injury Research Foundation (2012), roads with higher posted speed limits may have more wildlife vehicle collisions. For every large animal that is reported as killed on the roads in British Columbia, three additional killed wild animals will go unrecorded as the animal leaves the roadside area to die (Wildlife Collision Prevention Program 2016). However, typically only large animals, such as deer and moose, are reported as wildlife vehicle collisions. These represent a very small fraction of all wildlife vehicle collisions (Ontario Road Ecology Group 2010). Almost all of the reptiles (95%, 244/257) admitted to wildlife rehabilitation centers were as a direct result of a vehicle collision.

While explicit coding to identify injuries due to collisions with wind turbine developments is not standardized, it is estimated that 23 300 birds are killed from such collisions in Canada (Zimmerling et al. 2013). Similarly, it is estimated that 2.5 to 25.6 million birds are killed every year due to collisions with transmission lines (Rioux et al. 2013).

The term kidnapping refers to accidental orphan admittance. In other words, the animal was taken from its parent when it likely did not need to come in for rehabilitation. This practice is not uncommon in cases of fawns and neonate rabbits where the mother leaves the young alone for long periods during the day and members of the public believe they have been orphaned. Fledgling birds that have just left the nest and the parent(s) are still feeding the young bird are often mistaken by members of

the public as an injured bird and are brought into wildlife centers. True orphaned animals are identified when the parent is not around or found dead, and/or the baby animals will likely die without intervention. It is possible that the 31% (6134, 432) of orphaned and accidental orphaned (i.e., kidnapped) animals admitted to rehabilitation centers could have been orphaned as a result of the mother killed due to direct or indirect human involvement (e.g., mother shot in a hunting incident, hit by a car, poisoned, etc.) but the details of why the animals are orphaned are not always apparent by the finder nor the rehabilitator.

It was surprising to see how low the results were for admittance due to toxin given much information in the literature of toxicity reports from lead in raptors and water birds. This could be because the wildlife centers (at the time of data collection) did not have diagnostic equipment to test for these toxins. In one study, 25.6% (762/2980) of Bald eagle carcasses submitted for evaluation revealed lead toxicosis as the likely cause of death (Russell 2014).

Not all records listed the final disposition of the animal. Out of 18 202 records, 39% (7171) of animals were released, transferred, or placed with another 7% (1190) alive with a pending outcome. Reasons for euthanasia and death in care vary greatly based on the species admitted, the nature and injury, as well as resource limitations and protocols implemented in various wildlife facilities. For example, in times of a disease outbreak, such as raccoon distemper virus or parvo virus in a nursery, some wildlife rehabilitation centers will elect to depopulate the entire litter of animals to prevent the spread of the disease to healthy, immunocompromised animals. In other cases, most wildlife rehabilitation centers will immediately euthanize animals for which there is a poor chance to return to the wild as a healthy animal, such as an open fracture involving a joint of a raptor or complete loss of eyesight in an animal.

There are limitations and biases of these data. Many injured wild animals may not make it to a wildlife rehabilitation center and will succumb to their injuries in the wild. For example, at the time of writing this paper, there were two deer that were spotted over several weeks with protruding arrows from their body and no longer coming to feeders based on their usual routine (Fig. 2). It is possible that these animals succumbed to their injuries and are not included in data collected from rehabilitation centers. These represent a mere fraction of injured animals that will likely succumb to their wounds or illness without intervention. As mentioned, a Wildlife Collision Prevention Program study (2016) showed that for every one large animal killed by a vehicle, three more will likely



Fig. 2 Deer with an arrow at a feeding station.

succumb to death as they wander off the road injured, but not immediately killed. Such examples (and many others) lead to survivor bias.

While every attempt was made to reduce confirmation bias, this is a retrospective study, and some assumptions were made in terms of the correlation of direct and indirect human impact. The reasons for admittance did not consider intent versus accidental injury to animals, such as those injuries by gardening equipment, projectile (e.g., shot), or glue traps. Nonetheless, in such cases, the assumptions were made that there was some kind of human involvement resulting in the animal's injury.

Furthermore, not all wildlife rehabilitators are permitted to admit all species. Therefore, the number of cases is likely underrepresented, and reasons for admittance could change based on the species permitted for admittance under the wildlife rehabilitator's authorization.

In addition, coding errors, incorrect species identification, and spelling errors may alter the findings of these data. Assumptions were made based on the best available information provided by those entering data. Finally, while data were analyzed from more than 21 000 medical records, data from only three larger rehabilitation centers were evaluated. Certain species that exist in one part

of Canada do not exist in another part of Canada (e.g., Eastern cottontail rabbits of Ontario are not indigenous to Nova Scotia).

Conclusions

Analysis of more than 21 000 patient records from three wildlife rehabilitation centers across Canada demonstrated that up to 97% of wild animals brought into wildlife rehabilitation centers are thought to be directly or indirectly linked to anthropogenic causes. Trauma was the leading reason recorded for 61% of all cases admitted to rehabilitation centers. Orphaned wildlife was also a key reason why animals were admitted to wildlife rehabilitation centers in Canada.

This research will help wildlife rehabilitators and agencies be aware of the reasons why animals are admitted to rehabilitation centers in Canada and provide opportunities to develop mitigation strategies to potentially minimize human impact on indigenous wildlife.

There are opportunities to expand upon this research by broadening the number of wildlife rehabilitation centers used to evaluate reasons for admission to rehabilitation centers as well as encouraging wildlife rehabilitators to utilize electronic records and standardized coding to avoid some of the potential bias.

Acknowledgments

The author would like to thank Isabel Deutsch, Hope for Wildlife, Shades of Hope, MARS Wildlife Rescue, the National Wildlife Center, and all of the volunteers who help sick, injured, and orphaned wildlife every day.

Disclosure statement

No potential competing interest was reported by the author.

Funding

This work did not require funding.

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