THE REHABILITATION OF BLACK BEARS (*URSUS AMERICANUS*) IN NORTH AMERICA: A SURVEY OF CURRENT PRACTICES

by

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Abstract

Throughout the year, black bear (*Ursus americanus*) cubs are orphaned, abandoned, or permanently separated from their mothers due to natural or human causes. Although cubs have been the focus of limited rehabilitation efforts in North America for more than 30 years, information on bear rehabilitation remains sparse. Furthermore, a lack of agreement exists regarding the suitability of bears as rehabilitation candidates. There is concern that exposure to humans during the rehabilitation process may increase the likelihood of bears becoming nuisances upon release. Yet previous research suggests that their genetic predisposition to emigrate and lead relatively solitary lives may limit the effects of any habituation to humans that takes place during care. Clearly, given the lack of research as well as the controversy, there is a need to determine whether rehabilitation is a viable option for black bears in North America. Accordingly, a survey was sent out to 39 wildlife rehabilitation centres (9 in Canada and 30 in the United States) to obtain detailed information on how cubs are raised and released. Findings from the multi-institution, multi-year study suggest that black bears are suitable rehabilitation candidates, as they can be raised and released using a variety of methods, while achieving high survival rates and weights compared to bears at a similar age in the wild. The results of this study provide vital information for wildlife rehabilitators and government, and may be useful for the development of future policies and standards for the rehabilitation of black bear cubs in North America. Furthermore, with a better understanding of the rehabilitation process, government wildlife agencies may be more open to supporting black bear rehabilitation in the future.

Preface

This study was approved by the University of British Columbia Behavioural Research Ethics Board (BREB). The number of the ethics certificate awarded for the research was H08-00385, under the project title, "The Rehabilitation of Black Bears in North America."

Under the supervision of Drs. David Fraser and Marina von Keyserlingk, Meghann Cant developed and administered the survey, analyzed the data, and wrote the manuscript. Drs. John Beecham and Daniel Weary were also instrumental in providing feedback on the survey and manuscript.

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Chapter 1: Introduction

Historically, North Americans viewed wild animals as sources of pelts and food, dangerous predators, or pests (Lindsey and Adams 2006). Since the early 1970s, however, public interest in wildlife has intensified (Curtis et al. 1997). Today, North Americans are more likely to value wild animals in the same way they value companion animals and people. They are less likely to be involved in traditional consumptive activities like hunting, trapping, and fishing (Lindsey and Adams 2006). Instead, they are increasingly concerned about how wildlife is treated (Bath 1998) and, as a result, are more likely to respond with sympathy and a desire to "do something" when they come across an orphaned or injured wild animal (Lindsey and Adams 2006). Thus, popular support for the rescue and treatment of wildlife has grown (Kirkwood and Sainsbury 1996).

Not surprisingly, the field of wildlife rehabilitation has developed concomitantly with the growing public interest in wildlife. Wildlife rehabilitators seek to temporarily care for and treat injured, diseased, orphaned, and displaced wildlife with the goal of returning healthy animals to their natural habitats (Miller 2000; NWRA 2013). The field began to experience rapid growth in the early 1970s, as oil spills triggered large-scale attempts to save thousands of oiled aquatic birds (Miller 2000). For the most part, these efforts were characterized by makeshift facilities, limited funds, volunteer assistance, and no government support, and were carried out by compassionate, well-meaning, but often inadequately trained individuals (Miller 2000; Lindsey and Adams 2006).

Since then, wildlife rehabilitation has become increasingly established as a profession. Although donor dollars and volunteer labour remain fundamental to the field, paid positions are now more common, as are specialized wildlife care facilities (Miller 2000; Lindsey and Adams 2006; NWRA 2009). Most rehabilitators hold college degrees, and many have backgrounds in animal health care as veterinarians, veterinary students, or veterinary technicians (NWRA 2009). In North America, rehabilitators can join a national organization,

the National Wildlife Rehabilitators Association (NWRA), in addition to provincial and state rehabilitation networks. On a global level, rehabilitators are represented by the International Wildlife Rehabilitation Council (IWRC). Minimum care standards for the field have been developed, as have opportunities for continuing education via conferences, seminars, courses, and workshops (Miller 2000; Dubois 2003). Wildlife rehabilitation is now recognized not only for helping to satisfy public demand for assistance for wildlife in need, but for providing public education on the challenges facing wild animals and their natural habitats (Dubois 2003; Lindsey and Adams 2006). In addition, wildlife cases handled by rehabilitators can act as indicators of environmental health, serve as resources for scientific research on human impacts on wildlife, and provide insight into caring for threatened and endangered species (Fraser and Moss 1985; Dubois 2003).

As a blend of veterinary medicine, natural history, and animal behaviour (Dubois 2003), wildlife rehabilitation is challenging work. Rehabilitators must admit, stabilize, examine, treat, and evaluate animals for release, while operating under a scarcity of data on husbandry, nutrition and restraint techniques, disease susceptibility, biomedical parameters, and specific medical and surgical techniques (Kirkwood and Sainsbury 1996; Miller 2000). However, the field has also experienced rapid changes in information and techniques (Miller 2000). Today, many species are commonly cared for in captivity and released with success (Kirkwood and Sainsbury 1996): squirrels, raccoons, deer, owls, ducks, and finches, to name just a few examples (Gage 2002; Gage and Duerr 2007).

Though not seen as commonly as many of the species listed above, black bears (*Ursus americanus*) have nonetheless been the focus of limited rehabilitation efforts in North America for more than 30 years (Beecham 2006). Like any wild animal, caring for cubs in captivity requires an extensive knowledge of natural history and behaviour (NWRA 2013). Decisions on what to feed and how to house cubs at each stage of development are based on what is understood about black bears in the wild (Miller 2000); some of this information is outlined below.

1.1 Population status and distribution

North America is currently home to an estimated 850,000 to 950,000 black bears, a population more than twice that of all other species of bears combined (Garshelis et al. 2008). Although human settlement and development have diminished and fragmented black bear habitat across the continent, they are still found throughout much of the less settled, forested regions of Canada, the United States, and northern Mexico (Pelton 1982; Larivière 2001; Hristienko and McDonald Jr. 2007). In fact, except in a few isolated places, black bear populations are expanding both numerically and geographically; thus, they have been designated a species of least concern by the International Union for Conservation of Nature (Garshelis et al. 2008).

1.2 Natural history

1.2.1 Description

Black bears are large, heavily built carnivores with small eyes, small, rounded, erect ears, short tails, plantigrade feet, and short, curved, non-retractable claws (Pelton 1982; Larivière 2001). They are sexually dimorphic, with adult males usually weighing between 60 and 300 kilograms and measuring from 130 to 190 centimetres in length; adult females are typically a third smaller (Taylor 2006). Although black bears become sexually mature between 4 and 5 years of age, they do not reach their full height and length until they are about 7 or 8 years old (Davis et al. 2002; Kolenosky 2008). Black bears can be black, white, blue, blond, or brown (Larivière 2001; Taylor 2006). The black colour phase tends to be more prevalent in the east, while, in the west, the brown colour phase is more common. The white and blue colour phases are unique to the Pacific Northwest (Pelton 1982).

1.2.2 Reproduction

For the most part, black bears are solitary (Pelton 1982). Exceptions include mothers with cubs, young siblings, and males and females during mating season (Taylor 2006). Black bears typically mate between May and July (Garshelis et al. 2008). The resulting embryo, however, does not implant until the female is hibernating, usually in November or December (Larivière 2001). For a successful pregnancy to occur, the female must be in adequate body condition. She must have the fat reserves necessary to sustain herself and her cubs through the winter; otherwise, implantation will simply not take place (Davis et al. 2002). Generally speaking, gestation is considered likely to continue in females entering the den weighing at least 70 kilograms (Kolenosky 2008).

Adult female black bears breed every other year, usually producing from one to four cubs per litter (Pelton 1982; Larivière 2001). Average litter sizes in western North America tend to be smaller than those in eastern North America (Garshelis et al. 2008). When food is scarce, females have successful litters every 3 or 4 years; this is considered a very low reproductive rate (Davis et al. 2002; Garshelis et al. 2008). Cubs are born in January or February, while their mother hibernates (Pelton 1982). Mothers nurse their young into the summer and sometimes again the following spring (Ternent and Garshelis 1998). Female black bears are considered attentive mothers and will immediately tree their cubs to protect them from predators (Herrero 1972). Males, in contrast, are not involved in raising their young in any way. In fact, they have been known to kill and even cannibalize unfamiliar cubs. Without a nursing stimulus, the mother may come into estrus and mate with the infanticidal male (LeCount 1987).

1.2.3 Dispersal, home range, and habitat use

Cubs stay with their mother for approximately 17 months, at which age male offspring typically disperse and establish new territories. Female offspring, on the other hand, are

tolerated within or adjacent to their mother's territory (Rogers 1985). Dispersal distances can range from 13 to 219 kilometres (Larivière 2001). Adult male black bears have the largest home ranges, usually containing part or all of a number of adult female home ranges (Alt et al. 1980). Adult female home ranges are smaller and better defined (Davis et al. 2002). Generally speaking, however, poorer quality habitats lead to larger home ranges for both sexes (Larivière 2001).

Within their home ranges, black bears display seasonal variation in habitat use (Davis et al. 2002). Habitat use is affected by the distribution, availability, and abundance of their preferred foods, as well as by the amount of existing security cover (Alt et al. 1980). Habitats used by black bears are as varied as the foods they eat. Travelling customary routes, they can be found within forests, wetlands, subalpine meadows, avalanche chutes, swamps, and riparian areas, as well as on beaches and tundra (Garshelis et al. 2008; Kolenosky 2008).

1.2.4 Diet

Black bears are classified as carnivores, though in reality they are opportunistic omnivores (Garshelis et al. 2008). They feed on insects, grasses, berries, nuts, buds, and roots, as well as the leaves and stems of herbaceous plants (Pelton 1982; Garshelis et al. 2008). When available, however, black bears prefer richer, fattier foods like fish or deer, and will eat both their own kills and carrion (Bacon and Burghardt 1983; Davis et al. 2002; Garshelis et al. 2008). They have the ability to switch from food to food depending on its relative digestibility, distribution, and abundance (Davis et al. 2002).

1.2.5 Hibernation

In the late summer and early fall, black bears begin preparing for hibernation (Pelton 1982). They gorge themselves on food in order to fatten up during a period known as hyperphagia

(Davis et al. 2002). During this period, they consume three times as much food in a day as they do in the spring and early summer (Taylor 2006). They feed for as long as twenty hours a day, taking in from 15,000 to 20,000 kilocalories; in comparison, their normal daily caloric intake is around 8,000 kilocalories (Nelson et al. 1983). Hyperphagic bears are attracted to foods that are rich in nutrients and easy to digest and absorb (Davis et al. 2002). Such intense foraging often necessitates long-distance movements from their regular range (Pelton 1982; Larivière 2001).

By winter, black bears have gained up to a third of their normal body weight (Taylor 2006). Once hyperphagia ends, bears become increasingly lethargic as the denning period approaches (Beecham et al. 1983). Resting for 22 or more hours a day, they eat very little. Their metabolism begins to slow down and blood flow to their limbs gradually decreases (NABC 2013). Soon after, they enter their dens to hibernate (Taylor 2006). Winter dens may be cavities in trees or rocks, brush piles, root excavations, underground burrows, or open-ground beds. Dens are usually lined with vegetation, with entrances completely or partially plugged (Larivière 2001). Black bears tend to den for shorter periods in southern latitudes, entering later and emerging earlier than in northern latitudes (Johnson and Pelton 1980; Larivière 2001). Also, in southern areas, bears may use ground beds more than underground burrows or cavities (Larivière 2001). Pregnant females den first, followed by older females with cubs, solitary females, subadults, and, finally, adult males (Pelton 1982). During hibernation, bears lose weight, but use up little of their bone or muscle mass. They burn mainly fat as they sleep (Lohuis et al. 2005). They do not urinate or defecate or get up to eat and drink as other hibernators do, but they can be roused from hibernation at any point (Pelton 1982). In the spring, den emergence usually occurs in the reverse order, with adult males appearing first and mothers with cubs emerging last in April or May (Taylor 2006).

1.2.6 Longevity

Although black bears have been known to survive up to 35 years in the wild, few individuals ever reach 10 years of age (Pelton 1982; Garshelis 2004). Females tend to be longer lived than males, as they have smaller home ranges, more restricted movements, and display less aggressive behaviour. In a healthy population, the average age of males ranges from 3 to 5 years, while females average 5 to 8 years of age (Pelton 1982).

1.2.7 Learning and development

Black bears do not rely much on their sense of sight, but have very keen senses of smell and hearing (Kolenosky 2008). They are remarkably intelligent animals; they are able to learn quickly and have excellent memories (NABC 2013). As cubs, they likely learn about predators, dietary choices, and foraging sites from their mother, while some behaviours, such as den construction, appear to be innate (Rogers 1985; Mazur and Seher 2008). Throughout their lives, black bears remain curious and exploratory, willing to learn through trial and error (Bacon 1980). This natural combination of intelligence and curiosity enables them to exploit many food sources across a variety of habitats (Peine 2001). They are considered a highly adaptable species, not only to changing environments, but to the presence of humans within their range (Pelton 1982).

1.3 Objectives

As demonstrated above, research on black bears in the wild is widely available. In contrast, information on bear rehabilitation remains sparse, despite three decades of history. The seminal document on the subject, *Orphan Bear Cubs: Rehabilitation and Release Guidelines* (2006), outlines how bear species around the world are raised and released, and makes a number of recommendations regarding housing, minimizing habitation, and releases. However, the report was produced for a professional and public audience; as such, the work

has not been made available to the scientific community in a peer-reviewed journal. Furthermore, there is a lack of agreement regarding the suitability of bears as rehabilitation candidates (OBCRC 2000). In caring for black bears, rehabilitators encounter specific challenges. As large, potentially dangerous predators, black bears represent a threat to human safety, a risk posed by few other wildlife species in North America (OBCRC 2000; Hristienko and McDonald Jr. 2007). Consequently, government wildlife agencies have historically been cautious in allowing for the rehabilitation of cubs. Not only may bears present a danger to rehabilitators during care, there is concern that exposure to humans during the rehabilitation process may increase the likelihood of bears becoming nuisances upon release (NWRA 2013; OBCRC 2000). Normally, black bears retreat when they encounter people. However, repeated exposure to people without any negative experiences teaches bears that humans are not a threat and, eventually, they come to accept their presence; this process is known as habituation (GBSS 2007). Habituated bears are less likely to flee from humans. It is this type of behaviour that may increase the risk of injury to humans from bears (Davis et al. 2002). On the other hand, it has been argued that, as black bears naturally disperse and lead relatively solitary lives, the effects of any habituation to humans that takes place during care are limited (Beecham 2006). Clearly, given the lack of research as well as the controversy, there is a need to determine whether rehabilitation is a viable option for black bears in North America. Therefore, this study set out to gather information on the rehabilitation process, as well as weights and survival rates of cubs in care in order to make a recommendation regarding the suitability of black bears as rehabilitation candidates.

Chapter 2: A survey of black bear rehabilitators in Canada and the United States

2.1 Introduction

Throughout the year, black bear cubs are orphaned, abandoned, or permanently separated from their mothers due to natural or human causes. In the winter, mothers may abandon their cubs when recreational activities such as skiing and snowmobiling disturb the den. Winter dens may also be destroyed by logging, mining, or other industrial activities, forcing mothers to leave their cubs. Even researchers may disrupt denning families when they approach to take measurements and collar bears for tracking purposes (Linnell et al. 2000). In the late spring and early summer, cubs may be captured by well-meaning people who mistakenly believe them to be abandoned. Cubs routinely climb trees to escape danger, and their mothers, sensing the danger themselves, often leave the area rather than stay behind to defend them. People then "rescue" the cubs, permanently separating the family (Rogers 1985). Summer abandonment may occur when food crops fail, placing female bears under nutritional stress and causing them to reject their young (IDFG 2009; Bartareau et al. 2012). Wildfires also separate mothers from their cubs during the summer (IDFG 2009). Furthermore, cubs may be orphaned at any time when their mothers die from natural causes, are involved in vehicle collisions, killed by hunters or poachers, or shot in human-bear conflict situations (Clark et al. 2002; IDFG 2009).

When faced with an orphaned black bear cub, government wildlife agencies typically have a number of options: (1) humanely euthanize the cub, (2) allow a zoo or similar facility to adopt the bear, (3) introduce the cub to a wild foster mother, (4) leave the bear in the wild, or (5) place the cub in a licensed rehabilitation facility to be reared and re-released into the wild (Rogers 1985; Beecham 2006). Deciding the fate of the orphaned cub is no easy task. Government wildlife agents have many factors – and competing interests – to consider (Beecham 2006).

Generally speaking, euthanasia is not a popular alternative (OBCRC 2000). Government wildlife agencies have frequently been criticized for destroying orphaned cubs when other, more publically acceptable choices were available (Wasserman and Clumpner 1995; Beecham 2006). Zoos are subject to negative public perception as well (Lawrence and Terlouw 1993; Reade and Waran 1996). Black bears are long-lived animals and require large, stimulating captive environments that are difficult to provide (Manville 1990; Beecham 2006). In captivity, they are particularly susceptible to developing pacing stereotypies, possibly because they have complex feeding behaviours and large home ranges in the wild (Vickery and Mason 2003). Furthermore, zoos have limited space in their bear exhibits and, since the black bear population in North America is relatively stable, what little space is available is often devoted to other bear species believed to be in need of captive breeding and conservation (AZA Bear TAG 2008).

Although preferable to captive rearing, fostering orphaned black bear cubs in the wild is not always feasible (Wasserman and Clumpner 1995). The ability to use a wild foster mother depends on factors such as the time of year and the abundance of natural foods (Alt and Beecham 1984). Cub adoption becomes increasingly difficult outside the denning period and in poorer quality habitats (Manville 1990). Moreover, though a mother bear may well provide her young with food and protection from predators, cubs over 5 months of age are considered capable of surviving on their own (Erickson 1959; Alt and Beecham 1984). Although government wildlife agents can choose to leave orphaned cubs in the wild to fend for themselves (Rogers 1985), it is likely that older, larger cubs have better survival chances, as they become less vulnerable to predation with time. Thus, raising orphaned cubs in a rehabilitation facility allows them to grow and mature in a safe setting until they are ready to be released (Beecham 2006).

Many government wildlife agencies doubt the success of returning rehabilitated black bears to the wild. Having been raised by people, they are often regarded as potential threats or nuisances to humans upon release (OBCRC 2000). On the other hand, some evidence

indicates that orphaned cubs can be successfully rehabilitated and released without endangering human health or safety. In a study by Alt and Beecham (1984), 15 bears (out of 39) survived to 30 days post-release, at which time they were recovered in non-nuisance situations and found to be in good condition. Using the same criteria, Wasserman and Clumpner (1995) reported 5 successful releases out of a total of 9 and Clark et al. (2002) achieved success in 10 out of 11 cases. Thus, Beecham (2006) concludes that, firstly, survival rates for rehabilitated cubs are similar to those for wild cubs and, secondly, less than 2% of rehabilitated cubs become nuisances within 1 year of their release.

Given the dearth of scientific evidence, it is not surprising that no consensus has emerged on how black bears should be rehabilitated or whether they should be rehabilitated at all (Kolter and van Dijk 2005). Earlier work suggests that the centres attempting to raise orphaned cubs use a variety of different methods (Beecham 2006). Clearly, there is a need to determine whether rehabilitation is a viable option for black bears in North America.

Since no single wildlife rehabilitation facility in Canada or the United States admits enough bears to conduct a controlled experiment with adequate sample size, we carried out a multi-institution, multi-year study of all the centres that deal with black bears in North America. Multi-institution studies are recognized by zoo biologists and others as a way to achieve meaningful multivariate studies on animals that are kept in small numbers at different locations, and to improve the external validity of research (see Swaisgood and Shepherdson 2005). Accordingly, the objectives of this study were to: (1) describe in detail the rehabilitation process from intake to release, (2) determine weight gains and survival rates of cubs in care for comparison to wild cubs, (3) make a recommendation regarding the suitability of black bears as rehabilitation candidates, and (4) identify gaps where further scientific study is warranted.

2.2 Materials and methods

A survey was carried out to glean detailed information from black bear rehabilitators on how cubs are raised and released. The questionnaire was developed based on personal experience rehabilitating bear cubs, and in consultation with Dr. John Beecham, a bear biologist and rehabilitation expert. Three years prior to this study, Dr. Beecham produced a landmark document, *Orphan Bear Cubs: Rehabilitation and Release Guidelines* (2006), which represents the first comprehensive attempt at outlining the rehabilitation process. His research provided the framework for the survey.

2.2.1 Survey design

The questionnaire (Appendix 1) consisted of nine sections: demographics (9 questions); feeding (26 questions); housing (30 questions); health and sanitation (14 questions); handling and human exposure (15 questions); hibernation (5 questions); releases (16 questions); funding and expenses (3 questions); and government relations (2 questions). Questions were posed in open and closed formats, allowing participants to provide estimates and descriptions, as well as yes/no and multiple choice responses. The survey was 15 pages.

Accompanying the questionnaire was a consent form (Appendix 1), explaining the purpose of the study and advising respondents about the risks of participating. We specified that all participants would have access to the results at the end of the study. We welcomed any questions and acknowledged the value of their contribution. The consent form and survey were approved by the University of British Columbia Behavioural Research Ethics Board (BREB).

2.2.1.1 Demographics

Demographic questions focused on centre location and participant experience in rehabilitating bears and other wildlife. Participants were also asked to provide total animal and total bear intakes for the years 2004 through 2008.

2.2.1.2 Feeding

Feeding was divided into four stages: infancy (i.e. when cubs are only receiving milk), pre-weaning (i.e. when cubs are drinking milk and starting to eat some solids), weaning (i.e. when cubs are eating mostly solids and starting to drink less milk), and post-weaning (i.e. when cubs are no longer receiving any milk). Participants were asked how often per day and how much per feeding bears were fed at each stage. We also requested descriptions of formulas and lists of foods given to bears.

2.2.1.3 Housing

Housing was separated into two stages: up to weaning and after weaning. Questions centred on group sizes, numbers and sizes of cages, cage materials, and cage furnishings. Participants were asked to describe pacing and other unusual behaviours observed in bears, as well as provide daily time estimates for these behaviours.

2.2.1.4 Health and sanitation

Questions about health and sanitation focused on veterinarian involvement, quarantine periods, fecal and blood testing, treatment of internal and external parasites, and cleaning procedures.

2.2.1.5 Handling and human exposure

In an attempt to quantify bears' exposure to people, we asked participants to estimate how much time was spent with and around cubs at each feeding stage. Questions regarding numbers of caretakers, limiting contact, and restricting public access were also posed.

2.2.1.6 Hibernation

Participants were asked to report on methods used to prepare bears for hibernation, as well as criteria used to determine whether bears were ready for hibernation. A question on length of hibernation was also included.

2.2.1.7 Releases

Release questions focused on government involvement, as well as identification and monitoring methods. We also asked participants to elaborate on release site criteria and criteria used to determine bears' readiness for release.

2.2.1.8 Funding and expenses

Participants were asked to describe funding sources, estimate the cost of raising a bear, and rank categories of bear-related expenses from most to least costly.

2.2.1.9 Government relations

As a measure of the closeness of the relationship between rehabilitator and government, we asked questions regarding the frequency of contact with and visits from government wildlife agents.

2.2.2 Bear data

In order to solicit data on individual bears at rehabilitation facilities, participants who returned the survey were asked whether they could provide data sets on bears admitted between 2004 and 2008. Specific information requested included sex, age at admission, initial weight, final disposition, number of days in care, and final weight. If they were unable to provide the data, participants were asked instead to estimate the survival rate of bears while in care, from intake to release, for the same time period.

2.2.3 Pre-testing the survey

The questionnaire was beta-tested by four black bear rehabilitators known to the graduate student undertaking the research. They provided critical feedback on the difficulty, completeness, and clarity of the questions, and gave valuable insight into how the survey was understood by people working in the field. The feedback was received and the survey was amended accordingly.

2.2.4 Participant recruitment and selection

Survey participants were identified in several ways. Most were listed in *Orphan Bear Cubs: Rehabilitation and Release Guidelines* (2006); a few were found in the membership directories of the National Wildlife Rehabilitators Association (NWRA) and the International Wildlife Rehabilitation Council (IWRC). From the latter two documents, members were selected based on declaring “bears” or “black bears” as their rehabilitation specialty. Some participants were already known to the graduate student, while others were referred by fellow rehabilitators or government wildlife agents. All participants were directors or managers (and in some cases, founders) of their respective centres. Email addresses, telephone numbers, and mailing addresses were collected.

A total of 39 black bear rehabilitators representing 39 wildlife rehabilitation centres (9 in Canada and 30 in the United States) were invited to participate. The survey was sent electronically in January 2009. Email reminders were sent every 2 to 3 weeks, up to six times. If, after six attempts, the survey had not been returned, rehabilitators were contacted by telephone to determine their willingness to participate. On occasion, participants requested a hard copy of the survey instead, so it was sent by mail with a postage-paid, self-addressed return envelope. When surveys were returned, participants were thanked and, if required, asked to clarify specific responses. Surveys were returned between January 2009 and April 2010.

2.2.5 Data analysis

Quantitative data were analyzed using descriptive statistics and are presented, where applicable, as means, medians, or frequencies. Open-ended questions yielded qualitative data, which were analyzed using an inductive approach described by Babbie (2010). Responses were read repeatedly to identify concepts important to participants. Based on this close examination of the data, multiple codes were developed for each question. Codes were then refined by combining them where appropriate (for example, when describing release sites, factors such as “good food availability” and “available den sites” were considered two facets of the same concept, “habitat suitability”). Thus, with the codes simplified, the concepts became richer due to a greater depth of meaning. The author used previous bear rehabilitation experience, as well as *Orphan Bear Cubs: Rehabilitation and Release Guidelines* (2006) to inform the coding process. Coded concepts are presented as frequencies. All data were analyzed using SPSS 16.0.1 for Windows (SPSS Inc. 2007).

Sample size differed for most questions, as not every respondent answered each question. Also, as participants were able to select more than one answer as well as provide detailed answers, frequencies often exceeded sample size. Each centre was represented by a single participant, so the terms “centre” and “participant” are used interchangeably.

As one of our objectives was to determine survival rates and weights of cubs in care, we made every attempt to obtain full data sets on bears admitted between 2004 and 2008 at each facility. Our efforts resulted in complete data from two centres, partial data from seven centres, and estimates of survival from nine centres.

2.3 Results and discussion

From a total of 39 questionnaires sent out, 24 (7/9 in Canada and 17/30 in the United States) were completed for a return rate of 62%. Of the surveys not returned, two centres reported no longer being in operation, one was no longer permitted for bears, and one kept bears as permanent residents only. Adjusted return rate was therefore 69%. In comparison, the questionnaire that informed *Orphan Bear Cubs: Rehabilitation and Release Guidelines* (2006) had a 58% response rate. Few mail surveys ever achieve a response rate close to 70% (Babbie 2010).

2.3.1 Demographics

2.3.1.1 Location

The wildlife rehabilitation centres responding to the survey were located throughout Canada and the United States in both remote and populous areas (Appendix 2). Given that bears pose a potential threat – real and perceived – to human safety (Gore et al. 2006; Hristienko and McDonald Jr. 2007), centres in urban and suburban areas may need to pay greater attention to security, as escaped bears would be more of a concern to the public (Beecham 2006). However, urban and suburban centres may benefit from closer access to a large donor base (CPIU 2010). Presumably, location can place constraints on centres, as well as confer advantages.

2.3.1.2 Rehabilitation experience

Notably, the rehabilitators responding to the survey had higher-than-average experience with wildlife: 20.5 years (SD = 7.6, n = 24) compared to 13.3 years reported in a recent survey of 1,610 wildlife rehabilitators across North America (NWRA 2009). Eight participants had been rehabilitating bears for as long as they had been involved in wildlife rehabilitation (Appendix 2). Bear rehabilitation experience for the group, however, was lower by an average of 6.2 years ($\bar{x}$ = 14.3 years, SD = 6.8, n = 24). This difference was not unexpected, as black bears are considered a specialized species and government wildlife agencies may require past experience in wildlife rehabilitation before issuing a permit for bears (OBCRC 2000).

2.3.1.3 Intake

While a few centres specialized in bears, most (21/24) accepted a variety of species. Average annual intakes from 2004 to 2008 are shown in Appendix 2. Overall, average animal intake across all centres was 442 animals per year (SD = 792, n = 15), ranging from a minimum of 0 to a maximum of 4,584. Interestingly, when considering all species, Centre 23 consistently had the highest intake, which was at least 2.5 times that of the centre with the second highest intake.

Average bear intake overall was 7 bears per year (SD = 7, n = 20) with a minimum of 0 and a maximum of 53; no particular centre had the highest intake across years. For centres admitting multiple species, on average, bears represented less than 15% of total intake over the 5-year period ($\bar{x}$ = 12.4%, SD = 18.0, n = 12). The fact that centres are not normally overwhelmed with cubs from year to year is not surprising. Black bears are predominantly forest-dwellers and, while they may inhabit areas adjacent to towns and cities, they do not live in close association with people the way urban wildlife does (Davis et al. 2002; Burton and Doblar 2004). Therefore, the frequency with which they are found by the public is

normally much less than with animals such as raccoons and squirrels. Also, as government wildlife agencies are often responsible for fielding calls about cubs from the public, they may ultimately make the determination as to whether a cub is sent to rehabilitation (OBCRC 2000; IDFG 2009; CDFW 2012). Thus, not every cub that is found is deemed a rehabilitation candidate.

2.3.2 Feeding

As omnivores, black bears are morphologically, physiologically, and behaviourally adapted to a diet consisting of a wide range of foods that vary by season and in spatial distribution (Bourne and Vila-Garcia 2007). To formulate a suitable diet for cubs in care, rehabilitators should consider not only what foods to feed, but when and how to present them (MacLeod and Perlman 2004; Bourne and Vila-Garcia 2007). Thus, rehabilitators are challenged with finding the most appropriate substitutes, particularly during infancy.

2.3.2.1 Infancy

Bear milk is high in fat and low in carbohydrates, particularly lactose (Oftedal et al. 1993). The formulas used by participants in this study are shown in Figure 2.1. Most participants (12/20) used a single formula. Eight participants, however, combined a puppy milk replacer (Esbilac®, PetAg Inc., Hampshire, IL) and a multi-species milk replacer (Multi-Milk® or Zoologic™ Milk Matrix 30/55, PetAg Inc., Hampshire, IL), typically in a 1:3 ratio. Multi-species milk replacers are low in lactose, and have been recommended as a means of increasing fat and decreasing sugar levels in a mixed formula (MacLeod and Perlman 2004). Though participants did not indicate having problems with their respective formulas, further research is needed to determine how closely any of the formulas used at centres, mixed or otherwise, approximate bear milk.

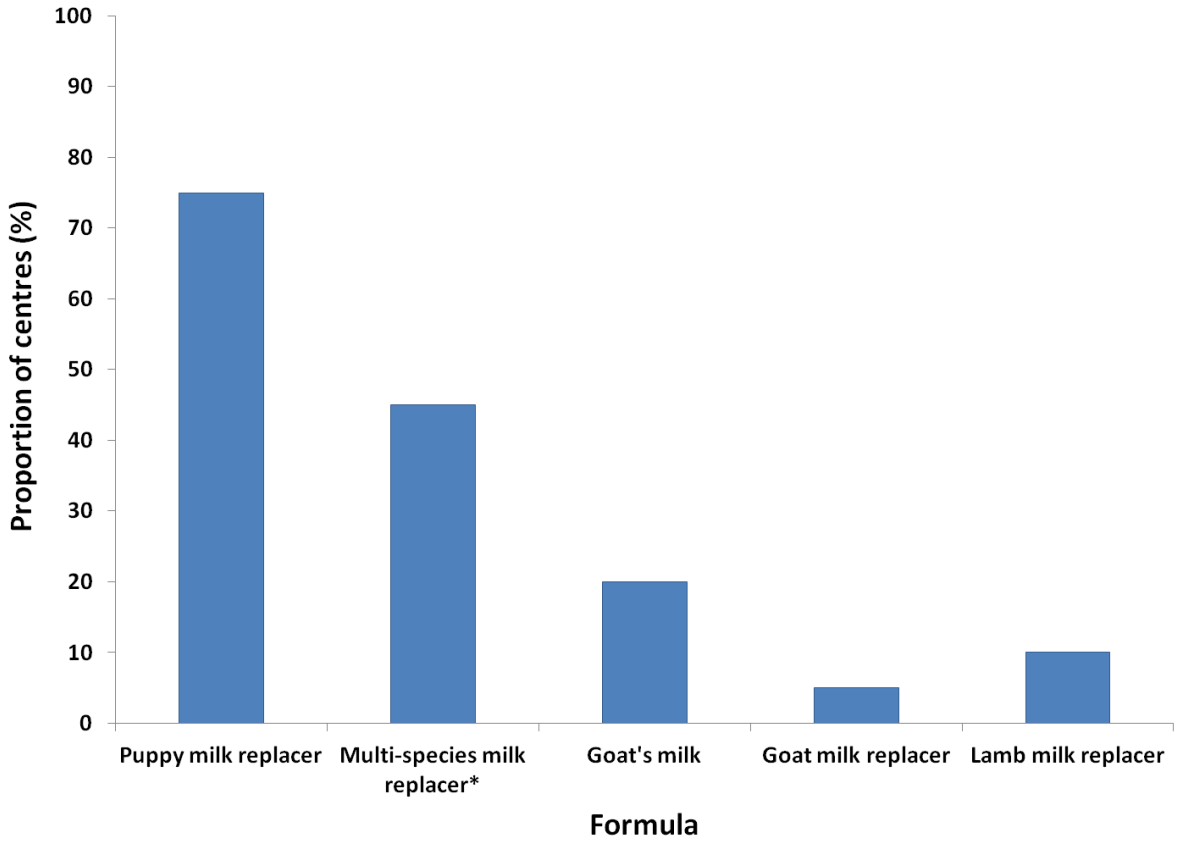

Figure 2.1. Milk formulas used at 20 wildlife rehabilitation centres located throughout North America that participated in a 2009 survey on black bear rehabilitation.
*Multi-species milk replacers are intended for wild and exotic non-domestic animals, and can be used alone or in combination with other formulas to simulate the nutritional content of a mammal's milk.

Tremendous variation was also noted in how participants reconstituted the formulas fed to cubs. For instance, not all participants made formulas to the same concentration. Four mentioned mixing formula in a 1:2 ratio with water, while one began at a ratio of 1:4 and gradually increased to a 1:1 ratio. Additions were also made by some participants to formulas in the form of nutritional supplements such as vitamins (4/20); digestive aids such as yogurt and powdered *Lactobacillus acidophilus* (3/20); thickeners such as baby rice cereal (5/20); and flavour enhancers such as honey, strained fruit baby food, and applesauce (6/20). One participant also reported adding whole cow's milk for underweight cubs. Caution should be exercised when using cow's milk, however, as it has been known to cause the formation of lactobezoars in bears (Loeffler 2007).

Participants were also divided on how to report the amounts of formula fed to cubs, with 7/13 reporting by volume and 6/13 reporting by percent of body weight (Table 2.1). The average volume consumed by infant bears was similar to volumes recorded for cubs raised in zoos (Butterworth 1969; Hulley 1976), whereas the average percent of body weight was lower than the 15 to 25% range recommended in the literature (Beecham 2006). The reason for this difference is unclear. Again, the tremendous variation observed across centres in the type of milk replacers, concentrations, and amounts indicates the need for controlled studies to determine what type of formula (and associated concentration fed) best simulates the sow's milk.

Little peer-reviewed literature is available on how best to provide milk to cubs, though recommendations have been published in *Orphan Bear Cubs: Rehabilitation and Release Guidelines* (2006). Infant bears require frequent feedings, as often as every 2 to 3 hours when they are very young. Then, when they have reached 30 days of age, they can be transitioned to only 5 to 7 feedings a day (Beecham 2006). With close to an average of 7 feedings per day, participants fed infant bears in accordance with these guidelines (Table 2.1).

Feeding methods also varied considerably from centre to centre, with 6/19 participants using only bottles and 2/19 participants using only dishes. Of interest was the fact that the majority of participants (11/19) used both, typically transitioning from bottles to dishes as soon as cubs were able to lap the milk. Four participants mentioned that using dishes enabled them to lessen contact with cubs. Wasserman and Clumpner (1995) describe how cubs as young as 8 weeks of age can be made to self-feed by holding the dish of formula in front of them and pushing their muzzles into it, if necessary. However, bottle feeding may allow closer monitoring of intake, as unsecured dishes can be tipped and formula spilled, making it more difficult to gauge how much cubs are taking in (Burghardt and Burghardt 1972; Maughan 2010).

Table 2.1. Feeding frequencies and amounts for cubs at different feeding stages at 24 wildlife rehabilitation centres located throughout North America that participated in a 2009 survey on black bear rehabilitation.

	Infancy	Pre-weaning	Weaning	Post-weaning
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Solid foods				
Number of feedings per day[1]	N/A	2.7 ± 0.9	2.2 ± 0.5	1.9 ± 0.7
Volume/weight given per feed[2]	N/A	0.8 cups ± 0.3	4.2 cups ± 1.3	3.1 kg ± 1.5
Formula				
Number of feedings per day[3]	6.6 ± 2.8	4.1 ± 1.4	1.9 ± 0.9	N/A
Volume given per feed[4]	217.6 mL ± 142.0	493.6 mL ± 273.1	807.1 mL ± 531.0	N/A
OR				
Percent of body weight given per feed[5]	9.7% ± 7.7	11.3% ± 10.6	10.8% ± 7.1	N/A

[1] n = 13 for pre-weaning, 15 for weaning, and 19 for post-weaning.
[2] n = 3 for pre-weaning, 3 for weaning, and 5 for post-weaning.
[3] n = 19 for infancy, 18 for pre-weaning, and 18 for weaning.
[4] n = 7 for infancy, 8 for pre-weaning, and 7 for weaning.
[5] n = 6 for infancy, 5 for pre-weaning, and 4 for weaning.

One participant observed that dish-fed cubs occasionally attempted to suck on caretakers' chins and fingers. Maughan (2010) reports that bottle-feeding satisfies the need to suckle and prevents cubs from nursing on paws or siblings; however, Burghardt and Burghardt (1972) report that bottle-fed bears also perform non-nutritive sucking. Non-nutritive sucking occurs in a wide range of mammals (de Passillé and Rushen 1997) and has been shown to increase during times of hunger in dairy calves (de Paula Vieira et al. 2008). Slowing the flow of milk to increase the duration of nursing may help reduce but not eliminate the behaviour (Haley et al. 1998), while providing sufficient quantities of milk has been shown to virtually eliminate non-nutritive visits to the nipple in dairy calves (de Paula Vieira et al. 2008). Further study would be required to elucidate whether infant black bears perform non-nutritive sucking out of hunger or as a result of being fed in an unnatural way, as has been found in other species (Wiepkema et al. 1987), and whether being denied the opportunity to nurse is a detriment to their welfare.

2.3.2.2 Pre-weaning

In the wild, cubs are about 3 to 4 months of age when they emerge from the den and begin eating solid foods (Pelton 1982; Elowe and Dodge 1989). Thus, it is not surprising that participants introduced solid foods when cubs were, on average, 3.4 months old (Table 2.2). Although it has been suggested that cubs start on solid foods at 9 weeks of age (Beecham 2006), only five participants introduced them this early. The foods fed to pre-weaned bears are shown in Table 2.3.

Table 2.2. Ages at which cubs are transitioned from formula to solid foods at 24 wildlife rehabilitation centres located throughout North America that participated in a 2009 survey on black bear rehabilitation.

	Responses	
	Mean ± SD	**Range**
Age when solid foods are introduced (n = 16)	3.4 months ± 1.0	8 weeks–5 months
Age when weaning begins (n = 17)	5.1 months ± 1.2	9 weeks–7 months
Age when weaning ends (n = 16)	6.0 months ± 1.4	11 weeks–8.5 months

Table 2.3. Comparison of pre-weaning, weaning, and post-weaning diets fed to cubs at 24 wildlife rehabilitation centres located throughout North America that participated in a 2009 survey on black bear rehabilitation.

	Number of centres							
Fruits and vegetables	Fruits	Vegetables	Baby foods					
Pre-weaning[1]	16	3	7					
Weaning[2]	22	12	2					
Post-weaning[3]	22	15	1					
Grain products	Rice	Oatmeal	Bread	Cereals	Baby cereals			
Pre-weaning[1]	1	5	2	2	8			
Weaning[2]	2	2	4	3	1			
Post-weaning[3]	1	1	3	2				
Milk and alternatives	Yogurt	Cottage cheese						
Pre-weaning[1]	5	2						
Weaning[2]	2	1						
Post-weaning[3]	1							
Meat and alternatives	Meat	Fish	Nuts	Seeds	Beans	Insects	Eggs	Peanut butter
Pre-weaning[1]	4	3	4			3	3	
Weaning[2]	4	8	6	1		5	6	1
Post-weaning[3]	10	12	11	2	2	6	5	1
Other	Dog food	Omnivore diet*	Bear diet**	Vegetation	Honey			
Pre-weaning[1]	9	2		9	1			
Weaning[2]	16	3		9	1			
Post-weaning[3]	17	4	1	13	2			

[1]n = 21; [2]n = 22; [3]n = 23 *Mazuri® Omnivore-Zoo Feed "A" (PMI Nutrition International, Brentwood, MO)

**Mazuri® Bear Diet (PMI Nutrition International, Brentwood, MO)

Given that teething in black bears begins around 40 days of age (Butterworth 1969), some participants emphasized introducing solid foods to cubs in the form of a mush. Others provided the food in small, cut-up chunks placed directly into dishes of formula. Similar strategies have been employed in zoo and research settings, where bears were started on chopped canned peaches, applesauce, and strained fruit baby foods or cottage cheese and raw eggs (Butterworth 1969; Burghardt and Burghardt 1972).

As solid foods were introduced, formula feedings decreased while formula amounts increased (Table 2.1). Milk intake is known to increase rapidly after den emergence in the wild (Farley and Robbins 1995). A similar trend was noted for pre-weaned bears in care: the average volume of formula consumed at each feed was more than double the average consumed during infancy. Beecham (2006) suggests that, after 90 days of age, formula feedings can be reduced to 10 to 20% of body weight. Average percent of body weight reported by participants was within this range (Table 2.1).

Solid foods were fed close to three times per day (Table 2.1), with most participants (10/13) reporting that cubs were fed as much as they were able to eat. A few participants (3/13) were able to provide estimates of volume of food consumed (Table 2.1).

Cubs continued to be fed with bottles (7/21) and dishes (21/21). A few participants (2/21) began to scatter food for cubs to find, a method commonly used in zoos as a means of encouraging natural foraging behaviour (Bourne and Vila-Garcia 2007).

2.3.2.3 Weaning

Cubs are approximately 6 to 7 months of age when milk intake in the wild peaks mid-summer before beginning to decline (Farley and Robbins 1995). Results of the survey, however, indicate that participants began to wean cubs when they were around 5 months old (Table 2.2). In addition to age, participants used the following criteria to determine

when weaning should take place: weight (4/19), body condition (4/19), health status (1/19), behavioural readiness (16/19), and time of year (1/19). The main behavioural indicator was an increased interest in solid foods, typically indicated by cubs mouthing and playing with foods initially, followed eventually by actual consumption. The sole participant reporting time of year as a factor mentioned that cubs were not ready to wean before "green up" – when buds appeared on the trees and grass began to grow at the centre.

In the wild, bears are weaned gradually, and have even been observed to suckle as yearlings (Ternent and Garshelis 1998). All centres (21/21) appeared to consider what occurs in nature, as all cubs were weaned gradually rather than abruptly. The weaning period took, on average, 1.0 month (SD = 0.6, n = 15), ranging from a minimum of 1.5 weeks to a maximum of 2.5 months. One participant noted that dish-fed cubs remained interested in formula past the time when bottle-fed cubs had weaned themselves.

Compared to pre-weaning bears, weaning bears were fed fewer grain and milk products and more foods from the fruits and vegetables, meat and alternatives, and other categories (Table 2.3).

With weaning underway, formula feedings continued to decrease as formula amounts increased (Table 2.1). In the wild, milk intake peaks at levels approximately four times higher than those occurring in the den (Farley and Robbins 1995). Again, this change in milk intake was, for the most part, emulated by cubs in care: average volume of formula consumed at each feed during weaning was 3.7 times more than was consumed during infancy. Average percent of body weight reported by participants was still within the range of 10 to 20% recommended by Beecham (2006) (Table 2.1). Similarly, solid foods were fed less often but in greater amounts (Table 2.1). Most participants (13/16) fed cubs as much as they were able to eat, while a few (3/16) were able to provide estimates of volume of food consumed (Table 2.1).

Food was presented to weaning bears in a variety of ways, including bottles (1/23), dishes (20/23), troughs (2/23), and self-feeders (2/23). Self-feeders were usually reserved for dog food. Participants increased their efforts to scatter (16/23) food, as well as hide (4/23) food for cubs. At some centres (4/23), enclosures allowed bears to forage on vegetation naturally present in the cage.

2.3.2.4 Post-weaning

Although black bear cubs in the wild nurse for about 9 months, Beecham and Ramanathan (2007) suggest that cubs in care be weaned as early as 2 to 3 months of age. MacLeod and Perlman (2004) warn against weaning animals before they are behaviourally ready. However, given the concern over human contact, weaning cubs at an earlier age may help to break the caretaker-cub bond and reduce the level of habituation (LaFond 1995; Beecham and Ramanathan 2007). On average, participants weaned bears by 6 months of age (Table 2.2). One participant reported supplementing injured or starved bears with formula, even when they arrived at the centre past weaning age.

The pattern noted above continued for weaned bears, with weaned bears fed fewer grain and milk products and more foods from the fruits and vegetables, meat and alternatives, and other categories than during the weaning period (Table 2.3).

Participants fed bears, on average, twice a day (Table 2.1), with most (12/17) offering cubs ad libitum access to food. Unfortunately, only 5/17 participants were able to provide an estimate of food provided to each bear (Table 2.1).

Weaned bears were fed with dishes (9/23), troughs (2/23), self-feeders (2/23), and baby pools (1/23). Participants also scattered (20/23) and hid (8/23) food for cubs, with one participant mentioning that food was spread out in an attempt to prevent fighting. In zoo settings, concentrating food in one area is discouraged (Bourne and Vila-Garcia 2007).

Scattering or hiding food is preferred, as bears are kept more active, as well as presented with physical and mental challenges (Law and Reid 2010). In addition, presenting food in increasingly complex ways may help to mimic the challenges of procuring food in the wild (MacLeod and Perlman 2004). About one-fifth of participants (5/23) employed methods of foraging enrichment used by zoos, such as drilling holes in pieces of PVC pipe to create puzzle feeders (Bourne and Vila-Garcia 2007). At some centres (4/23), enclosures allowed bears to forage on vegetation naturally present in the cage.

2.3.2.5 Donated versus purchased foods

Participants were asked to estimate how much food was bought versus donated for bears at their centre; responses indicated that approximately half of the food was purchased ($\bar{x}$ = 44.7%, SD = 30.0, n = 19). Considerable variation existed in terms of the proportion of purchased food used at a particular centre: the lowest estimate given was 0%, indicating that all food was donated. Likewise, the lowest estimate for donated food was 5%, meaning that 95% of food was bought. It is unclear whether participants felt donated food was a limiting factor in determining bear diets.

2.3.2.6 Natural foods

All participants (23/23) reported that bears were fed natural foods (i.e. naturally occurring foods that bears would find in the wild), with more than half of the post-weaning diet estimated as being composed of natural foods ($\bar{x}$ = 52.9%, SD = 33.7, n = 19). Estimates of natural foods ranged from 5 to 100% of the diet, and one participant noted that the ability to provide natural foods depended on the time of year. The most commonly fed natural foods were fruits such as berries (20/23), vegetation such as dandelions and skunk cabbage (17/23), fish such as salmon and trout (12/23), nuts such as acorns (10/23), meat such as venison (9/20), and insects such as mealworms (8/23).

Although participants made an effort to feed natural foods, the available literature appears to be divided on whether they are required for bears in care. On one hand, there exists a belief among wildlife rehabilitators that no animal should be released without having been exposed to as many natural foods as possible (MacLeod and Perlman 2004). As MacLeod and Perlman (2004, 72) state, "A lack of familiarity with foods as they occur in the wild, and the inability to procure, manipulate, and ingest these foods, results in starvation." However, other work suggests that providing natural foods to bears may not influence their post-release success. Binks (2008) tracked 60 bears released from three different facilities in Ontario, where they had been fed stale doughnuts and muffins, dog food, fruits, and vegetables. One year after release, the bears were compared with wild bears in the same age class and found to be in similar body condition, indicating that they had been able to forage successfully in the wild. However, we caution the interpretation that natural foods have no place in bear rehabilitation, as providing natural foods may be more important for promoting natural foraging behaviours than strictly for teaching food recognition (Beecham and Ramanathan 2007).

2.3.3 Weight gains in care

To compare weights of cubs at release to weights of bears at a similar age in the wild, average weights and ages at release were calculated from the data provided by two participants (Table 2.4). From a descriptive standpoint, bears stayed longer at Centre 15 and gained weight at a lower rate than bears at Centre 9. Centre 15 released bears that were older and weighed more than bears from Centre 9. Females at both centres, however, tended to stay longer, gain less weight, and gain weight more slowly than males. Overall, the average weight of bears at release was 50.4 kilograms (SD = 17.2, n = 180). They were released at an average age of 15.0 months (SD = 2.8, n = 180) and, thus, belonged to the yearling age class.

Table 2.4. Summary of bear weights and rates of gain at Centre 9 (1989-2008) and Centre 15 (1995-2008).

	Age at admittance (months)	Initial weight (kg)	Final weight (kg)	Weight gain (kg)	Days in care	Rate of gain (g/d)	Age at release (months)
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Centre 9							
Males (n = 80)	7.7 ± 2.4	10.9 ± 4.4	53.7 ± 20.0	42.9 ± 20.5	221.2 ± 72.4	197.4 ± 77.2	15.1 ± 2.4
Females (n = 66)	7.0 ± 3.0	8.8 ± 4.7	43.0 ± 11.8	34.2 ± 11.8	229.9 ± 78.7	163.5 ± 78.0	14.7 ± 2.7
All bears (n = 146)	7.4 ± 2.7	9.9 ± 4.6	48.9 ± 17.6	39.0 ± 17.6	225.1 ± 75.2	182.1 ± 79.1	14.9 ± 2.5
Centre 15							
Males (n = 18)	6.1 ± 3.9	11.8 ± 12.6	60.6 ± 17.2	48.9 ± 23.2	276.9 ± 135.0	184.6 ± 72.9	15.3 ± 4.1
Females (n = 16)	4.9 ± 0.6	6.7 ± 2.3	52.4 ± 7.7	45.7 ± 9.1	333.6 ± 93.8	150.4 ± 54.2	16.0 ± 3.0
All bears (n = 34)	5.5 ± 2.9	9.4 ± 9.6	56.7 ± 14.0	47.4 ± 17.8	303.6 ± 119.2	168.5 ± 66.1	15.6 ± 3.6

Weights of wild bears fluctuate according to food supply, which, in turn, varies geographically, yearly, and seasonally (Marks and Erickson 1966; Rogers 1983). In the southern Appalachians, for instance, yearling weights ranged from 6 to 12 kilograms (Wathen and Pelton 1984), while in Pennsylvania, yearlings weighed between 19 and 64 kilograms (Rogers 1993). Yearling weights averaged 22 kilograms in a Montana study; 2 years later, average yearling weight in the same region was 10 kilograms lower (Jonkel and Cowan 1971). Bears are capable of substantial short-term weight gains (Marks and Erickson 1966; Davis et al. 2002). Yearlings in Minnesota, for example, showed increases of 43% in mean weight between late winter and early summer (Noyce and Garshelis 1998). Furthermore, bears display sexual dimorphism, with males weighing more than females (Larivière 2001). For instance, yearling males in Michigan weighed an average of 42 kilograms, 10 kilograms more than their female counterparts (Marks and Erickson 1966). Despite the variation seen in the wild, it is clear from the data provided by two participants in this study that cubs in care may outweigh most – though not all – wild bears in their age class. It is also apparent that, as only two centres were able to provide the data necessary to make the above calculations, keeping detailed records on cubs, including ages, weights, and dates of intake and final disposition, would benefit future research efforts in this area.

2.3.4 Housing

As with any wild animal, a suitable captive environment for bears – even a temporary one – provides both quantity and quality of space (Young 2003). Rehabilitators should therefore ensure that cages and the furnishings within allow bears to express natural behaviours, as well as choose where to rest and retreat. Bear housing should also be designed to keep both the animals and the people looking after them safe (Bourne and Vila-Garcia 2007).

2.3.4.1 Cage numbers and sizes

Having multiple enclosures of varying sizes allows centres some flexibility in accommodating bears admitted throughout the year (Beecham 2006). Accordingly, the average number of cages available for bears was 6 (SD = 4, n = 22), and ranged from a minimum of 2 cages at one centre to a maximum of 16 cages at another centre (Appendix 2).

Though not scientifically derived, housing guidelines for ursids are set out in the *Minimum Standards for Wildlife Rehabilitation* (2000). It is recommended that pre-weaned bears be kept in cages measuring at least 1.7 square metres, while cages for weaned bears should measure at least 66.9 square metres. For the centres responding to the survey, cage sizes ranged from 1.5 to 40,468.6 square metres, with a mean cage size of 1,379.5 square metres (SD = 5,640.0, n = 22). Most centres (15/22) had cages under 511 square metres, while nearly a third (7/22) had cages above 1,400 square metres (Appendix 2). In fact, all but one centre met the recommendation for pre-weaned bears, and all but three centres met the recommendation for weaned bears. Smaller cages obviously restrict how many bears can be housed together at any given time (Beecham 2006). However, they are also a concern from an enrichment perspective: smaller cages place limitations on the complexity of the environment that can be created for bears, as there is simply not enough room to add a variety of cage furnishings (Bourne and Vila-Garcia 2007; Young 2003).

2.3.4.2 Cage materials and escape deterrents

The *Minimum Standards for Wildlife Rehabilitation* (2000) suggest using materials such as wood, wire, concrete, and brick in the construction of bear cages, together with natural dirt flooring. Cage materials varied from centre to centre. Floor and substrate materials included sand (2/24), dirt (16/24), gravel (4/24), concrete (12/24), wire (4/24), wood (4/24), straw (3/24), sawdust (1/24), peat (1/24), and rubber mats (1/24). It should be noted, however, that five centres did not meet the recommendation for natural dirt flooring.

Although damage to foot pads is anecdotally cited as the reason for the recommendation, participants at centres with non-natural floors did not mention this as a concern. The walls or sides of cages were composed of metal sheeting (3/24), wood (7/24), wire (21/24), sheetrock (1/24), concrete (6/24), and plastic deer fencing (1/24). Roof or ceiling materials used were metal sheeting (4/24), plastic sheeting (1/24), wood (7/24), wire (20/24), and sheetrock (1/24).

Regardless of the materials used, cages must be durable and secure (Beecham 2006). Black bears are curious animals and will investigate their cages thoroughly (Bacon 1980; Beecham 2006). They are also skilled climbers and reasonable diggers (Rogers 1976; Aune 1994). Not surprisingly, therefore, all centres (19/19) took precautions to prevent bears from escaping, whether by buried wire (9/19), buried concrete (2/19), electric fencing (11/19), metal or plastic sheeting (4/19), or overhangs (2/19). Buried wire and concrete prevented cubs from digging out from under cages. At two centres, electric fencing was used to keep cubs from hanging from wire roofs. Most often, though, electric fencing was used around the perimeters of cages. Metal and plastic sheeting prevented cubs from being able to grip and climb up the sides of cages. Overhangs kept cubs from climbing over the tops of cages, particularly those with no roof. One participant also mentioned having a double-entry door system to reduce the risk of escape, as recommended by the *Minimum Standards for Wildlife Rehabilitation* (2000).

2.3.4.3 Indoor versus outdoor caging

Centres had indoor and outdoor caging, as well as cages that were a combination of the two. Beecham (2006) reports that cubs under 12 weeks of age are less able to withstand exposure to the elements; in the wild, they would not have yet left the den. Prior to release, however, bears should be acclimatized to weather conditions (Miller 2000). Accordingly, most bears were provided with indoor and outdoor access up to weaning (19/22) and housed strictly outdoors after weaning (16/24).

It is interesting to note that a third of centres (8/24) had enclosures with no roof. The *Minimum Standards for Wildlife Rehabilitation* (2000) dictate that, for roofless cages, animals should be protected from precipitation and temperature extremes through the provision of another form of shelter within the cage such as a den box. All eight centres met this recommendation.

2.3.4.4 Cage furnishings

As mentioned earlier, suitable housing is not only a function of size, but of complexity (Bourne and Vila-Garcia 2007). Cage furnishings, therefore, are important to encourage the expression of natural behaviours (Law and Reid 2010). Black bears are playful animals and have been observed in the wild interacting with stumps, logs, and trees (Pruitt 1976; Ternent and Garshelis 1998). The *Minimum Standards for Wildlife Rehabilitation* (2000) have limited recommendations for cage furnishings; only a den, heavy logs, and a large, indestructible tub for bathing are suggested. Most centres met these recommendations, however, with 22/24 having dens; 19/24 having logs; and 21/24 having natural water sources such as streams and ponds (4/21), artificial water sources such as stock tanks and concrete pools (15/21), or both (2/21).

Participants clearly considered cage furnishings a key component of bear housing. In addition to the recommended furnishings described above, all cages contained natural features such as trees, vegetation, stumps, rocks, and branches (24/24). Likely, in smaller cages, natural features would have to be planted or brought in from the outside, whereas larger enclosures may have these features as part of the landscape already (Bourne and Vila-Garcia 2007). Cages were also furnished with hanging structures such as tire swings, ropes, and hammocks (9/24), as well as climbing structures such as slides and jungle gyms (8/24). At six centres, bears were provided with toys such as bowling balls, basketballs, and tires. A number of participants (8/24) identified the importance of swapping items in and out of cages to keep cubs occupied. Research, however, has questioned the relevance of

providing unnatural items such as toys to wild animals destined for release, suggesting that efforts could be better spent on modifying the captive environment to be more similar to wild habitat (Newberry 1995). Others have proposed that toys can elicit desirable behaviour patterns, allowing animals to practice skills such as exploration and information gathering important for survival in the wild (Young 2003). Thus, given the lack of consensus in the scientific literature, continued work on the relevance of cage furnishings to bear rehabilitation is strongly encouraged.

2.3.4.5 Visual barriers

Most participants (16/23) reported making an effort to limit bears' visibility from their cages, using either natural barriers such as trees (4/16) or artificial barriers such as shade cloth and fences (10/16). At two centres, both natural and artificial barriers were used. Government wildlife agencies and bear rehabilitators alike have traditionally placed emphasis on visual barriers to prevent bears from becoming habituated to humans (Wasserman and Clumpner 1991; Clark et al. 2002). However, Beecham (2006) reports that visual barriers may do little to prevent bears from recognizing people, as they rely more on sound and scent than sight. Instead, visual barriers may better serve as a means of minimizing stress in animals by providing opportunities for concealment (Miller 2000; Beecham 2006; Morgan and Tromborg 2007).

2.3.4.6 Pacing

In zoos, bears are particularly susceptible to developing pacing stereotypies, possibly because they have complex feeding behaviours and large home ranges in the wild (Vickery and Mason 2003). Pacing is not unique to the zoo setting; half of participants (12/22) in this study observed bears pacing in their cages. Estimates of time spent pacing per day ranged from 30 minutes to 2 hours ($\bar{x}$ = 67.5 minutes per day, SD = 37.7, n = 4). Participants remarked that pacing was highly variable (4/4), and was more commonly seen in single bears (3/4), when caretakers entered cages (1/4), or close to the time of release (1/4).

Black bears are active animals, spending at least half of each day foraging (Paisley and Garshelis 2006). Pacing can be reduced, though not always eliminated, by increasing enclosure size and complexity, as well as by feeding smaller meals throughout the day and providing food in novel ways that encourage searching and handling (Bourne and Vila-Garcia 2007).

Further research would be required to better understand pacing in the rehabilitation setting. At centres where pacing was observed, cage size ranged from 42 to 32,375 square metres. All cages contained natural and artificial furnishings; at three centres, enclosures were simply fenced-in natural habitat. At all but three centres, efforts were made to scatter and hide food, as well as use foraging enrichment methods such as puzzle feeders.

Growing up in a captive environment that is more restrictive than the wild, as rehabilitation centres necessarily are, can alter how animals learn (McPhee and Carlstead 2010). Stereotypies have been associated with decreased behavioural flexibility (Vickery and Mason 2003). Thus, any behavioural changes that have the potential to affect how bears respond to challenges in the wild upon release likely warrant further study.

2.3.4.7 Group housing

In wildlife rehabilitation, group housing is generally recommended as a strategy to prevent animals from habituating to humans (Miller 2000). Allowing cubs to socialize may be a key way to limit human contact, as it tends to redirect their focus from their caretakers to one another (Beecham and Ramanathan 2007). Furthermore, although black bears are generally solitary animals in the wild, a notable exception includes young siblings (Pelton 1982; Taylor 2006). Siblings have even been observed together after dispersal (Clevenger and Pelton 1990; Ternent and Garshelis 1998). Housing bears in groups may therefore promote the expression of natural behaviours, as well as play a role in the social and physical development of cubs (Beecham and Ramanathan 2007). In light of this

information, it is not surprising that many centres employed some form of group housing. Up to weaning, bears were kept in groups averaging 2 (SD = 1, n = 18) to 7 (SD = 4, n = 18) individuals, though three participants allowed groups of 10 or more. Similarly, after weaning, groups contained an average of 2 (SD = 2, n = 18) to 8 (SD = 5, n = 18) bears, with four participants allowing groups of 10 or more. In fact, only one participant reported having different group sizes after weaning (8 to 15 bears) as compared to before weaning (2 to 3 bears). The remaining participants (17/18) kept group sizes the same throughout the rehabilitation process.

Three participants expressed concern over raising lone cubs; one raised single cubs with a dog until another cub arrived at the centre, while one mixed single cubs with grizzlies (*Ursus arctos*) until another black bear cub arrived at the centre. There is some indication that such practices are considered controversial among bear rehabilitators (Beecham and Ramanathan 2007). Instead, the *Minimum Standards for Wildlife Rehabilitation* (2000) recommend transferring single animals between rehabilitation centres to create groups.

Regardless of weaning stage, bears were grouped on the basis of age (6/20), size (7/20), body condition (2/20), health status (2/20), relatedness (13/20), and behavioural compatibility (2/20). Siblings were always kept together, and efforts were made to group cubs that were close in age and similar in size. At two centres, however, yearlings were sometimes housed with cubs-of-the-year (i.e. bears less than 1 year of age), another practice not generally accepted among bear rehabilitators, given the potential for smaller individuals to be hurt during the introduction process (Beecham and Ramanathan 2007).

Some participants also took into account area of origin (3/20) and date of intake (6/20). In these cases, cubs from the same region were often grouped together, as they would likely be released at the same site. Frequently, spring and fall arrivals were prevented from mixing at centres. Fall arrivals tend to be underweight and require feeding through the winter, while spring arrivals, having spent more time in rehabilitation, are in better body

condition and usually hibernate. This typically necessitates separate housing (Beecham 2006), which may have been a challenge given the physical set-up at many of the centres.

Some participants (3/20) mentioned that group size was limited by available space. Overcrowding is a concern from both a health and behavioural point of view. Not only can diseases and parasites spread more easily, but bears in smaller cages may feel stressed without enough space to retreat from one another (Bourne and Vila-Garcia 2007; Morgan and Tromborg 2007).

2.3.4.8 Infant housing

As infant bears are altricial, they require specialized housing to keep them warm and dry (Pelton 1982; Beecham 2006). The *Minimum Standards for Wildlife Rehabilitation* (2000) recommend that infant bears be housed in a 76 litre aquarium or small kennel lined with cloth or other suitable materials. Reports from participants indicated that, in addition to dog kennels (6/9), bank cages (1/9), squeeze cages (1/9), incubators (1/9), and walk-in cages (1/9) were also used. Two participants reported using natural bedding materials such as evergreen boughs in addition to blankets. The *Minimum Standards for Wildlife Rehabilitation* (2000) also suggest using a rolled sock or stuffed animal for security, particularly for lone infants; two participants mentioned providing a pillow or stuffed animal for this purpose. Research in raccoons, however, suggests that such items may not substitute for a cage-mate, as singly-raised kits actually spent less time resting and interacting with a stuffed animal than pair-housed kits (Kanaan and Pajor 2010). Similar research may be warranted in bears.

Infant bears are unable to thermoregulate and rely on their mother for warmth while still in the den (Rogers 1993). The *Minimum Standards for Wildlife Rehabilitation* (2000) recommend using heating pads or hot water bottles to keep infants warm. However, only a third of participants (7/21) routinely provided heat to bears up to weaning. Heat sources

used included heat disks (2/4), heating pads (1/4), hot water bottles (1/4), and heat lamps (2/4). Heat was provided continuously (4/4). A source of humidity is also recommended (Miller 2000). Only one participant commented on the need for a humid environment, reporting that a cup of boiling water was placed in the kennel with cubs.

2.3.5 Health and sanitation

A primary goal of wildlife rehabilitation is the return of healthy animals to the wild (Miller 2000). Prompt and appropriate medical care is therefore essential to the rehabilitation process, not only to treat health conditions and reduce suffering, but to prevent the spread of diseases and parasites between cubs at centres and, ultimately, to bears in the wild upon release (Miller 2000; Beecham and Ramanathan 2007).

2.3.5.1 Physical exams

Conducting a physical exam at intake is routine practice in wildlife rehabilitation (Miller 2000). As with any wild animal, assessing health status is "a critical step in determining the suitability of a cub for rehabilitation" (Beecham and Ramanathan 2007, 13). All but a few centres performed a routine exam on bears at intake (Appendix 2). Beecham and Ramanathan (2007) state that, in the absence of a veterinarian, physical exams may be carried out by qualified staff; however, the individuals doing so must be experienced. In this study, half of participants (10/20) reported that health checks of bears upon arrival were performed by staff, whereas at 7/20 centres, both a veterinarian and staff conducted health checks at intake.

Likewise, it is considered good practice to conduct a physical exam prior to release (Miller 2000). To ascertain whether they are suitable release candidates, cubs require confirmation that they are healthy and in good physical condition (Beecham 2006; Beecham and Ramanathan 2007). Unfortunately, some participants reported that bears were not

examined prior to release (Appendix 2). At the centres where pre-release health checks were performed, they were conducted by a veterinarian (2/20), staff (8/20), or by both a veterinarian and staff member (7/20).

Only one centre performed periodic health checks on bears while they were in care (Appendix 2). This centre had a team of veterinarians on staff full time, and bears received from one to three checkups over the course of their stay in rehabilitation. The lack of regular physical exams at all other centres was not unexpected. As bears grow, they become increasingly difficult to handle and often require chemical restraint (Wasserman and Clumpner 1991). However, even though bears at other centres did not receive periodic health checks, they still had access to veterinary care. Participants reported that cubs saw a veterinarian on an as needed basis when they were sick or injured (19/19). Furthermore, one participant commented that, as handling was avoided, reliance on extensive observations of coat quality, feces, feeding behaviour, and activity levels increased.

2.3.5.2 Quarantine and separation periods

The *Minimum Standards for Wildlife Rehabilitation* (2000) recommend that all new animals be housed separately upon arrival. Black bears in the wild have tested positive for a variety of diseases, including rabies, brucellosis, tularemia, leptospirosis, canine distemper, and canine infectious hepatitis (Binninger et al. 1980; Mortenson 1998; Woodford 2000). Although none appear to be significant sources of morbidity or mortality, good practice dictates that animals confirmed or suspected of having contagious diseases be isolated (Rogers 1983; Miller 2000; O'Brien 2010). Accordingly, most centres routinely quarantined new arrivals, as well as sick bears (Appendix 2).

For bears, the suggested quarantine period is 2 to 4 weeks to ensure new cubs do not transmit diseases or parasites to cubs already in care (Beecham and Ramanathan 2007). In this study, length of quarantine for new bears ranged from 1 day to 42 days, with a mean

quarantine period of 14.5 days (SD = 9.9, n = 12). Length of quarantine for sick bears varied, depending on the illness. Sick bears were kept in quarantine until they had recuperated (8/10), were ready for group housing (4/10), or had been cleared by veterinarian (1/10).

Similarly, all injured bears were routinely separated (Appendix 2). Length of separation for injured bears was dependent on injury, as well as age. Injured bears were kept separated until they had regained a desired level of function (3/18), were fully healed (11/18), were ready for group housing (3/18), or had been cleared by a veterinarian (2/18).

2.3.5.3 Blood tests

The *Minimum Standards for Wildlife Rehabilitation* (2000) recommend that blood work be completed at intake, to aid in treatment, and prior to release, to determine whether animals have normal blood values. However, in this study, less than half of participants performed routine blood testing on bears (Appendix 2) and, of those, only three performed more than one test.

2.3.5.4 Fecal tests

According to the *Minimum Standards for Wildlife Rehabilitation* (2000), animals should be routinely examined for parasites upon arrival. For animals requiring a lengthier stay in rehabilitation, re-examination at intervals is recommended. Less than half of participants, however, performed routine fecal testing on bears (Appendix 2). Of those, six conducted more than one test.

2.3.5.5 Parasite treatments

Black bears are known to carry both internal and external parasites, and cubs may be particularly susceptible to infestation as they arrive at rehabilitation centres in

compromised health (Beecham 2006). Common endoparasites include hookworms, roundworms, and tapeworms; common ectoparasites include mites, ticks, lice, and fleas (Bourne and Vila-Garcia 2007; Bourne et al. 2010). Prophylactic treatment is therefore recommended, as is the practice of rotating drugs to avoid the development of drug resistance (Beecham and Ramanathan 2007). Most centres routinely treated for both types of parasites (Appendix 2).

The most common treatments used for internal parasites were ivermectin (Ivomec®, Merial, Duluth, GA) (10/14) and pyrantel pamoate (Strongid® or Nemex®, Zoetis, Madison, NJ) (6/14). Ten centres used a single drug, while four centres used a combination of medications. Internal parasites were treated in a single dose (3/13), repeated doses (6/13), or on an as needed basis (4/13).

For external parasites, participants used ivermectin most commonly (12/12). Ten centres used a single drug, while two centres used a combination of medications. As with internal parasites, external parasites were treated in a single dose (1/11), repeated doses (5/11), or on an as needed basis (5/11).

2.3.5.6 Vaccinations

Vaccination is recommended when the endemic disease risks at the release site are known, yet the practice remains controversial (Beecham and Ramanathan 2007; Bourne and Vila-Garcia 2007). In particular, using a modified live virus vaccine in a species it was not intended for carries the risk of inducing active disease (Loeffler 2007). Bears were routinely vaccinated at only one centre (Appendix 2). This centre vaccinated cubs against tetanus once during the course of their stay in rehabilitation. This participant adopted the vaccination protocol after a bear died from a suspected case of the disease.

2.3.5.7 Cleaning procedures

The *Minimum Standards for Wildlife Rehabilitation* (2000) recommend that cages be disinfected between animals or groups of animals to prevent disease and parasite transmission. Accordingly, participants placed more emphasis on disinfection when cages were empty (14/24) than when bears were still in care (1/24).

Routine cleaning typically involved picking up scat and leftover food, changing bedding, cleaning food and water receptacles, changing the water in pools or ponds, and replacing used play items such as branches. Participants also described scrubbing cage furnishings such as den boxes and ponds or pools. Cage substrates such as wood chips were regularly replaced as well.

Preparing for new bears generally involved more thorough cleaning, including using a disinfectant such as bleach. Participants typically emptied cages before scrubbing and spraying them down with a hose or pressure washer. It should be noted, however, that the use of pressure washers has been associated with the spread of pathogens, as well as the aerosolization of pathogens (Bourne and Vila-Garcia 2007). Cages were often allowed to air dry. Cage furnishings were cleaned and the ground was raked. Participants then readied cages for new occupants with new bedding and substrate.

Waiting until after bears have been released to thoroughly clean cages may be a useful strategy to balance bear health and human contact concerns. Larger enclosures may have the further advantage of requiring less frequent cleaning or shorter cleaning times while bears are in care (Bourne and Vila-Garcia 2007).

2.3.6 Survival rates in care

To compare survival rates of cubs in care to survival rates of bears at a similar age in the wild, mean annual survival rates were calculated from the data provided by nine participants (Appendix 2). Overall, average annual survival rate for these centres was 92.5% (SD = 8.0, n = 9). Nine centres only provided an estimate of annual survival; this ranged from 91 to 100% for the same 5-year period (Appendix 2). Thus, calculated and estimated survival rates were similar. Combining both groups, the average age of bears at release was 14.3 months (SD = 3.3, n = 17) and, thus, they belonged to the yearling age class.

Determining survival rates in the wild is difficult, as estimates vary geographically and yearly (Kolenosky 1990). Although there have been reports as low as 17% and as high as 100%, most estimates of survival to 1 year of age fall between 50 and 65% (Garrison et al. 2007). Thus, compared to cubs in care, the probability of wild bears surviving to a similar age may be considerably lower. Most mortality occurs before cubs are 5 months of age, when they are small and more vulnerable to predation (Elowe and Dodge 1989). As cubs get older, they become less vulnerable to predation but more at risk from human mortality sources such as hunting and vehicle collisions (Elowe and Dodge 1989; Wooding and Hardisky 1994). Food scarcity affects younger and older cubs alike (Rogers 1993). In general, cub mortality due to disease, congenital abnormalities, or natural accidents is low (LeCount 1987; Elowe and Dodge 1989; Garrison et al. 2007).

2.3.7 Handling and human exposure

Minimizing human contact is a critical component of wildlife rehabilitation (Miller 2000). The concern is even greater for bear rehabilitators, given the potential for bears to pose a threat, both real and perceived, to human safety upon release (Gore et al. 2006; Hristienko and McDonald Jr. 2007). Consequently, although three centres were open to the public, no centre permitted public viewing of the bears (n = 24).

Most participants (22/24) were directly involved in caring for bears and, at four centres, participants were the sole caretaker. Other caretakers included staff, interns, volunteers, and family (Appendix 2). Restricting the total number of caretakers to 1 to 2 people has been identified as a possible means of reducing the level of habituation in bears (Beecham and Ramanathan 2007). While 6/23 centres had between 4 and 15 caretakers, most (17/23) had from 1 to 3 caretakers (Appendix 2); the median number was 2 (n = 23). Given how long bears are typically in care, some centres may have difficulty keeping caretakers the same from intake to release. Although bears may have only 1 or 2 caretakers at any given time (Figure 2.2), they may end up being exposed to more people as caretakers are rotated throughout the year; thus, they may face a greater risk of habituation.

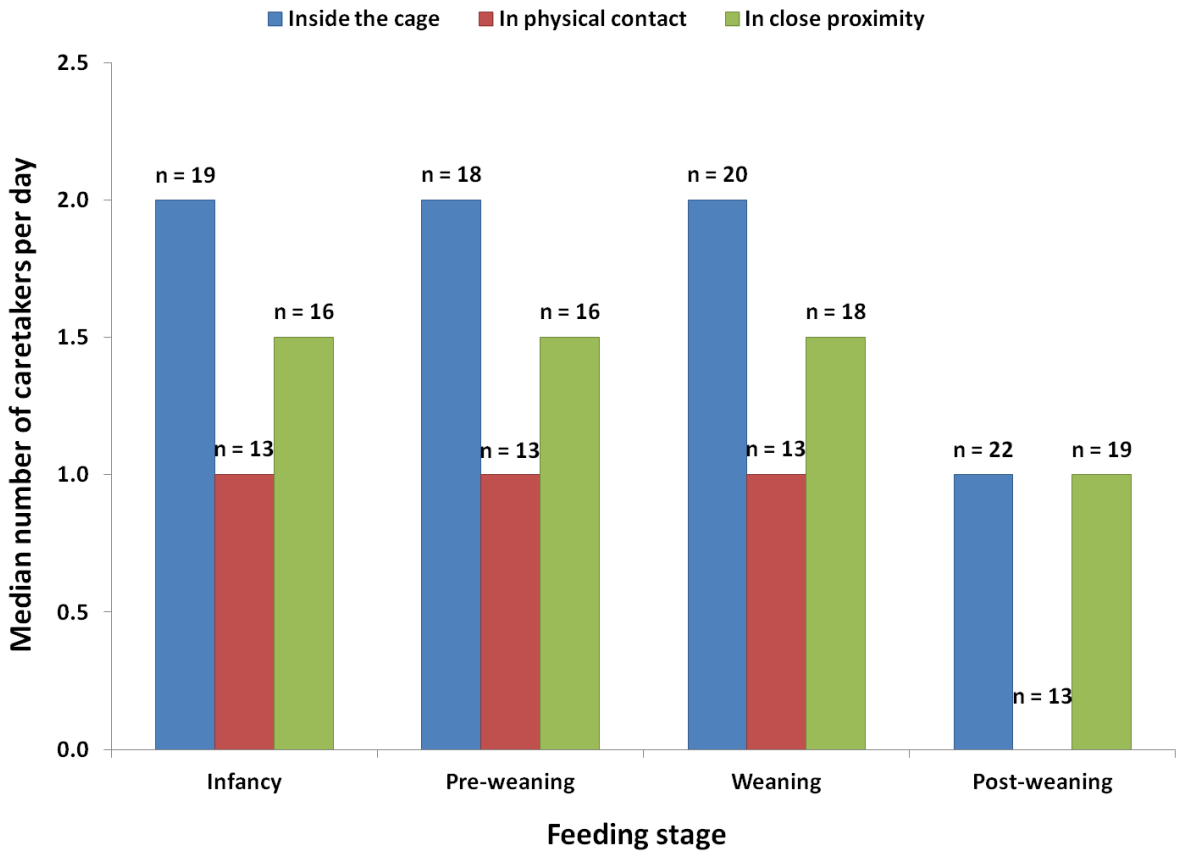

Figure 2.2. Median number of bear caretakers inside the cage, in physical contact, and in close proximity to cubs at different feeding stages at 24 wildlife rehabilitation centres located throughout North America that participated in a 2009 survey on black bear rehabilitation.

Minimizing interactions between caretakers and cubs, particularly after weaning, is another strategy thought to be important for reducing the level of habituation in bears (Beecham 2006). For obvious reasons, infant bears require the most intense care. They need continuous nutrition and assistance to urinate and defecate, and must be monitored closely to ensure they are kept warm and dry (Bourne and Vila-Garcia 2007). As bears grow, however, this reliance subsides; they become more independent, and there is less of a need for caretakers to be in their immediate presence. Feeding and cleaning schedules can be coordinated and should be kept as short as possible (Beecham 2006).

This trend towards decreasing contact and exposure as cubs progressed through the rehabilitation process was observed at the centres in this study. At each feeding stage, less time was spent inside the cage with the bears (Figure 2.3), in physical contact with the bears (Figure 2.4), and in close proximity to the bears (Figure 2.5). There was considerable variation, however, with bears at one or two centres consistently receiving more contact and exposure to people. Thus, cubs at these latter centres may be more at risk of habituation.

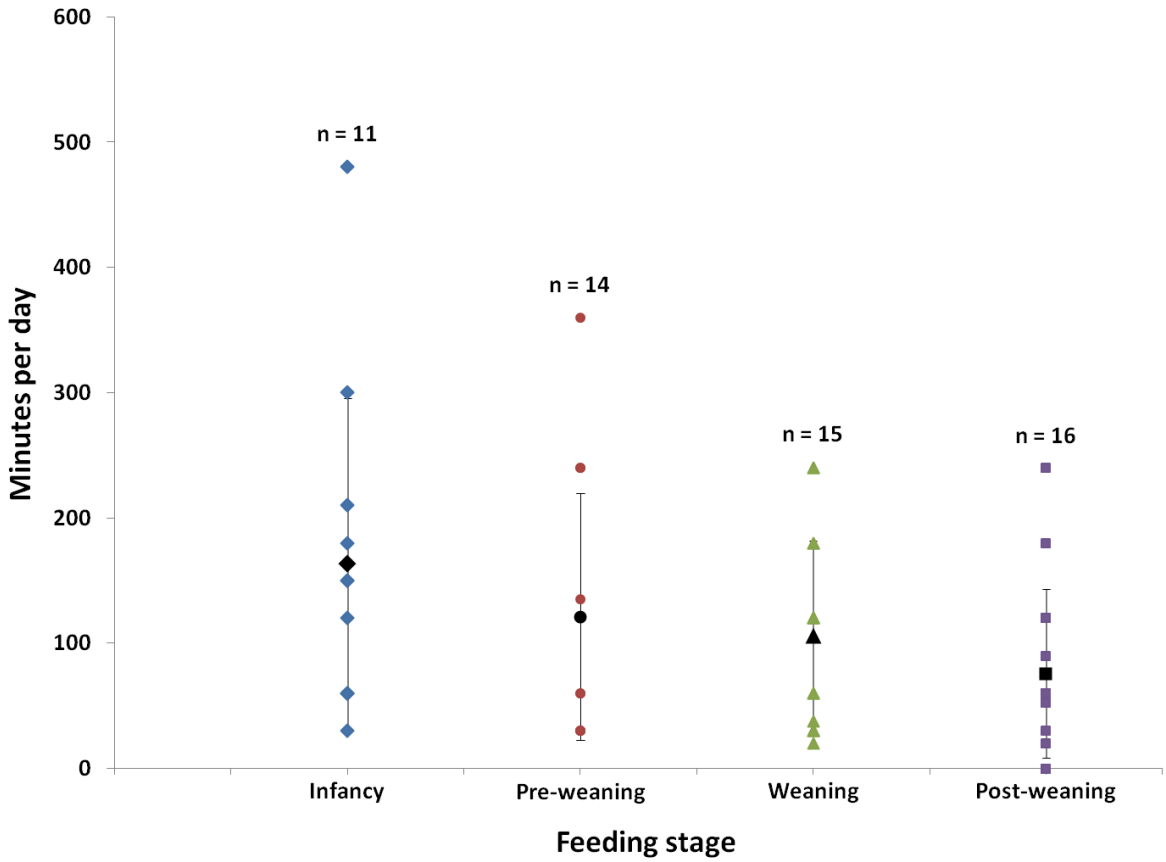

Figure 2.3. Mean time (min/d) spent by caretakers inside cages with cubs at different feeding stages at 24 wildlife rehabilitation centres located throughout North America that participated in a 2009 survey on black bear rehabilitation (the black point represents the mean, the coloured points represent data provided by each individual centre, and the error bars represent the standard deviation). Data points may overlap, as some centres provided the same time estimate.

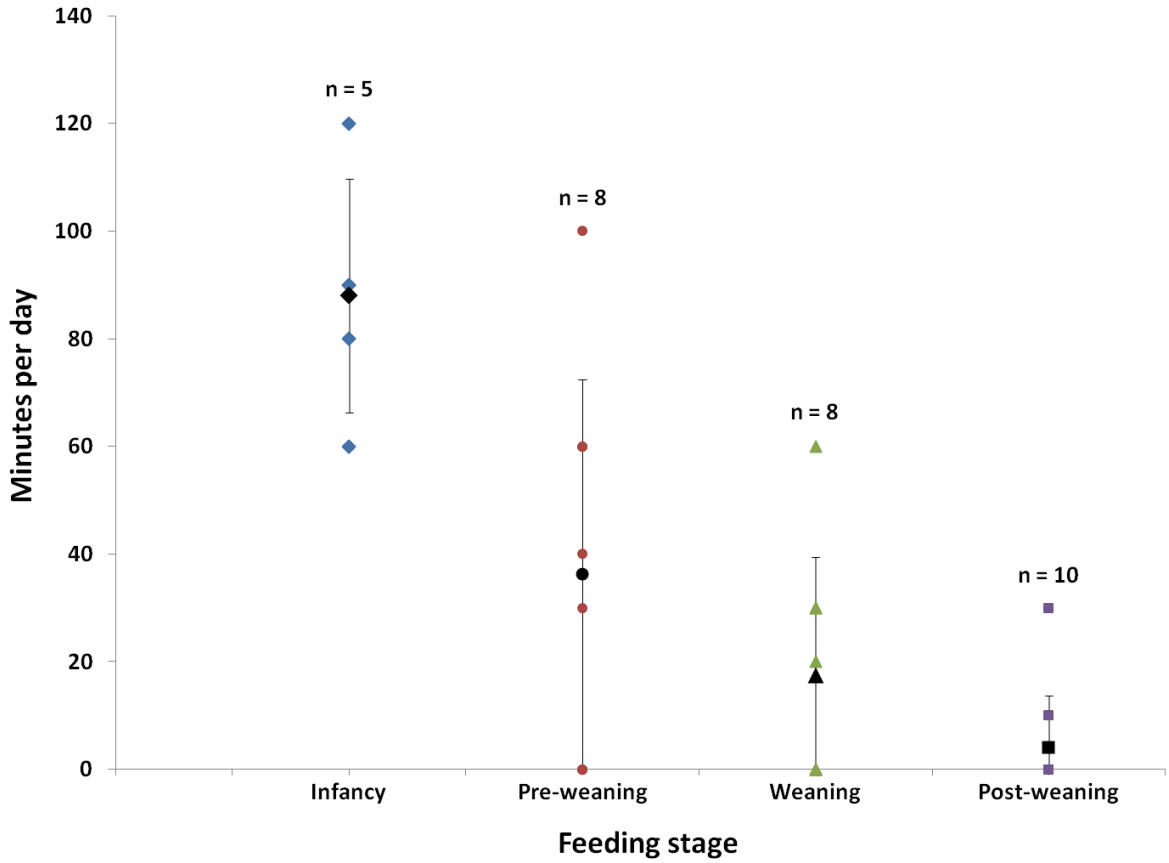

Figure 2.4. Mean time (min/d) spent by caretakers in physical contact with cubs at different feeding stages at 24 wildlife rehabilitation centres located throughout North America that participated in a 2009 survey on black bear rehabilitation (the black point represents the mean, the coloured points represent data provided by each individual centre, and the error bars represent the standard deviation). Data points may overlap, as some centres provided the same time estimate.

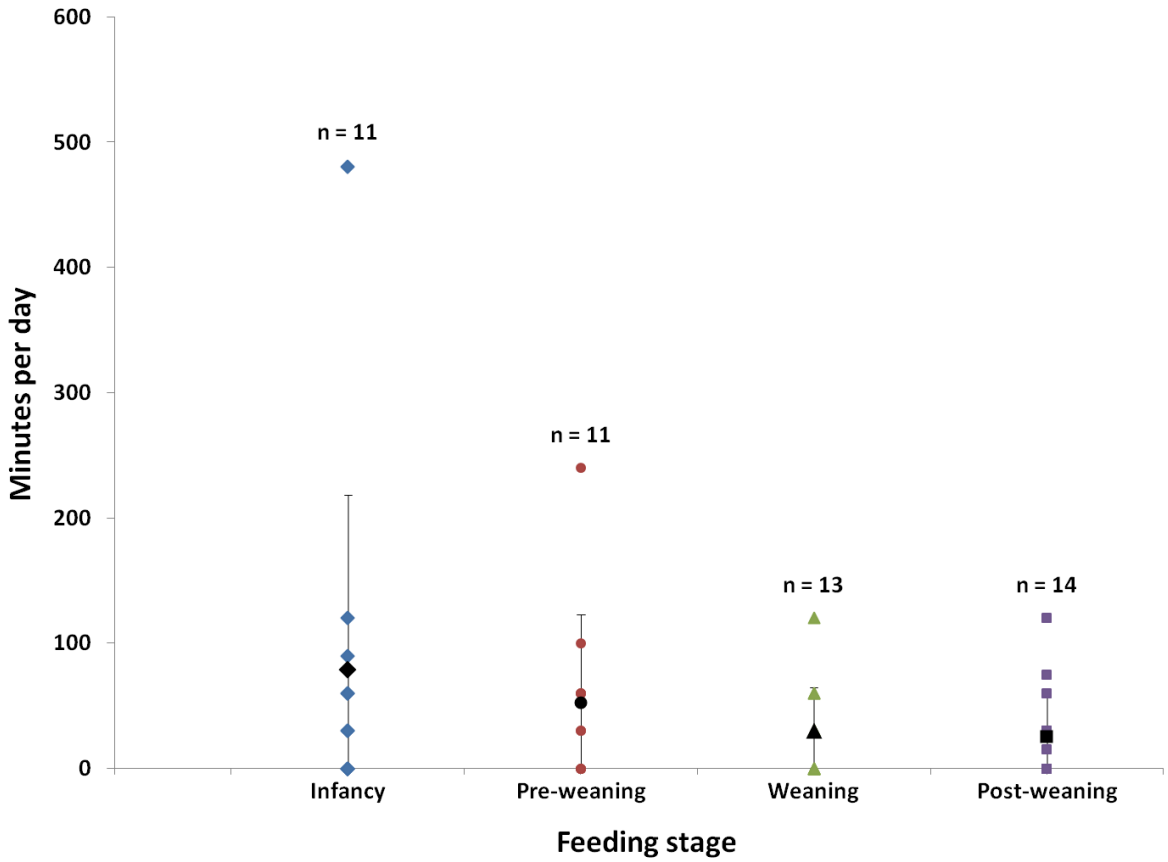

Figure 2.5. Mean time (min/d) spent by people in close proximity to cubs at different feeding stages at 24 wildlife rehabilitation centres located throughout North America that participated in a 2009 survey on black bear rehabilitation (the black point represents the mean, the coloured points represent data provided by each individual centre, and the error bars represent the standard deviation). Data points may overlap, as some centres provided the same time estimate.

Some centres made a concerted effort to limit human contact with cubs, employing such methods as remote cameras (10/24), restricting conversation around cubs (2/24), playing recorded nature sounds to block out human sources of noise (1/24), and preventing cubs from seeing caretakers enter cages to feed and clean (5/23). Feeding practices have drawn particular attention, as both government wildlife agencies and bear rehabilitators have promoted remote feeding as a means of keeping bears from associating people with food (Wasserman and Clumpner 1995; OBCRC 2000). At most centres (15/23), however, bears were able to see caretakers during feeding and cleaning. Whether habituation is reduced by visually shielding bears from these activities remains unclear, as work has indicated that

they rely more on sound and scent than sight (Beecham 2006; Beecham and Ramanathan 2007). Although questionably important from a habituation standpoint, visual barriers may help to provide bears with the ability to retreat from routine husbandry procedures that may serve as a potential stressor (Morgan and Tromborg 2007).

2.3.8 Hibernation

Bears went into hibernation at all but three centres (n = 24). In the wild, hibernation typically begins between October and January and ends between March and May. Black bears tend to den for shorter periods in southern latitudes, entering later and emerging earlier than in northern latitudes (Johnson and Pelton 1980; Larivière 2001). Mean length of hibernation for cubs in care was 4.0 months (SD = 1.3, n = 13). The range was 2.5 to 6.0 months, the latter reported at two centres located in Canada. In addition, female bears generally den for longer periods than males in the wild (Larivière 2001); one participant observed this pattern for male and female cubs in care.

Factors prompting black bears in the wild to enter dens include weather and snow accumulation (Larivière 2001). Similar factors may be at work in the rehabilitation setting: three participants mentioned that cubs hibernated according to snowfall, while four participants commented on the need for local weather conditions to "cooperate" in order for cubs to hibernate. In the wild, bears will delay hibernation when food availability is abundant (Johnson and Pelton 1980), and cubs in care are known to do the same (Beecham 2006). At one centre, bears were frequently seen to get up and eat, as food was made available to them throughout the winter. Furthermore, at three centres, bears were observed to become active for short periods in milder weather, which Beecham (2006) suggests is not uncommon for cubs in care.

Most participants (22/24) prepared bears for hibernation. At two centres, preparations were made even though bears did not hibernate. More than half of participants (13/22)

limited food intake, typically accomplished by gradually withdrawing food from cubs as the denning period approached. All participants (22/22) provided cubs with a den box or culvert den to use, with most participants (19/22) also providing materials such as hay and branches for insulation. All but one centre used a combination of these methods and, at two centres, cubs were observed using natural dens rather than the ones provided. Additionally, one participant reported that environmental conditions were simulated by changing the photoperiod within the cage and cooling the denning area. At this centre, bears had limited or no access to outdoor housing.

Participants identified the following criteria as important in determining whether bears were ready for hibernation: age (1/20), weight (5/20), body condition (7/20), health status (3/20), and behavioural readiness (13/20). In the wild, black bears may lose up to 30% of their body weight over the winter (Rogers 1981). Therefore, as hibernation involves some weight loss, body condition usually determines which cubs need to be fed over the winter and which cubs are deemed healthy enough to hibernate (Beecham 2006). The most common behavioural indicators used to identify bears ready for hibernation were decreased activity levels and reduced food consumption. Similar to wild bears, cubs in care usually become lethargic in the late fall, and naturally begin to eat less as the denning period approaches (Beecham 2006).

2.3.9 Releases

Releases represent the culmination of the rehabilitation process. Decisions regarding where, when, and how to release cubs must be made carefully, as they can have a significant effect on cub survival and, thus, a considerable influence over whether rehabilitation efforts are deemed successful (Waples and Stagoll 1997; Beecham 2006; Beecham and Ramanathan 2007).

2.3.9.1 Release site criteria

When asked to list release site criteria, participants identified the following factors as important: habitat suitability (16/19), land use (16/19), area of origin (5/19), topography (2/19), and bear population status (5/19). To participants, a suitable habitat meant an area with sufficient food, water, and den sites available. The area should also be within the historic or current distribution range of bears, and capable of supporting a viable bear population (Beecham 2006; Beecham and Ramanathan 2007).

The land use criterion referred to the risk of bears coming into contact with people. Human-bear conflicts are more likely in areas where human densities are high (Don Carlos et al. 2009). Conflicts can also occur in areas where the land is used for agriculture, resource extraction, or recreation (Mattson 1990; Beecham and Ramanathan 2007). Accordingly, participants preferred remote locations for releases and, in some instances, areas with limited or no hunting.

Releasing cubs in or near the area they were found may be a government requirement intended to prevent the unnatural spread of genetic material, diseases, and parasites (Waples and Stagoll 1997; Miller 2000; OBCRC 2000). However, one participant mentioned that cubs were frequently found in developed areas and, therefore, the area of origin was almost never suitable as a release site.

Topography was identified as a possible means of preventing bears from encountering human settlements. Bears are known to travel along mountain ridgelines or borders between forested and open areas (McArthur 1981; Lee and Vaughan 2003; Cushman and Lewis 2010); however, travel may be precluded by geographical barriers such as large bodies of water (Binks 2008). These dispersal patterns are important for understanding the potential post-release movements of cubs (Beecham 2006). One participant also

mentioned topography in relation to den sites, preferring elevated areas where dens would be protected from flooding during the spring thaw.

To reduce the risk of intraspecific conflict, participants indicated that cubs should be released in areas with low bear densities and, in particular, few adult males. Young bears may experience competition for resources in landscapes dominated by older bears. Furthermore, adult males have been known to kill young bears (Beecham 2006; Beecham and Ramanathan 2007).

Although participants provided detailed release site criteria, only one participant confirmed having the ability to choose release sites. In both Canada and the United States, wildlife is a resource managed by the government in the public interest (Casey and Casey 2000). Therefore, given the public safety concern, bear releases are typically handled by government wildlife agencies (OBCRC 2000; Beecham 2006). However, more than half of participants (12/23) were able to choose release dates, and most (18/24) took part in releases themselves.

2.3.9.2 Bear release criteria

When determining whether bears were ready for release, participants used the following criteria: age (13/20), weight (12/20), body condition (6/20), health status (6/20), behavioural readiness (5/20), and government input (2/20). Where age was identified as important, the average age at release was 14.6 months (SD = 3.4, n = 12). The reported range was 8.5 to 18.0 months. Where weight was given as a factor, mean release weight was 39.2 kilograms (SD = 19.9, n = 7) with a minimum of 27.2 kilograms and a maximum of 81.6 kilograms. Two participants specified that cubs at release should be larger than wild cubs in the same age class, as the additional weight is believed to enhance their survival prospects, at least initially as they adjust to their new environment (Beecham 2006; Loeffler 2007). The main behavioural indicator identified by participants was the level of habitation

displayed by cubs, with minimal levels being desirable. At one centre, government input was a release weight guideline; at another centre, government input came in the form of a release recommendation from a government wildlife agent.

2.3.9.3 Release techniques

At most centres (18/22), bears were released either as singles or in groups. One centre used a soft release technique, which involves confining bears at the release area for a period of time before releasing them into the wild. Soft releases allow for gradual acclimation to the release site, and are thought to limit post-release movements of bears (van Manen and Pelton 1997; Waples and Stagoll 1997). However, as they require access to a remote location and can be costly, soft releases are not widely practiced (Eastridge and Clark 2001; Beecham and Ramanathan 2007).

Hard releases, on the other hand, involve releasing bears directly into the wild. Although they have been associated with long-range movements from the release site, they are less expensive and more commonly used than soft releases (Beecham 2006; Binks 2008). Accordingly, all centres (24/24) used hard releases. Two participants mentioned that food (fruit or nuts) was left for bears at the release site in an attempt to hold them there, while two participants reported hazing bears to encourage them to leave the release site. Hazing is an aversive technique normally applied to conflict situations, whereby nuisance bears are dispersed with deterrents such as dogs, bean bags, rubber bullets, and noisemakers (Hopkins III et al. 2010).

Some participants (5/17) reported using a winter den release, which involves transferring bears to a natural or artificial den in the wild while they are hibernating. As with soft releases, winter den releases may restrict post-release movements; bears have been known to abandon the den they were placed in, only to move a short distance before building another one (van Manen and Pelton 1997; Beecham 2006). One participant mentioned that

used bedding was brought from the centre to create a familiar scent in the den and possibly encourage bears to stay. Winter den releases are logistically challenging, however, as they require a considerable investment of time and labour to plan and execute (Beecham 2006).

2.3.9.4 Release timing

Winter releases are done at a time when wild bears are hibernating and few people are about (Beecham 2006). Some participants (5/17) also released bears in the spring, just as natural foods are becoming abundant and people have yet to resume significant outdoor activity (Beecham and Ramanathan 2007). Furthermore, natural family break-up occurs in the spring, meaning bears are released at a time when they would normally be leaving their mother in the wild (Beecham 2006). Bears were released in the late summer or early fall as well (10/17). Although natural foods are plentiful at this time of year, allowing wild bears to begin fattening up for hibernation, more people are outdoors (Beecham and Ramanathan 2007).

Regardless of when bears are released, length of stay is an important consideration. The longer cubs are kept in care, the higher the costs and the greater the exposure they have to humans. However, older, larger cubs are thought to be less vulnerable to predation upon release (Beecham 2006; Beecham and Ramanathan 2007).

2.3.9.5 Identification and post-release monitoring

At most centres (21/24), bears were routinely marked for identification before release, which in many cases may be a government requirement (CDFW 2012). Ear tags were used most commonly (12/21), though a combination of methods was also reported: tattoos and ear tags (6/21); tattoos, ear tags, and microchips (2/21); and ear tags and microchips (1/21). Identification serves as a passive form of post-release monitoring. Information on the fates of released bears comes mainly from chance reports of individuals captured in research or

nuisance situations, or killed during legal hunting seasons, in road accidents, or under depredation permits (Beecham 2006). At less than a third of centres (5/21), bears also underwent genetic testing before release, typically accomplished by taking hair samples. Genetic testing is carried out to ensure compatibility between released bears and recipient bear populations (Beecham and Ramanathan 2007).

Routine post-release monitoring was conducted at more than half of centres (13/24). Centres used radio collars (10/13), GPS collars (5/13), ear transmitters (4/13), and transmitter implants (1/13). Six centres cited having experiences with more than one type of monitoring device. As Lander et al. (2002, 19) state, post-release monitoring is "essential to determine the efficacy of wildlife rehabilitation." Knowing how bears navigate the landscape after they are released, and whether they survive, manage to avoid conflict, and ultimately reproduce can feed back into and improve rehabilitation methods (Waples and Stagoll 1997; Beecham and Ramanathan 2007; IUCN SSC 2012). As discussed earlier, there clearly are advantages and disadvantages to releases done with different methods and at different times of year. Further research is needed to determine what combination of release method and timing provides bears with the greatest chance of post-release success. However, having the necessary financial and personnel resources in place is a common impediment to conducting post-release monitoring (OBCRC 2000).

Given the concern over human-bear conflicts, participants were asked to estimate the probability of bears coming into contact with people or human habitations within 2 weeks of being released. Most participants (12/20) believed the probability was less than 10%. The remaining eight participants selected a probability of 10 to 25% (2/20), 26 to 50% (2/20), 51 to 75% (3/20), and 76 to 100% (1/20). There is some evidence to suggest that nuisance behaviour is limited to incidental contact with humans as bears disperse from the release site (Binks 2008). Thus, Beecham (2006) concludes that bears should be released when the risk of encountering people shortly after release is low. However, in light of the

estimates made by participants, some bears are clearly being released in areas or at times of year when conflict may be likely.

2.3.10 Funding and expenses

The vast majority of wildlife rehabilitation centres are non-profit organizations (Lindsey and Adams 2006). Not surprisingly, therefore, most centres (20/22) received no government funding. The two participants who confirmed receipt of government funds worked at centres that were government-run facilities. All centres (23/23) relied on private funding in the form of donations and grants. Most participants (16/21) reported using personal funds as well.

When asked to estimate the cost of raising a healthy bear from infancy to release, most participants (15/18) judged the cost to be less than $300.00 per month. The average cost was $153.53 per month (SD = 165.55, n = 18). The lowest estimate given was $7.81 per month, while the highest was $527.78 per month.

Participants were also asked to rank their bear-related expenses in order on a scale of 1 to 5, with 1 being the most costly and 5 being the least costly. Food was ranked the highest ($\bar{x}$ = 1.8 ± 1.1), followed by housing ($\bar{x}$ = 2.3 ± 1.3), labour ($\bar{x}$ = 2.8 ± 1.3), health care ($\bar{x}$ = 3.7 ± 0.7), and releases ($\bar{x}$ = 4.4 ± 0.9) (n = 17). The order is not surprising when one considers how long cubs are formula-fed and kept in care, and how large an enclosure they require and how destructive they can be. Labour costs may be offset somewhat by relying on volunteers and interns. Health care was not cited as a significant expense, which corresponds to participants' comments on the lack of serious health concerns and the resilience of bears. Centres may not be responsible for release costs, as releases are typically carried out by government wildlife agencies.

2.3.11 Government relations

Given the concern for public safety, bear rehabilitation may necessitate a closer working relationship between rehabilitators and government wildlife agencies compared to other species (Fenwick 2011). Most participants (17/20) were in contact with a government wildlife agent via telephone calls or email messages 5 or more times a year (Appendix 2). Visits from a government wildlife agent, on the other hand, were more variable and tended to be less frequent (Appendix 2).

Whether this level of interaction is considered atypical in the wildlife rehabilitation field is unclear. Research suggests it may not be: in a study unrelated to bears, Dubois and Fraser (2003) found similar levels of interaction between rehabilitators and government wildlife agencies, with frequency of contact varying from once a month to a few times a year. Nonetheless, the benefits of a close working relationship remain clear. In assuming responsibility for releases, government wildlife agencies see the rehabilitation process through to its conclusion. Therefore, in working closely with them, rehabilitators can ensure that bears are released under favourable conditions (Beecham 2006).

2.4 Conclusions

Black bear rehabilitators across Canada and the United States were surveyed in order to glean detailed information on how cubs are raised and released. The questionnaire covered all aspects of the rehabilitation process considered pertinent to the care of cubs, including feeding, housing, health and sanitation, handling and human exposure, hibernation, releases, funding and expenses, and government relations. Our findings suggest that a variety of methods can be used to successfully raise cubs to release. Black bears were admitted to a diverse array of wildlife rehabilitation centres, ranging from small, home-based programs taking in fewer than a hundred animals a year to large, fully-staffed facilities receiving several thousand animals annually. Relying mainly on donations and

grants, rehabilitators cared for a total of 144 cubs a year on average, at a mean cost of $154 per bear each month. Efforts were made to feed natural foods and provide an environment that allowed for hibernation and stimulated natural behaviours such as climbing, playing, and foraging. Although generally free of serious health concerns, cubs received veterinary treatment as needed and, facilitated by government wildlife agencies, were released back into the wild at an average age of 14 months. Given that black bears pose a potential threat to human safety, rehabilitators were well aware of the risks associated with handling and human exposure. With an average of nearly 15 years of experience rehabilitating bears, participants were careful to limit contact with cubs and keep caretaker numbers to a minimum. Cubs were also housed in groups to reduce habituation and permit more normal social development. Furthermore, cubs in care were shown to have high survival rates and weights in relation to bears at a comparable age in the wild. Therefore, we conclude that black bear cubs are suitable rehabilitation candidates, as they can be raised to release age with low mortalities and high weight gains using non-uniform methods.

Chapter 3: Conclusion

This study built upon the recommendations provided by *Orphan Bear Cubs: Rehabilitation and Release Guidelines* (2006), the first document to outline the rehabilitation process in detail. Our findings confirm what was presented in this earlier work: a variety of methods can be used to successfully raise cubs to release. Furthermore, the research presented in this thesis is the first to show that cubs in care achieve high survival rates and weights compared to bears at a similar age in the wild. Taken together, the results of this survey lend support to the conclusion made by Beecham (2006) that rehabilitation appears to be a suitable option for orphaned black bear cubs in North America. Our findings also indicate that the following practices may be important in the rehabilitation of black bears:

1. **Feed cubs in ways that stimulate natural foraging behaviour**

   Bears in the wild spend at least half the day foraging for food, even longer as they begin preparing for hibernation (Nelson et al. 1983; Paisley and Garshelis 2006). Making cubs work to find and access their food may occupy more of their time and help to prevent or reduce stereotypic behaviours such as pacing (Carlstead and Seidensticker 1991).

2. **Keep cubs in large, complex enclosures away from human activity**

   Larger enclosures containing natural and artificial features may provide a more complex environment for cubs and thus more opportunities to express natural behaviours such as climbing and foraging, which may again help to mitigate stereotypies (Beecham 2006; Bourne and Vila-Garcia 2007). In addition, isolated enclosures may help to limit the exposure cubs have to humans compared to cages located in high traffic areas.

3. **House cubs in groups**

   Although adult bears are generally solitary, cubs spend the first year and a half of their life in constant, close association with their mother and siblings (Ternent and

Garshelis 1998). Providing cubs in care with companionship may therefore help to facilitate their social and physical development, as well as reduce their level of habituation by allowing them to focus on each other instead of their caretakers (Beecham and Ramanathan 2007).

4. **Administer routine medical care**

   Routine medical care includes physical exams, blood and fecal tests, and parasite treatments, all of which are important for releasing healthy cubs back into the wild. Physical exams are necessary to determine whether cubs require treatment at the outset of care, and to assess whether cubs are fit for release (Loeffler 2007). They also represent an ideal opportunity to obtain cub weights. Blood tests are useful for detecting disease, as well as for establishing normal values as a reference point for sick or injured cubs. Fecal tests can determine the degree and nature of parasite infestation (Miller 2000). Treatment for parasites helps to prevent their spread within facilities, as well as to bears in the wild once cubs are released (Beecham 2006).

5. **Minimize caretaker numbers and interactions with cubs**

   Some degree of habituation in cubs is expected due to the nature of the rehabilitation process (Beecham and Ramanathan 2007). However, where possible, steps can be taken to reduce habituation. As cubs grow older and become increasingly independent, interactions can be limited to feeding and cleaning only. Also, having fewer caretakers limits the number of people cubs are exposed to during their stay in rehabilitation (Beecham 2006).

6. **Develop a good relationship with government wildlife agencies**

   Release decisions are at the discretion of government wildlife agencies and, therefore, rehabilitators often have little control over where or when cubs are released. In maintaining a close relationship with government wildlife agencies,

rehabilitators can work to ensure that cubs are released under favourable conditions (Beecham 2006).

7. **Keep detailed records on cubs admitted**

   Although record keeping is considered an essential task in rehabilitation (Moore and Joosten 2002), many rehabilitators simply do not have concrete protocols for collecting information on animals admitted (Hill 2004). Recording ages, sexes, and weights, as well as intake and final disposition dates for all cubs in care will make future evidence-based studies on bear rehabilitation possible.

To date, there have been few studies on bear rehabilitation, and most have been limited to bears kept at a single facility (ex. Wasserman and Clumpner 1991; Ashraf et al. 2008; Treptow 2009). Although multi-institution studies are becoming increasingly common in the zoo literature (ex. Montaudouin and Le Pape 2005; Kuhar et al. 2006), they are surprisingly lacking in the wildlife rehabilitation field, particularly in North America (ex. South Africa: Wimberger et al. 2010; Australia: Guy and Banks 2012). Thus, this study provides a precedent for multi-institution data analysis among wildlife rehabilitation centres in Canada and the United States. In addition, previous multi-institution work on bear rehabilitation has included other bear species (ex. Beecham 2006; Beecham and Ramanathan 2007). To our knowledge, the work presented in this thesis is the first to focus solely on black bears.

The earlier work by Beecham (2006) has been referenced by government wildlife agencies in policy documents (ex. IDFG 2009) and by wildlife rehabilitation organizations in minimum standards (ex. WRNBC 2012). The findings presented in this thesis, which were the result of a scholarly, multi-institution survey, should have a similar, if not greater, impact in setting black bear rehabilitation policies and standards, particularly as attempts are made to quantify the rehabilitation process where possible. The current results and associated references to the known scientific literature (ex. feeding schedules, handling times, etc.)

may be helpful as reference points in establishing guidelines. Furthermore, the findings of the survey provide clear evidence that rehabilitators recognize the challenges associated with excessive human-bear contact during the rehabilitation process and, where possible, minimize habituation. Government wildlife agencies may therefore be more open to supporting black bear rehabilitation in the future. As this study has identified potentially important rehabilitation practices, the findings presented should also inform wildlife rehabilitators new to raising and releasing bears.

3.1 Strengths and limitations of the research

Our 69% response rate can be considered a strength, as few mail surveys ever achieve a response rate close to 70% (Babbie 2010). In comparison, the questionnaire that informed *Orphan Bear Cubs: Rehabilitation and Release Guidelines* (2006) had a 58% response rate. Non-response bias was not tested; however, it is likely that, had surveys been received from all the centres initially contacted, the combined results would further speak to the variability of rehabilitation methods, likely strengthening our conclusion.

For the most part, this study was able to avoid the sampling and non-coverage errors common to survey research (Dillman 1991; Babbie 2010). All known black bear rehabilitators were invited to participate; there was no need to draw a random sample from this population, but rather to be as inclusive as possible. Also, as the method of survey delivery can itself restrict participation (Dillman 1991), questionnaires were sent both electronically and in the mail to accommodate rehabilitator preference.

Measurement error, also common to survey research (Dillman 1991), was minimized by beta-testing the survey, as well as by phrasing questions in a neutral manner. For instance, the word “unusual” was substituted for “abnormal” when asking participants about stereotypic behaviours seen in bears, as the stronger term “abnormal” may have been

perceived as judgmental. Thus, with the milder phrasing, participants were less likely to feel pressured to answer one way or another (Dillman 1991; Babbie 2010).

Another strength of this study lies in its comprehensiveness and specificity. Few studies have described the rehabilitation of a single species at multiple centres in this detail; rather, as mentioned earlier, many focus on one facility or one aspect of husbandry such as diet or housing (ex. Guarnera 1995; MacRae et al. 2011). As a result, what has emerged from the research is a picture of the process in its entirety: not only how rehabilitators care for bears, but also how the success of what they do is impacted by factors beyond the day-to-day work of looking after cubs, release decisions and government relations in particular.

There may be a trade-off in survey research, however, between detail and length. The survey was 15 pages, with many questions requiring in-depth answers. Surveys longer than 100 questions or 10 pages can have a detrimental effect on response rate (Burchell and Marsh 1992). Attempts were made to increase response rate by following up with rehabilitators in person, a technique generally known to boost response rates (Scott 1961; Babbie 2010). However, when asked in person, some rehabilitators indicated a willingness to participate, but never completed the questionnaire. We suspect that perhaps, once they received the survey, they were somewhat daunted by its length. Therefore, our response rate may have been lower than if we had requested less information from participants. In retrospect, we could have administered a series of shorter surveys, each on a different aspect of the rehabilitation process, to potentially achieve a higher response rate.

The complexity of the questionnaire may also have been an issue, as some of the questions may have unintentionally been oriented to larger, more professional centres with formal standard operating procedures. When surveys were returned, a number of participants commented on not being able to answer all the questions as, operating a small, home-based centre, they did not have established protocols. In hindsight, combining the survey with interviews would likely have bridged the gap by giving participants an opportunity to

explain themselves rather than making them feel forced to leave questions blank (Babbie 2010).

3.2 Future research directions

Through the research presented in this thesis, a number of areas of potential study have been identified. Further work is called for on the composition of milk formulas fed to cubs; the motivation for non-nutritive sucking in infant bears; the role of cage furnishings in bear rehabilitation; the prevalence and implications of stereotypic pacing in cubs; the social development of single cubs raised with an artificial cage-mate; and the comparison of release methods and timing for bears. Research in these areas could lead to substantial improvements to rehabilitation methods, as well as bear welfare.

As both this study and the earlier work by Beecham (2006) were descriptive in nature, what remains to be developed are evidence-based best practices for the rehabilitation of black bear cubs in North America. Future research on this topic, therefore, should focus on factor analysis (see Molony et al. 2007) to determine what rehabilitation methods are most closely associated with survival and weight gains in care, as well as post-release survival. No study on wildlife rehabilitation would be complete without acknowledging the need for post-release monitoring. Rehabilitation methods cannot truly be deemed successful without knowing what influence they have on the ability of bears to survive, avoid conflict, integrate into the wild population, and, ultimately, reproduce (Clark et al. 2002).

References

Alt, G.L., G.J. Matula Jr., F.W. Alt, and J.S. Lindzey. 1980. Dynamics of home range and movements of adult black bears in northeastern Pennsylvania. Bears: Their Biology and Management 4: 131-136.

Alt, G.L. and J.J. Beecham. 1984. Reintroduction of orphaned black bear cubs into the wild. Wildlife Society Bulletin 12: 169-174.

Ashraf, N.V.K., T. Dadda, P. Boro, and N. Akhtar. 2008. Walking the bears: Rehabilitation of Asiatic black bears in Arunachal Pradesh. New Delhi, India: Wildlife Trust of India.

Aune, K. 1994. Comparative ecology of black and grizzly bears on the Rocky Mountain front, Montana. Bears: Their Biology and Management 9: 365-374.

AZA Bear TAG (Association of Zoos and Aquariums Bear Taxon Advisory Group). 2008. North American black bear adoption/placement/rescue guidelines. http://www.bearden.org/, accessed 19 August 2008.

Babbie, E. 2010. The practice of social research (12th ed.). Belmont, California: Wadsworth.

Bacon, E.S. 1980. Curiosity in the American black bear. Bears: Their Biology and Management 4: 153-157.

Bacon, E.S. and G.M. Burghardt. 1983. Food preference testing of captive black bears. Bears: Their Biology and Management 5: 102-105.

Bartareau, T.M., N.C. Larter, H.D. Cluff, and E.H. Leone. 2012. Body condition and growth dynamics of American black bears in northern Canada. Ursus 23: 12-20.

Bath, A.J. 1998. The role of human dimensions in wildlife resource research in wildlife management. Ursus 10: 349-355.

Beecham, J.J., D.G. Reynolds, and M.G. Hornocker. 1983. Black bear denning activities and den characteristics in west-central Idaho. Bears: Their Biology and Management 5: 79-86.

Beecham, J. 2006. Orphan bear cubs: Rehabilitation and release guidelines. http://www.bearsmart.com/managingBears/Rehab.html, accessed 1 March 2008.

Beecham, J. and A. Ramanathan (eds.). 2007. Proceedings of the 2007 international workshop on the rehabilitation, release and monitoring of orphan bear cubs. http://www.ifaw.org/sites/default/files/Bear%20Workshop%202007.pdf, accessed 26 January 2013.

Binks, M.J. 2008. Post-release behaviour and survival of shelter reared, juvenile black bears in central Ontario. Master's Thesis. Sudbury, Ontario: Laurentian University.

Binninger, C.E., J.J. Beecham, L.A. Thomas, and L.D. Winward. 1980. A serologic survey for selected infectious diseases of black bears in Idaho. Journal of Wildlife Diseases 16: 423-430.

Bourne, D.C. and G. Vila-Garcia (eds.). 2007. Bears: Health and management. DVD. London, United Kingdom: Wildlife Information Network.

Bourne, D.C., J.M. Cracknell, and H.J. Bacon. 2010. Veterinary issues related to bears (Ursidae). International Zoo Yearbook 44: 16-32.

Burchell, B. and C. Marsh. 1992. The effect of questionnaire length on survey response. Quality & Quantity 26: 233-244.

Burghardt, G.M. and L.S. Burghardt. 1972. Notes on the behavioral development of two female black bear cubs: The first eight months. Bears: Their Biology and Management 2: 207-220.

Burton, D.L. and K.A. Doblar. 2004. Morbidity and mortality of urban wildlife in the midwestern United States. Proceedings of the 4th International Urban Wildlife Symposium: 171-181.

Butterworth, B.B. 1969. Postnatal growth and development of *Ursus americanus*. Journal of Mammalogy 50: 615-616.

Carlstead, K. and J. Seidensticker. 1991. Seasonal variation in stereotypic pacing in an American black bear *Ursus americanus*. Behavioural Processes 25: 155-161.

Casey, A. and S. Casey. 2000. A study of the state regulations governing wildlife rehabilitation during 1999. Wildlife Rehabilitation 18: 173-192.

CDFW (California Department of Fish and Wildlife). 2012. Black bear policy 2071. http:// www.dfg.ca.gov/wildlife/hunting/bear/statewidepolicy.html, accessed 26 July 2013.

Clark, J.E., M.R. Pelton, B.J. Wear, and D.R. Ratajczak. 2002. Survival of orphaned black bears released in the Smoky Mountains. Ursus 13: 269-273.

Clevenger, A.P. and M.R. Pelton. 1990. Pre and post breakup movements and space use of black bear family groups in Cherokee National Forest, Tennessee. Bears: Their Biology and Management 8: 289-295.

CPIU (The Center on Philanthropy at Indiana University). 2010. Charitable giving by type of community: Comparing donation patterns of rural and urban donors. Indianapolis, Indiana: Trustees of Indiana University.

Curtis, P.D., D.J. Decker, R.J. Stout, M.E. Richmond, and C.A. Loker. 1997. Human dimensions of contraception in wildlife management. In: Kreeger, T.J. (ed.). Contraception in Wildlife Management. Washington, District of Columbia: USDA APHIS, pp. 247-255.

Cushman, S.A. and J.S. Lewis. 2010. Movement behavior explains genetic differentiation in American black bears. Landscape Ecology 25: 1613-1625.

Davis, H., D. Wellwood, and L. Ciarniello. 2002. "Bear Smart" community program: Background report. Victoria, British Columbia: Ministry of Water, Land and Air Protection.

de Passillé, A.M. and J. Rushen. 1997. Motivational and physiological analysis of the causes and consequences of non-nutritive sucking by calves. Applied Animal Behaviour Science 53: 15-31.

de Paula Vieira, A., V. Guesdon, A.M. de Passillé, M.A.G. von Keyserlingk, and D.M. Weary. 2008. Behavioural indicators of hunger in dairy calves. Applied Animal Behaviour Science 109: 180-189.

Dillman, D.A. 1991. The design and administration of mail surveys. Annual Review of Sociology 17: 225-249.

Don Carlos, A.W., A.D. Bright, T.L. Teel, and J.J. Vaske. 2009. Human-black bear conflict in urban areas: An integrated approach to management response. Human Dimensions of Wildlife 14: 174-184.

Dubois, S. 2003. A survey of wildlife rehabilitation goals, impediments, issues, and success in British Columbia, Canada. Master's Thesis. Vancouver, British Columbia: University of British Columbia.

Dubois, S. and D. Fraser. 2003. Conversations with stakeholders, part 1: Goals, impediments, and relationships in wildlife rehabilitation. Journal of Wildlife Rehabilitation 26: 14-22.

Eastridge, R. and J.D. Clark. 2001. Evaluation of 2 soft-release techniques to reintroduce black bears. Wildlife Society Bulletin 29: 1163-1174.

Elowe, K.D. and W.E. Dodge. 1989. Factors affecting black bear reproductive success and cub survival. Journal of Wildlife Management 53: 962-968.

Erickson, A.W. 1959. The age of self-sufficiency in the black bear. Journal of Wildlife Management 23: 401-405.

Farley, S.D. and C.T. Robbins. 1995. Lactation, hibernation, and mass dynamics of American black bears and grizzly bears. Canadian Journal of Zoology 73: 2216-2222.

Fenwick, C.A. 2011. Regulation of American black bear rehabilitation in the United States. Master's Thesis. Charles Town, West Virginia: American Public University System.

Fraser, J.D. and M.B. Moss. 1985. A need for agency policies on wildlife rehabilitation. Wildlife Society Bulletin 13: 202-204.

Gage, L.J. 2002. Hand-rearing wild and domestic mammals. Ames, Iowa: Iowa State Press.

Gage, L.J. and R.S. Duerr. 2007. Hand-rearing birds. Ames, Iowa: Blackwell Publishing.

Garrison, E.P., J.W. McCown, and M.K. Oli. 2007. Reproductive ecology and cub survival of Florida black bears. Journal of Wildlife Management 71: 720-727.

Garshelis, D.L. 2004. Variation in ursid life histories. In: Lindburg, D.G. and K. Baragon (eds.). Giant Pandas: Biology and Conservation. Berkeley, California: University of California Press, pp. 53-73.

Garshelis, D.L., D. Crider, and F. van Manen. 2008. *Ursus americanus*. http://www.iucnredlist.org/details/41687/0, accessed 10 August 2013.

GBSS (Get Bear Smart Society). 2007. Responding to human-black bear conflicts: A guide to non-lethal bear management techniques. Whistler, British Columbia: Get Bear Smart Society.

Gore, M.L., B.A. Knuth, P.D. Curtis, and J.E. Shanahan. 2006. Education programs for reducing American black bear-human conflict: Indicators of success? Ursus 17: 75-80.

Guarnera, T.R. 1995. Rehabilitation of the great gray owl (*Strix nebulosa*). Wildlife Rehabilitation 13: 67-77.

Guy, A.J. and P. Banks. 2012. A survey of current rehabilitation practices for native mammals in eastern Australia. Australian Mammalogy 34: 108-118.

Haley, D.B., J. Rushen, I.J.H. Duncan, T.M. Widowski, and A.M. de Passillé. 1998. Effects of resistance to milk flow and the provision of hay on nonnutritive sucking by dairy calves. Journal of Dairy Science 81: 2165-2172.

Herrero, S. 1972. Aspects of evolution and adaptation in American black bears (*Ursus americanus pallus*) and brown and grizzly bears (*Ursus arctos linné*) of North America. International Union for Conservation of Nature & Natural Resources 23: 221-231.

Hill, J. 2004. The (other) value of rehabilitators, part 1: Where, oh where, did the data go? Journal of Wildlife Rehabilitation 27: 28-29.

Hopkins III, J.B., S. Herrero, R.T. Shideler, K.A. Gunther, C.C. Schwartz, and S.T. Kalinowski. 2010. A proposed lexicon of terms and concepts for human-bear management in North America. Ursus 21: 154-168.

Hristienko, H. and J.E. McDonald Jr. 2007. Going into the 21st century: A perspective on trends and controversies in the management of the American black bear. Ursus 18: 72-88.

Hulley, J.T. 1976. Hand-rearing American black bear cubs *Ursus americanus* at Toronto Zoo. International Zoo Yearbook 16: 202-205.

IDFG (Idaho Department of Fish and Game). 2009. Guidelines and best management practices for successful rehabilitation of black bears in Idaho. Boise, Idaho: Department of Fish and Game.

IUCN SSC (International Union for Conservation of Nature Species Survival Commission). 2012. Guidelines for reintroductions and other conservation translocations. Gland, Switzerland and Cambridge, United Kingdom: IUCN/SSC Re-introduction Specialist Group.

Johnson, K.G. and M.R. Pelton. 1980. Environmental relationships and the denning period of black bears in Tennessee. Journal of Mammalogy 61: 653-660.

Jonkel, C.J. and I.M. Cowan. 1971. The black bear in the spruce-fir forest. Wildlife Monographs 27: 3-57.

Kanaan, V.T. and E.A. Pajor. 2010. Increasing pre-weaning social complexity affects orphan raccoon behavioral development before and after weaning. Journal of Wildlife Rehabilitation 30: 7-15.

Kirkwood, J.K. and A.W. Sainsbury. 1996. Ethics of interventions for the welfare of free-living wild animals. Animal Welfare 5: 235-243.

Kolenosky, G.B. 1990. Reproductive biology of black bears in east-central Ontario. Bears: Their Biology and Management 8: 385-392.

Kolenosky, G. 2008. Black bear. http://www.hww.ca/en/species/mammals/black-bear.html, accessed 16 July 2013.

Kolter, L. and J. van Dijk (eds.). 2005. Rehabilitation and release of bears: For the welfare of conservation or the conservation of welfare? http://www.ceinst.org/Smeeton&Waters%202005.pdf, accessed 8 January 2009.

Kuhar, C.W., T.S. Stoinski, K.E. Lukas, and T.L. Maple. 2006. Gorilla behavior index revisited: Age, housing and behavior. Applied Animal Behaviour Science 96: 315-326.

LaFond, C. 1995. Rearing of young red fox (*Vulpes vulpes*). Wildlife Rehabilitation 13: 123-128.

Lander, M.E., J.T. Harvey, K.D. Hanni, and L.E. Morgan. 2002. Behavior, movements, and apparent survival of rehabilitated and free-ranging harbor seal pups. Journal of Wildlife Management 66: 19-28.

Larivière, S. 2001. *Ursus americanus*. Mammalian Species 647: 1-11.

Law, G. and A. Reid. 2010. Enriching the lives of bears in zoos. International Zoo Yearbook 44: 65-74.

Lawrence, A.B. and E.M. Terlouw. 1993. A review of behavioral factors involved in the development and continued performance of stereotypic behaviors in pigs. Journal of Animal Science 71: 2815-2825.

LeCount, A.L. 1987. Causes of black bear cub mortality. Bears: Their Biology and Management 7: 75-82.

Lee, D.J. and M.R. Vaughan. 2003. Dispersal movements by subadult American black bears in Virginia. Ursus 14: 162-170.

Lindsey, K.J. and C.E. Adams. 2006. Public demand for information and assistance at the human-wildlife interface. Human Dimensions of Wildlife 11: 267-283.

Linnell, J.D.C., J.E. Swenson, R. Andersen, and B. Barnes. 2000. How vulnerable are denning bears to disturbance? Wildlife Society Bulletin 28: 400-413.

Loeffler, K. 2007. Veterinary considerations for rehabilitation and release of bear cubs (with emphasis on principles of anesthesia for bears). In: Beecham, J. and A. Ramanathan (eds.). Proceedings of the 2007 International Workshop on the Rehabilitation, Release and Monitoring of Orphan Bear Cubs. http://www.ifaw.org/sites/default/files/Bear%20Workshop%202007.pdf, accessed 26 January 2013, pp. 51-73.

Lohuis, T.D., T.D.I. Beck, and H.J. Harlow. 2005. Hibernating black bears have blood chemistry and plasma amino acid profiles that are indicative of long-term adaptive fasting. Canadian Journal of Zoology 83: 1257-1263.

MacLeod, A. and J. Perlman. 2004. Wildlife feeding and nutrition (2nd ed.). Oakland, California: International Wildlife Rehabilitation Council.

MacRae, A.M., M. Haulena, and D. Fraser. 2011. The effect of diet and feeding level on survival and weight gain of hand-raised harbor seal pups (*Phoca vitulina*). Zoo Biology 30: 532-541.

Manville, A. 1990. Rearing and management of orphaned black bear cubs. Wildlife Rehabilitation 8: 57-64.

Marks, S.A. and A.W. Erickson. 1966. Age determination in the black bear. Journal of Wildlife Management 30: 389-410.

Mattson, D.J. 1990. Human impacts on bear habitat use. Bears: Their Biology and Management 8: 33-56.

Maughan, S. 2010. Black bear rehabilitation handbook. http://www.bearrehab.org/2010_handbook.pdf, accessed 31 October 2010.

Mazur, R. and V. Seher. 2008. Socially learned foraging behaviour in wild black bears, *Ursus americanus*. Animal Behaviour 75: 1503-1508.

McArthur, K.L. 1981. Factors contributing to effectiveness of black bear transplants. Journal of Wildlife Management 45: 102-110.

McPhee, M.E. and K. Carlstead. 2010. The importance of maintaining natural behaviors in captive mammals. In: Kleiman, D.G., K.V. Thompson, and C.K. Baer (eds.). Wild Mammals in Captivity: Principles and Techniques for Zoo Management (2nd ed.). Chicago, Illinois: University of Chicago Press, pp. 303-313.

Miller, E.A. (ed.). 2000. Minimum standards for wildlife rehabilitation (3rd ed.). St. Cloud, Minnesota: National Wildlife Rehabilitators Association.

Molony, S.E., P.J. Baker, L. Garland, I.C. Cuthill, and S. Harris. 2007. Factors that can be used to predict release rates for wildlife casualties. Animal Welfare 16: 361-367.

Montaudouin, S. and G. Le Pape. 2005. Comparison between 28 zoological parks: Stereotypic and social behaviours of captive brown bears (*Ursus arctos*). Applied Animal Behaviour Science 92: 129-141.

Moore, A.T. and S. Joosten. 2002. Keeping records. In: Moore, A.T. and S. Joosten (eds.). NWRA Principles of Wildlife Rehabilitation: The Essential Guide for Novice and Experienced Rehabilitators (2nd ed.). St. Cloud, Minnesota: National Wildlife Rehabilitators Association, pp. 3.5-3.6.

Morgan, K.N. and C.T. Tromborg. 2007. Sources of stress in captivity. Applied Animal Behaviour Science 102: 262-302.

Mortenson, J.A. 1998. Serologic survey of infectious disease agents in black bears (*Ursus americanus*) of California, Oregon, and Washington. Master's Thesis. Corvallis, Oregon: Oregon State University.

NABC (North American Bear Centre). 2013. Five stages of activity and hibernation. http://www.bear.org/website/bear-pages/black-bear/hibernation/191-5-stages-of-activity-and-hibernation.html, accessed 16 July 2013.

Nelson, R.A., G.E. Folk Jr., E.W. Pfeiffer, J.J. Craighead, C.J. Jonkel, and D.L. Steiger. 1983. Behavior, biochemistry, and hibernation in black, grizzly, and polar bears. Bears: Their Biology and Management 5: 284-290.

Newberry, R.C. 1995. Environmental enrichment: Increasing the biological relevance of captive environments. Applied Animal Behaviour Science 44: 229-243.

NWRA (National Wildlife Rehabilitators Association). 2009. NWRA 2008 member survey report: Part 1. The Wildlife Rehabilitator 9: 5-6.

NWRA (National Wildlife Rehabilitators Association). 2013. What is wildlife rehabilitation? http://www.nwrawildlife.org/content/what-wildlife-rehabilitation, accessed 18 August 2013.

Noyce, K.V. and D.L. Garshelis. 1998. Spring weight changes in black bears in northcentral Minnesota: The negative foraging period revisited. Ursus 10: 521-531.

O'Brien, D. 2010. Overview of infectious diseases in black bears. http://cvmstudent.cvm.msu.edu/zwc/MembersOnly/BearDiseaseFall2010.pdf, accessed 22 July 2013.

OBCRC (Orphan Bear Cub Review Committee). 2000. Orphan bear cub review committee recommendations. Victoria, British Columbia: Ministry of Environment, Lands and Parks.

Oftedal, O.T., G.L. Alt, E.M. Widdowson, and M.R. Jakubasz. 1993. Nutrition and growth of suckling black bears (*Ursus americanus*) during their mothers' winter fast. British Journal of Nutrition 70: 59-79.

Paisley, S. and D.L. Garshelis. 2006. Activity patterns and time budgets of Andean bears (*Tremarctos ornatus*) in the Apolobamba range of Bolivia. Journal of Zoology 268: 25-34.

Peine, J.D. 2001. Nuisance bears in communities: Strategies to reduce conflict. Human Dimensions of Wildlife 6: 223-237.

Pelton, M.R. 1982. Black bear. In: Chapman, J.A. and G.A. Feldhammer (eds.). Wild Mammals of North America: Biology, Management and Economics. Baltimore, Maryland: The Johns Hopkins University Press, pp. 504-514.

Pruitt, C.H. 1976. Play and agonistic behavior in young captive black bears. Bears: Their Biology and Management 3: 79-86.

Reade, L.S. and N.K. Waran. 1996. The modern zoo: How do people perceive zoo animals? Applied Animal Behaviour Science 47: 109-118.

Rogers, L.L. 1976. Effects of mast and berry crop failures on survival, growth, and reproductive success of black bears in northeastern Minnesota. North American Wildlife and Natural Resources Conference 41: 431-438.

Rogers, L.L. 1981. A bear in its lair. Natural History 90: 64-70.

Rogers, L.L. 1983. Effects of food supply, predation, cannibalism, parasites, and other health problems on black bear populations. In: Bennell, F.L., D.S. Eastman, and J.M. Peek (eds.). Symposium on Natural Regulation of Wildlife Populations. Moscow, Idaho: University of Idaho, pp. 194-211.

Rogers, L.L. 1985. Aiding the wild survival of orphaned bear cubs. Wildlife Rehabilitation 4: 104-111.

Rogers, L.L. 1993. The role of habitat quality in the natural regulation of black bear populations. Proceedings of the 4th Western Black Bear Workshop: 95-102.

Scott, C. 1961. Research on mail surveys. Journal of the Royal Statistical Society, Series A (General) 124: 143-205.

SPSS 16.0.1. 2007. SPSS for Windows. Chicago, Illinois: SPSS Inc.

Swaisgood, R.R. and D.J. Shepherdson. 2005. Scientific approaches to enrichment and stereotypies in zoo animals: What's been done and where should we go next? Zoo Biology 24: 499-518.

Taylor, D. 2006. Black bears: A natural history. Markham, Ontario: Fitzhenry and Whiteside.

Ternent, M.A. and D.L. Garshelis. 1998. Male-instigated break-up of a family of black bears. Ursus 10: 575-578.

Treptow, J. 2009. Evaluating the success of grizzly bear rehabilitation in British Columbia, Canada. Master's Thesis. Munich, Germany: Technical University of Munich.

van Manen, F.T. and M.R. Pelton. 1997. Procedures to enhance the success of a black bear reintroduction program. Bears: Their Biology and Management 9: 67-77.

Vickery, S.S. and G.J. Mason. 2003. Behavioral persistence in captive bears: Implications for reintroduction. Ursus 14: 35-43.

Waples, K.A. and C.S. Stagoll. 1997. Ethical issues in the release of animals from captivity. Bioscience 47: 115-121.

Wasserman, J.A. and C.J. Clumpner. 1991. Rehabilitation of orphaned and injured black bear cubs (*Ursus americanus*). Wildlife Rehabilitation 9: 35-40.

Wasserman, J.A. and C.J. Clumpner. 1995. Post-release survival and movements of captive-reared black bear cubs (*Ursus americanus*). Wildlife Rehabilitation 13: 153-169.

Wathen, W.G. and M.R. Pelton. 1984. Characteristics of black bear cubs in the southern Appalachians. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 38: 61-69.

Wiepkema, P.R., K.K. van Hellemond, P. Roessingh, and H. Romberg. 1987. Behaviour and abomasal damage in individual veal calves. Applied Animal Behaviour Science 18: 257-268.

Wimberger, K., C.T. Downs, and R.S. Boyes. 2010. A survey of wildlife rehabilitation in South Africa: Is there a need for improved management? Animal Welfare 19: 481-499.

Woodford, M.H. (ed.). 2000. Quarantine and health screening protocols for wildlife prior to translocation and release into the wild. Gland, Switzerland and Paris, France: IUCN/SSC Veterinary Specialist Group, Office International des Epizooties, Care for the Wild, and European Association of Zoo and Wildlife Veterinarians.

Wooding, J.B. and T.S. Hardisky. 1994. Home range, habitat use, and mortality of black bears in north-central Florida. Bears: Their Biology and Management 9: 349-356.

WRNBC (Wildlife Rehabilitators' Network of British Columbia). 2012. Minimum standards for wildlife rehabilitation for the province of British Columbia. http://www.wrnbc.org/wp-content/uploads/2011/03/Minimum-Standards-WRNBC_final.pdf, accessed 31 July 2013.

Young, R.J. 2003. Environmental enrichment for captive animals. Oxford, United Kingdom: Blackwell Science Ltd.

Appendix 1: Consent form and survey

2357 Main Mall, Vancouver, BC V6T 1Z4, Canada • www.landfood.ubc.ca/animalwelfare/

Black Bear Rehabilitation Survey

Research Team
Principal Investigator: Dr. David Fraser, Professor
Co-Investigator: Meghann Cant, Graduate Student
Animal Welfare Program
Faculty of Land and Food Systems
The University of British Columbia

Before completing the survey below, please take your time to review this consent form. Feel free to contact our research team to discuss any questions you may have.

We are investigating different methods of rehabilitating and releasing black bear cubs in order to develop best practices for the species. We would therefore like to draw on your knowledge and experiences. Our study should provide useful information to wildlife rehabilitators, as well as government and future graduate students studying and working in wildlife rehabilitation. We are contacting black bear rehabilitators throughout Canada and the United States, so your views are very important to us. We would be grateful if you would consent to participate in the project.

Your participation is entirely voluntary. You may refuse to participate or decide to withdraw from the study at any time. Should there be a survey question that you are unable or do not want to answer, you are not required to do so. We will respect your preferences.

Due to the specific nature of the topic being studied, it is possible that you may be identified by the content of your answers. Please be assured, however, that all information provided by you and other study participants will be treated with the utmost respect. Specific measures will be taken to protect your privacy and ensure that identifying information is kept confidential. Pseudonyms (false names) will be substituted for your real name. All surveys will be identified by code and kept on a password-protected computer or in a locked filing cabinet in the project offices at the University of British Columbia. Only the immediate members of our research team will have access to the data.

This study is being carried out as part of a Master's thesis and is funded by the Natural Sciences and Engineering Research Council of Canada (NSERC) and the British Columbia Veterinary Medical Association (BCVMA). The information gained from our research may appear in various publications,

reports, and conference proceedings. As a study participant, you are welcome to request copies of these documents. They will also be shared with other interested agencies.

When this project is complete, our research team may wish to conduct additional studies on wildlife rehabilitation. Thus, we are requesting your permission to keep your anonymized survey and other research documents related to the present study for an indefinite period of time. If you agree, they will be kept by the Principal Investigator (Dr. David Fraser) or Co-Investigator (Meghann Cant) on a password-protected computer or in a locked filing cabinet in the project offices at the University of British Columbia. Should you only wish to participate in the present study with the stipulation that all research documents related to your participation be destroyed 5 years after publication of the original analysis, please indicate so below.

☐ I agree that the anonymized survey and other research documents resulting from my participation in this study may be kept by the Principal Investigator/Co-Investigator in a secure location for an indefinite period of time for the purpose of conducting comparative analyses with other similar studies.

☐ I do **not** agree that the anonymized survey and other research documents resulting from my participation in this study may be kept by the Principal Investigator/Co-Investigator in a secure location for an indefinite period of time for the purpose of conducting comparative analyses with other similar studies and I therefore request that all such documents be destroyed 5 years after publication of the original analysis.

There are no known risks of participating in the project. You may or may not find any personal benefit from your participation. From our research, we hope to develop best practices for the rehabilitation and release of black bear cubs in North America, which may ultimately prove useful to you in your line of work.

The survey should take about 30 to 45 minutes to complete. It is very important that your participation be entirely voluntary and based on a clear understanding. So, if you have any questions, please contact Meghann Cant, the Co-Investigator. Filling out and returning the survey indicates that:

1. Any questions have been answered to my satisfaction,
2. I understand that my participation is entirely voluntary and that I may refuse to participate or decide to withdraw from the study at any time, and
3. I understand this consent form and agree to complete a survey dealing with the topic described above.

Thank you for your time and effort. Your participation will make an important contribution to the project.

Section A: Introductory Questions

1. What wildlife centre do you work at now? _____

_____

2. Location (Town or City/Province or State): _____

3. How would you describe the area surrounding your centre? *(Please check all that apply)*

- ☐ Rural
- ☐ Agricultural
- ☐ Urban
- ☐ Suburban
- ☐ Wilderness
- ☐ Other: _____

4. Your position(s): _____

5. How long have you been involved in wildlife rehabilitation? _____ year(s)

6. How long have you been involved in rehabilitating black bears? _____ year(s)

7. Does your centre rehabilitate any animals other than black bears? ☐ Yes ☐ No

8. How many animals (including bears) did your centre receive in…
   2008? _____
   2007? _____
   2006? _____
   2005? _____
   2004? _____

9. How many black bears did your centre receive in…
   2008? _____
   2007? _____
   2006? _____
   2005? _____
   2004? _____

Section B: Feeding Questions

Infancy (i.e. when cubs are only receiving milk)

1. What formula(s) do you feed your infant bears? Please describe: _____

_____

_____

_____

_____

2. How often do you feed an infant bear in a day? _____ times per day

3. How much do you feed an infant bear in one feed? _____ percent of body weight

4. What method(s) do you use to feed your infant bears (ex. bottles, dishes, etc.)? Please describe: _____

_____

Pre-Weaning (i.e. when cubs are drinking milk and starting to eat some solids)

1. At approximately what age do you begin introducing solid foods to your bears? _____
2. What food(s) do you feed your pre-weaned bears? Please list: _____

3. How often do you feed a pre-weaned bear in a day?
   - Milk: _____ times per day
   - Solids: _____ times per day

4. How much do you feed a pre-weaned bear in one feed?
   - Milk: _____ percent of body weight
   - Solids: _____

5. What method(s) do you use to feed your pre-weaned bears (ex. bottles, dishes, etc.)? Please describe: _____

Weaning (i.e. when cubs are eating mostly solids and starting to drink less milk)

1. At approximately what age do your bears begin to wean? _____
2. Other than age, what criteria do you use to determine when your bears are ready for weaning? Please explain: _____
3. Your bears are weaned… ☐ Abruptly ☐ Gradually
4. Approximately how long do your bears take to wean? _____
5. What food(s) do you feed your weaning bears? Please list: _____
6. How often do you feed a weaning bear in a day?
   - Milk: _____ times per day
   - Solids: _____ times per day

7. How much do you feed a weaning bear in one feed?

Milk: _____ percent of body weight

Solids: _____

_____

8. What method(s) do you use to feed your weaning bears (ex. bottles, dishes, scatter feeding, etc.)? Please describe: _____

_____

_____

_____

Post-Weaning (i.e. when cubs are no longer receiving any milk)

1. By approximately what age are your bears completely weaned? _____
2. What food(s) do you feed your weaned bears? Please list: _____

_____

_____

_____

_____

3. How often do you feed a weaned bear in a day? _____ times per day
4. How much do you feed a weaned bear in one feed? _____

_____

_____

5. What method(s) do you use to feed your weaned bears (ex. dishes, scatter feeding, etc.)? Please describe: _____

_____

_____

_____

_____

6. In a year, what percentage of the food you give to your bears would you say is…

bought? _____

donated? _____

7. Do you feed natural foods (i.e. naturally occurring foods that bears would find in the wild) to your bears? ☐ Yes ☐ No
8. If you answered yes, what natural foods do you feed? Please list: _____

_____

_____

_____

_____

9. What percentage of your bears' diet would you estimate is natural foods? _____

Section C: Housing Questions

Up to Weaning

1. Up until they are weaned, your bears are housed… ☐ Indoors ☐ Outdoors ☐ Both
2. Minimum group size that you allow: _____ bear(s)
3. Maximum group size that you allow: _____ bear(s)
4. On what basis do you group bears together? Please explain: _____

_____

_____

_____

_____

5. Do you routinely provide heat for your bears? ☐ Yes ☐ No
6. If you answered yes, what type of heat source(s) do you provide? _____

_____

_____

_____

7. In a day, how many hours do you provide heat for? _____
8. Number of cages (including those that could be used by other animals): _____
9. Cage sizes (L × W × H): _____

_____

10. Cage materials:
    - Floor/substrate: _____
    - Roof/ceiling: _____
    - Walls/sides: _____

11. Please describe any other pertinent factors about how your bears are housed up until they are weaned: _____

_____

_____

_____

_____

_____

_____

After Weaning

1. After they are weaned, your bears are housed… ☐ Indoors ☐ Outdoors ☐ Both
2. Minimum group size that you allow: _____ bear(s)
3. Maximum group size that you allow: _____ bear(s)
4. On what basis do you group bears together? Please explain: _____

_____

_____

5. Do you routinely provide heat for your bears? ☐ Yes ☐ No

6. If you answered yes, what type of heat source(s) do you provide? _____

7. In a day, how many hours do you provide heat for? _____

8. Number of cages (including those that could be used by other animals): _____

9. Cage sizes (L × W × H): _____

10. Cage materials:

Floor/substrate: _____

Roof/ceiling: _____

Walls/sides: _____

11. Please describe any other pertinent factors about how your bears are housed after they are weaned: _____

12. Do you limit your bears' visibility from their cages? ☐ Yes ☐ No

13. If you answered yes, how do you limit their visibility? _____

14. What natural features do your cages contain (ex. trees, rocks, streams, vegetation, etc.)?
Please list: _____

15. What permanent furnishings do you use in your cages (ex. logs, den boxes, pools, ropes, etc.)?
Please list: _____

16. Do the bears ever pace in their cages? ☐ Yes ☐ No

17. If you answered yes, how many minutes per day would you say the bears spend pacing? ____

18. Please describe any other unusual behaviours that the bears might perform in their cages: ___

19. How many minutes per day would you say the bears spend performing these unusual behaviours? _____

Section D: Health/Sanitation Questions

1. Do your bears routinely see a veterinarian…
   - when they are first admitted? ☐ Yes ☐ No
   - before they are released? ☐ Yes ☐ No
   - for regular checkups? ☐ Yes ☐ No If yes, how often? _____

2. Do you or your staff perform a complete physical exam on your bears…
   - when they are first admitted? ☐ Yes ☐ No
   - before they are released? ☐ Yes ☐ No
   - for regular checkups? ☐ Yes ☐ No If yes, how often? _____

3. How often do sick or injured bears see a veterinarian? _____

4. Do you routinely quarantine…
   - new bears? ☐ Yes ☐ No If yes, for how long? _____
   - sick bears? ☐ Yes ☐ No If yes, for how long? _____

5. Do you routinely keep injured bears separate from other bears? ☐ Yes ☐ No

6. If you answered yes, how long are they separated for? _____

7. Do you routinely perform…
   - fecal tests on your bears? ☐ Yes ☐ No If yes, how often? _____
   - blood tests on your bears? ☐ Yes ☐ No If yes, how often? _____

8. Do you routinely treat your bears for…
   - internal parasites? ☐ Yes ☐ No If yes, with what? _____
     How often? _____
   - external parasites? ☐ Yes ☐ No If yes, with what? _____
     How often? _____

9. Do you routinely vaccinate your bears? ☐ Yes ☐ No

10. If you answered yes, what vaccine(s) do you use? _____

How often? _____

11. Please describe your daily cleaning procedures: _____

12. Please describe your weekly cleaning procedures: _____

13. Please describe your monthly cleaning procedures: _____

14. Please describe how you clean empty cages in preparation for a new bear/group of bears: ___

Section E: Handling/Human Exposure Questions

1. Who looks after the bears? *(Please check all that apply)*

- ☐ Yourself
- ☐ Staff
- ☐ Interns
- ☐ Volunteers
- ☐ Other: _____

2. How many bear caretakers do you have in total? _____

3. How many hours per day do bear caretakers spend inside the cage with the bears (ex. feeding, cleaning, medicating, observing, etc.)?

Infancy (milk only): _____

Pre-weaning (milk and some solids): _____

Weaning (mostly solids and some milk): _____

Post-weaning (no milk): _____

4. In a day, how many different bear caretakers spend time inside the cage with the bears (ex. feeding, cleaning, medicating, observing, etc.)?

Infancy (milk only): _____

Pre-weaning (milk and some solids): _____

Weaning (mostly solids and some milk): _____

Post-weaning (no milk): _____

5. How many hours per day do bear caretakers spend looking after the bears without being inside the cage with them (ex. preparing bear food, washing bear dishes, doing bear laundry, etc.)?

Infancy (milk only): _____

Pre-weaning (milk and some solids): _____

Weaning (mostly solids and some milk): _____

Post-weaning (no milk): _____

6. Do bear caretakers come into physical contact with the bears (ex. holding, playing, touching, etc.)? □ Yes □ No

7. If you answered yes, how many minutes per day are bear caretakers in physical contact with the bears (ex. holding, playing, touching, etc.)?

Infancy (milk only): _____

Pre-weaning (milk and some solids): _____

Weaning (mostly solids and some milk): _____

Post-weaning (no milk): _____

8. In a day, how many different bear caretakers are in physical contact with the bears (ex. holding, playing, touching, etc.)?

Infancy (milk only): _____

Pre-weaning (milk and some solids): _____

Weaning (mostly solids and some milk): _____

Post-weaning (no milk): _____

9. How many minutes per day would you say the bears are exposed to people in close proximity (ex. people walking by, observing from outside the cage, working nearby, etc.)?

Infancy (milk only): _____

Pre-weaning (milk and some solids): _____

Weaning (mostly solids and some milk): _____

Post-weaning (no milk): _____

10. In a day, how many different people would you say are in close proximity to the bears (ex. people walking by, observing from outside the cage, working nearby, etc.)?

Infancy (milk only): _____

Pre-weaning (milk and some solids): _____

Weaning (mostly solids and some milk): _____

Post-weaning (no milk): _____

11. Once they are weaned, can the bears see their caretakers during…

cleaning? ☐ Yes ☐ No

feeding? ☐ Yes ☐ No

12. Do you monitor your bears with cameras? ☐ Yes ☐ No

13. Do you go out of your way to limit contact with the bears at some point? ☐ Yes ☐ No

14. If you answered yes, at what point do you limit contact? _____

_____

_____

_____

_____

15. Do you restrict public access to…

your centre? ☐ Yes ☐ No

the bears? ☐ Yes ☐ No

Section F: Hibernation Questions

1. Do your bears hibernate? ☐ Yes ☐ No

2. Do you prepare your bears for hibernation? ☐ Yes ☐ No

3. If you answered yes, how do you prepare them? *(Please check all that apply)*

☐ Limiting food intake

☐ Providing a den to sleep in

☐ Providing materials to construct a den with

☐ Other: _____

4. What criteria do you use to determine whether or not your bears are ready to hibernate?

Please explain: _____

_____

_____

_____

_____

5. How long do your bears usually hibernate for? _____

Section G: Release Questions

1. Please list your release site criteria (ex. remote, food availability, etc.): _____

_____

_____

_____

_____

2. Do you choose release sites yourself? ☐ Yes ☐ No

3. Do you choose release dates yourself? ☐ Yes ☐ No

4. Please list your release criteria for your bears (ex. reach a certain age, weight, etc.): _____

5. Do you physically participate in releases yourself? ☐ Yes ☐ No

6. Do you release bears in groups? ☐ Yes ☐ No

7. Do you release single bears? ☐ Yes ☐ No

8. Do your bears undergo genetic testing before they are released? ☐ Yes ☐ No

9. Do you use soft release techniques (i.e. bears are confined at the release area for a period of time before being released into the wild)? ☐ Yes ☐ No

10. Do you use hard release techniques (i.e. bears are released directly into the wild)?

☐ Yes ☐ No

11. Do you routinely mark your bears for identification purposes in preparation for release?

☐ Yes ☐ No

12. If you answered yes, what identification method(s) do you use? *(Please check all that apply)*

- ☐ Tattoo
- ☐ Ear tag
- ☐ Freeze brand
- ☐ Microchip
- ☐ Other: _____

13. Do you routinely monitor your bears after they are released? ☐ Yes ☐ No

14. If you answered yes, what monitoring method(s) do you use? *(Please check all that apply)*

- ☐ Transmitter implant
- ☐ Radio collar
- ☐ GPS collar
- ☐ Other: _____

15. What would you estimate is the probability of a bear of yours coming into contact with people or human habitations within two weeks of being released?

- ☐ Less than 10 %
- ☐ 10 to 25 %
- ☐ 26 to 50 %
- ☐ 51 to 75 %
- ☐ 76 to 100 %

16. Please describe any other pertinent factors about how your bears are released: _____

_____

_____

_____

_____

_____

_____

Section H: Funding/Expenses Questions

1. At your centre, do you…

receive government funding? ☐ Yes ☐ No

receive private funding? ☐ Yes ☐ No

use your own personal funds? ☐ Yes ☐ No

2. Not including labour, what would you estimate is the cost to raise a healthy bear from infancy to release? _____ per bear when released at _____ months of age

3. On a scale of 1 to 5, please rank your bear-related expenses in order, with 1 being the most costly and 5 being the least costly:

Food: _____

Housing (including maintenance): _____

Health care: _____

Labour: _____

Releases: _____

Section I: Government Relations Questions

1. In a year, how often does a provincial or state wildlife agent visit your centre in person?

☐ 5 or more times a year

☐ 3 or 4 times a year

☐ 1 or 2 times a year

☐ Less than once a year

2. In a year, how often are you in contact (ex. via email, telephone, etc.) with your provincial or state wildlife agency?

☐ 5 or more times a year

☐ 3 or 4 times a year

☐ 1 or 2 times a year

☐ Less than once a year

Thank you for taking the time to fill out our survey. Your answers are greatly appreciated. Please send your completed questionnaire back to Meghann Cant in the envelope provided.

Appendix 2: Details on location, animal intake, human resources, bear facilities, bear health care, and government relations for 24 wildlife rehabilitation centres located throughout North America that participated in a 2009 survey on black bear rehabilitation (blank cells indicate no data provided by the centre).

	Centre Identification																							
	1	2	3	4	5*	6	7	8	9	10*	11	12	13	14	15	16	17*	18	19	20	21	22	23	24
Description of location (A = agricultural, R = rural, S = suburban, U = urban, W = wilderness)																								
Description	A R	R W	A R W	S U	W	W	R	A	S	W	R	A R	R	R	A R	R	R W	W	W	R	A R	W	S	A R
Average annual animal intake for the period of 2004-2008 ((a) 0-100, (b) 101-500, (c) 501-1,000, (d) 1,001-2,000, (e) 2,001-3,000, (f) 3,001-4,000)																								
Animal intake (including bears)	a		b	a	a	b	b	c		a		c	a	c		b	a				a		f	
Average annual bear intake for the period of 2004-2008 ((a) 0-5, (b) 6-10, (c) 11-15, (d) 16-25, (e) 26-35)																								
Bear intake	a	c	a	e	b	a	a	b	d	a		a	c	a	a	a	c	a			b	a	a	
Average annual survival rate of bears in care for the period of 2004-2008 (%)																								
Calculated survival rate								88.5	97.0			98.2	87.6	100.0	93.3	100.0					93.3	75.0		
Average annual survival rate of bears in care for the period of 2004-2008 ((a) 91-100%, (b) 76-90%, (c) 51-75%, (d) 26-50%, (e) 10-25%, (f) less than 10%)																								
Estimated survival rate		a	a	a		a				a	a						a			a			a	
Participant total years of rehabilitation experience																								
Wildlife in general	29	16	37	10	19	14	16	26	32	18	25	20	19	31	23	20	18	20	4	11	25	13	20	26

	Centre Identification																							
	1	2	3	4	5*	6	7	8	9	10*	11	12	13	14	15	16	17*	18	19	20	21	22	23	24
Bear specific	29	16	22	3	6	7	16	5	21	16	24	14	18	9	14	9	18	15	4	11	25	13	15	13
Total number and types of bear caretakers (Y = yes, N = no)																								
Total number of caretakers	1	1	3	15	1	6	2	4	3	1	1	2	2	2	8	3	1	3	2	5	2	2	6	
Staff	N	Y	Y	Y	N	Y	N	Y	Y	N	N	N	N	Y	Y	Y	N	N	Y	Y	N	N	Y	Y
Interns	N	N	N	Y	N	N	Y	Y	N	N	N	N	N	N	N	N	N	Y	N	Y	N	N	N	
Volunteers	N	N	N	Y	N	N	N	N	Y	N	N	N	Y	Y	Y	Y	N	N	N	Y	N	N	N	
Family										Y		Y									Y	Y		
Total number and sizes of bear cages																								
Total number of cages	4	14	4	16	4	3	3	7	5	4	3	10	9	2	2	10	6	2	6		5	3	7	
Average cage size ((a) less than 100 m^2, (b) 101-500 m^2, (c) 501-1,000 m^2, (d) 1,001-10,000 m^2, (e) 10,001-20,000 m^2)																								
Average cage size		e	d	a	d	a	a	b	b	e	a	a	b	a	b	a	a	d	a	b	a	e	a	
Bear health care (Y = yes, N = no)																								
Quarantine new bears	Y	Y	Y	N	N	Y	N	N		Y	Y	N	Y	Y	Y	Y	N	N	Y	Y	Y		Y	Y
Physical exam at intake	Y	Y	Y	Y	N	Y	Y	Y		N	N	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	
Physical exam at release	Y	Y	Y	N	N	Y	Y	Y		N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N		Y	Y	
Physical exam at regular intervals	N	N	N	N	N	N	N	N		N	N	N	N	N	N	N	N	N		N	N		Y	
Isolate sick bears		Y		N	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y		Y	
Separate injured bears		Y	Y	Y	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	
Blood testing	N	N	N	N	N	Y	N	N		N	N	N	N	Y	N	Y	N	Y	N	Y	N		Y	Y
Fecal testing	N	N	Y	N	N	Y	N	N		N	N	N	Y	Y	N	Y	N	Y	N	Y	Y		Y	
Treat internal parasites	Y	N	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y		Y	Y
Treat external parasites	Y	N	N	Y	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	Y		Y	

	Centre Identification																							
	1	2	3	4	5*	6	7	8	9	10*	11	12	13	14	15	16	17*	18	19	20	21	22	23	24
Vaccinate	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N		N	
Frequency of contact with government wildlife agencies ((a) 5 or more times a year, (b) 3 or 4 times a year, (c) 1 or 2 times a year, (d) less than once a year)																								
Non-visit contact by government	a	a	a		a	b	a	b		a	a	b	a	a	a	a	a	a	a	a	a		a	
Site visit by government	a	b	a		a	b	a	c		c	a	b	c	b	c	a	c	b	a	b	a		b	

*Centres specializing in bear rehabilitation