Analysis of criteria for potential release sites for rehabilitated American black bears (*Ursus americanus*)

Bachelor thesis

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presented by

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Eberswalde, Germany 28. July 2010

Declaration of independent work

With this statement, I declare that this Bachelor thesis was prepared by me, only using the given references in this paper. The connections with companies, governmental organizations and similar was only made with the agreement of my Bachelor thesis advisor.

(Sabrina Dreßel)

Eberswalde, 28. July 2010

Abstract

In North America, professional rehabilitation centres and private licensed persons care for orphaned or injured black bears (cubs, sub-adults and adults) and release them back into the wild (Van Dijk 2005). The rehabilitation and release of those bears offers wildlife managers an alternative to euthanizing or transferring them permanently into captive facilities (Beecham 2006).

As releases are often ad hoc and not part of long term programs, there is not much documentation and for many releases no detailed information exist (Van Dijk 2005).

This bachelor thesis is part of the “Protocol development for potential release sites for rehabilitated wildlife”-program of the Cochrane Ecological Institute (CEI) and tries to analyse release site criteria for black bears. As to choose a high quality area is a main aspect for the success of a release (Griffith et al. 1989); therefore it is essential to carry out habitat evaluation studies before releasing wildlife. (Pelton and Van Manen 1997).

The model, described in this bachelor thesis, is a formalized synthesis of biological and habitat information published in the scientific literature.

The assumptions necessary for organizing and synthesizing the species-habitat information into formulated release site criteria are discussed.

A result of this research was that an adequate release site has to fulfil not only environmental criteria, which are necessary to provide food, water and cover for the species, but also a variety of human-related factors. For some of the criteria it is either difficult to define a clear set point that must be met or it is not sure, if it is practicable to prove that the potential release site fulfils the criterion. The outcomes have also shown that further research is needed for some topics.

The set release site criteria should be regarded as a hypothesis of species-habitat relationships and not as a statement of proven cause and effect relationships.

Zusammenfassung

In Nordamerika kümmern sich berufsständische Wildtier-Rehabilitations-Zentren und lizenzierte Privatpersonen um die Pflege von verwaisten und verletzten Schwarzbären (Jungtiere, sub-adulte und adulte Individuen) und entlassen diese anschließend wieder in die Wildnis (Van Dijk 2005). Die Rehabilitierung und Auswilderung solcher Bären bietet Wildtiermanagern eine Alternative zur Einschläferung oder dauerhaften Unterbringung dieser in Gefangenschaft (Beecham 2006).

Nachdem Auswilderungen oft ad hoc geschehen und nicht Teil von Langzeitprogrammen sind, gibt es keine ausreichenden Dokumentation und in vielen Fällen existieren keine detailierten Angaben (Van Dijk 2005).

Diese Bachelorarbeit ist Teil des “Protocol Development for potential release sites for rehabilitated wildlife”-Programms des Cochrane Ecological Instituts (CEI) und versucht Kriterien für potentielle Auswilderungsorte von Schwarzbären zu analysieren. Da die Auswahl eines hochwertigen Gebietes ein Hauptaspekt für den Erfolg einer Auswilderung ist, ist es nötig im Voraus eine Habitat-Bewertung durchzuführen (Griffith et al. 1989, Pelton and Van Manen 1997). Das Model, welches in dieser Bachelorarbeit beschrieben wird, besteht aus einer formalisierten Synthese von wildbiologischen- und Habitat-Informationen, welche in wissenschaftlicher Fachliteratur zu finden waren.

Die Annahmen, welche zur Organisation und Verbindung der Habitatinformationen und letztendlich zur Formulierung der Kriterien für einen Auswilderungsort führten, werden dabei erörtert.

Ein Ergebnis dieser Untersuchung war, dass ein angemessener Auswilderungsort neben den ökologischen Kriterien, welche die Versorgung mit Nahrung, Wasser und Deckung sichern, auch noch eine Vielzahl von menschenbezogenen Faktoren erfüllen sollte. Für einige der Kriterien ist es entweder schwierig einen klaren Grenzwert zu definieren welcher erreicht werden muss, oder es ist ungewiss ob man messbar feststellen kann, ob ein potentieller Auswilderungsort das Kriterium erfüllt. Die Ergebnisse haben ebenfalls gezeigt, dass in einigen Bereichen weitere Untersuchungen nötig sind.

Die festgelegeten Kriterien für einen potentiellen Auswilderungsort sollten als Hypothese von Beziehungen zwischen einer Art und deren Lebensräumen betrachtet werden und nicht als bewiesene Wirkungszusammenhänge.

Acknowledgements

First of all I want to thank Clio Smeeton, she did not only give me the opportunity to do my internship at her Institute; she was also a great inspiration for my future. Her life is an unbelievable example of how much a single person can achieve in terms of ecosystem conservation and wildlife rescue.

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1. Introduction

Intensive land-use practises like oil and gas exploration, forestry or agriculture restrict the habitat of black bears and lead to a rising number of man-bear encounters. Often the latter have to pay for that with their lives, for example by being killed in traffic accidents or hunting related incidents. Especially female black bears that are raising cubs tent to react aggressive towards anthropogenic disturbances.
Besides humans, environmental factors like natural hazards (e.g. fire or drought) may cause female bears to abandon their offspring. If the remaining orphaned cubs are found, there are four methods to deal with them:

- leave the cubs in the wild to fend for themselves
- euthanize the cubs
- capture the cubs and place them permanently in a zoo or research facility
- capture the cubs and place them temporarily in a rehabilitation facility for a later release

(Beecham 2006)

There is no doubt that the last of the four methods, to place them temporarily in a rehabilitation facility, is the most expensive and most arduous. But this method has also shown a high rate of success in the past and rehabilitated bears became a functioning member of the ecosystem. Orphans raised to self-sufficiency with a minimum of human contact have caused few nuisance problems, when released in remote areas (Alt and Beecham 1984).
Despite this fact there is unfortunately no financial support for rehabilitation facilities from the Government of Canada. Most release activities are realized by NGOs or private wildlife rehabilitation centres;

who work from the conviction that most of the rehabilitation cases result from human intervention in the first place (e.g. illegal/legal hunting, land-use practices, road/train accidents) and argue that rehabilitation is a way of restoring the balance. Rehabilitation facilities often depend on funding from private welfare organizations, personal funds and grants to undertake their projects (Beecham 2006).

The Cochrane Ecological Institute (CEI) in Alberta, Canada, is one of those facilities offering wildlife rehabilitation and release. Their work includes the process of providing aid to injured, orphaned, displaced or distressed wild animals in such a way, that they will survive when released to their native habitats. The spectrum of activities ranges from direct care of wildlife to arranging the release.

The suitability of habitat is one of the key factors for a successful reintroduction of rehabilitated wildlife (Griffith et al. 1989). With the fast increase of development and human settlement, it is becoming more and more difficult to find accessible, appropriate natural areas to use as release sites. Most animals simply need a place to get started, an area with suitable cover and resources where they can settle into life in the wild before moving on.

Up to now most of the release locations have been chosen on an ad hoc basis (Van Dijk 2005).

Although the state of knowledge on habitat requirements of different animals is tremendous, there is no specified procedure how to select a potential release site by including all contributing anthropogenic factors. It would be necessary to establish an evaluation protocol, due to those sites can be easily found.

Therefore the CEI is working on the so called “Protocol development for potential release sites for rehabilitated wildlife”- program which will locate good release sites for different wildlife species within Alberta.

This bachelor thesis will contribute to the detection of adequate release sites for American black bears.

2. Study area

As mentioned before, this bachelor thesis will contribute to the “Protocol development for potential release sites for rehabilitated wildlife”- program of the Cochrane Ecological Institute. The target area of this project is the Canadian Province of Alberta.

Alberta covers approximately 661,848 km^2 and has a population of 3.7 million people (Natural Regions Committee 2006).

Figure 1 illustrates the six natural regions of Alberta:
Boreal Forests, the Rocky Mountains, Foothills, the Canadian Shield, Parkland, and Grassland.
‘Boreal Forests’ cover nearly 58% of the Province and appear in elevations between 200m in the ‘Northern Mixedwood’ natural subregion, near the Alberta–Northwest Territories border, to 1225m in the ‘Upper Boreal Highlands’. ‘Dry-, Central- and Northern-Mixedwood’ forests are the main subregions of ‘Boreal Forests’ and are characterized by pure or mixed aspen forests, with white and black spruce or jack pine. These forests contain a lot of peatlands, lakes and streams and offer a lot of undisturbed habitat for wildlife. Cultivation of crops is limited to those areas that have a relatively long growing season.
In the south-west of Alberta the Rocky Mountain range stretches along the border to British Columbia. Montane, subalpine and alpine regions occur on mean elevations of 1400, 1750 and 2350 m. While alpine areas are largely non-vegetated, lower subalpine regions are covered with mixed coniferous forests. Douglas fir, white spruce, and lodgepole pines build together with aspen the mixed forests of montane subregions. Extreme slopes are typically for the alpine subregion, while the other two have a ridged and rolling landscape.
Adjacent to the Rocky Mountains the Foothills form around 10% of Alberta’s landscape. They consist in the lower areas of ‘Mixedwood

Forests' (aspen, lodgepole pine and white spruce) and in the higher altitudes of mainly closed coniferous forests.
The Parklands of Alberta are extensively cultivated and have the highest population density within Alberta. Aspen clone and continuous forests are interspersed with grasslands and 4 to 10% wetlands.
On the undulating plains in the south of Alberta different Grassland types cover close to 15% of the province's surface and are sometimes called prairie. 'Grasslands' contain plants like fescue or needle-and-thread; wet areas are often shrubby, containing buckbrush (Natural Regions Committee 2006).

Over 2 million hectares of Alberta's surface are preserved by parks or protected areas (Natural Regions Committee 2006).

During the literature research, especially data sets on habitat requirements for black bears in north-east America were sighted. Therefore the results of this bachelor thesis can not only be used as a guideline for black bear releases in the study area, but also for regions within North America with similar kind of ecosystems.

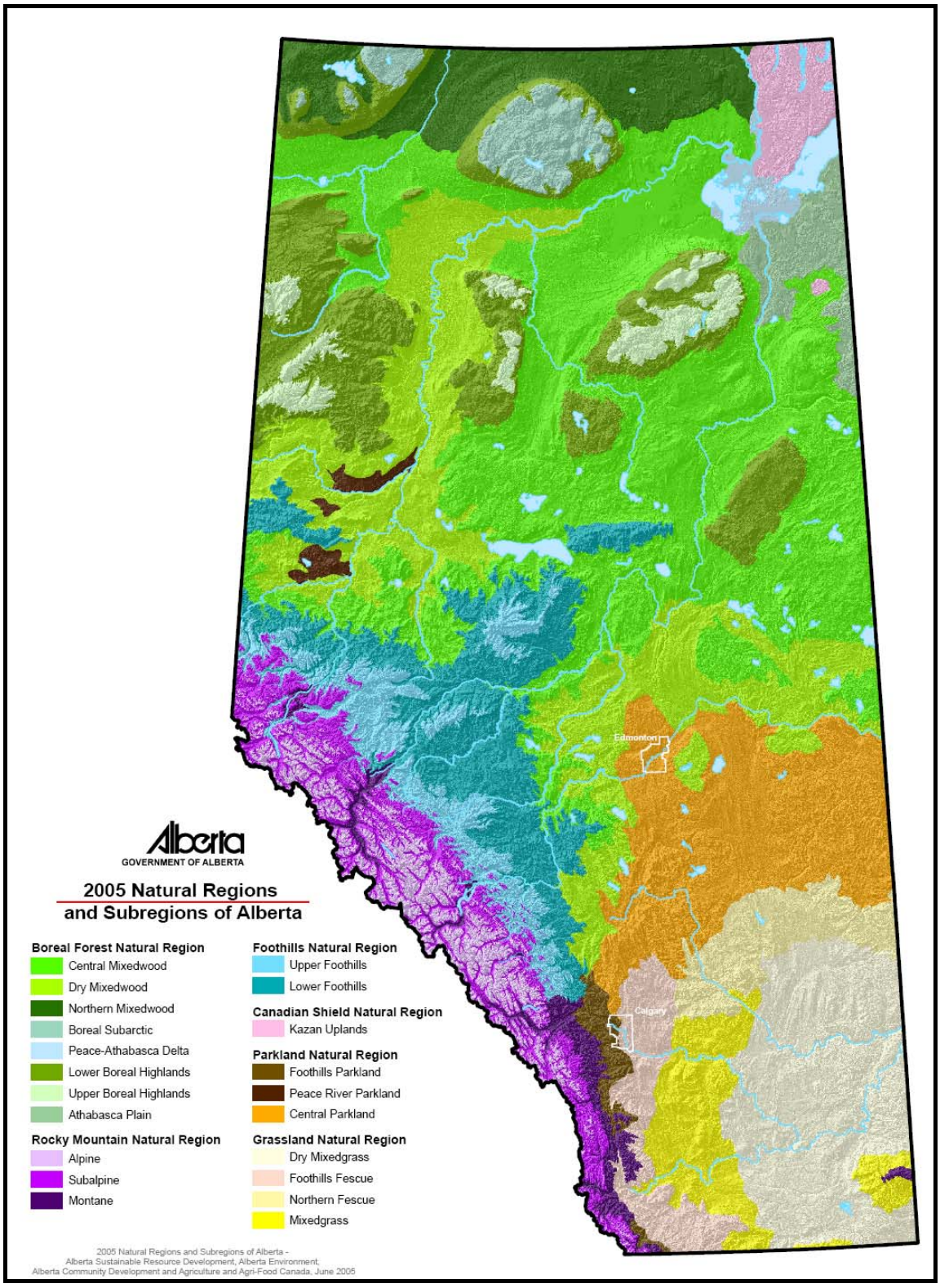


Figure 1: Natural Regions and Subregions of Alberta
[From Natural Regions Committee 2006]

3. Methods

3.1. "Protocol development for potential release sites for rehabilitated wildlife"- program

The program "Protocol development for potential release sites for rehabilitated wildlife" of the CEI is characterized by eight steps, which can be found in Table 1.

Table 1: List of project steps of the "Protocol development for potential release sites for rehabilitated wildlife" program of the Cochrane Ecological Institute, Alberta, Canada

Project step	Comments
1. Do a literature research to quantify biology, habitat requirements, and behaviour of the species	• Create summary and synthesis of all resources
2. Develop release site criteria for species	• Include human-related aspects
3. Investigate the jurisdiction of the government agencies	• Interview the federal government of Canada, Parks Canada, Canadian Wildlife Service, and Prairie Farm Rehabilitation Association (PFRA), Department of National Defence to determine the requirements for the potential release on federal lands

Project step	Comments
	• Interview the provincial government of Alberta (Sustainable Resource Development, Fish & Wildlife Division) to determine the requirements for potential release on provincial lands.
4. Select sites within Alberta, which match the criteria and seem promising	• Set up a preliminary suggestion
5. Interview stakeholder (e.g. residents, landowners and hunters)	• Find out if locals have any objections to the release of rehabilitated wildlife in their region • Find out if locals would like to be involved in post release monitoring
6. Investigate the existing and potential land-use policies of the site	• forestry • agriculture (e. g. farming, ranching and beekeeping) • tourism • access in general

Project step	Comments
7. Ground truth the selected sites to evaluate their suitability for the releases	• Carry out a flora / fauna survey • Carry out a prey / predator analysis
8. Provide publishable information	• Use for paper or poster • Transfer method to other species

This bachelor thesis focuses on step 1 to 3 of the project and offers a base for further research on the remaining points.

Step 1 Do a literature research to quantify biology, habitat requirements, and behaviour of the species

Sources for the literature research were different specialist books, the internet and a collection of scientific papers.
Habitat information for American black bears consisted of scattered data sets collected during different seasons and years and from different sites throughout the range of the species.

The focus of the literature research was based on the following aspects:

- Native habitat of the species (forest cover, vegetation composition....)
- Home range size
- Territoriality
- Specific food requirements / seasonal food habits
- Activity patterns

- Best release period
- Additional aspects (e. g. predators / competitors)
- Human-related specifics

After the perusal of all documents a comparison and synthesis of the findings on different categories was made, in order to get an adequate summary of all resources.

Step 2 Develop release site criteria for species

Release site criteria were formulated to estimate the relative suitability of an area as black bear habitat.

Communication with different wildlife experts helped to prioritize selected aspects of the results from step 1.

Step 3 Investigate the jurisdiction of the government agencies

The assay of different law texts and other sources showed the legal regulations for the release of rehabilitated wildlife.

For the potential release on federal lands the federal government of Canada, Parks Canada, Canadian Wildlife Service, Prairie Farm Rehabilitation Association (PFRA) and the Department of National Defence determine the requirements.

The provincial government of Alberta (represented by Sustainable Resource Development, Fish & Wildlife Division) sets up the laws for potential releases on provincial lands.

A meeting with Stan Hawes, the responsible District Fish & Wildlife Officer for Cochrane, Alberta displayed the governments' attitude towards a

potential black bear release and stated their possible suggestions for release locations.

3.2. Forage analyses of black bear cubs at the Cochrane Ecological Institute

Besides the main project steps, a small scale research was planned and implemented to get direct information on feeding habits from 4 black bear cubs at the CEI. In August the four were kept in a small pen, but an extension of 3 hectare was scheduled.
This offered the opportunity for a vegetation analyses in the extension before the cubs entered and then a second one around two weeks after their relocation; in hope to find out, which plants are preferred by them.

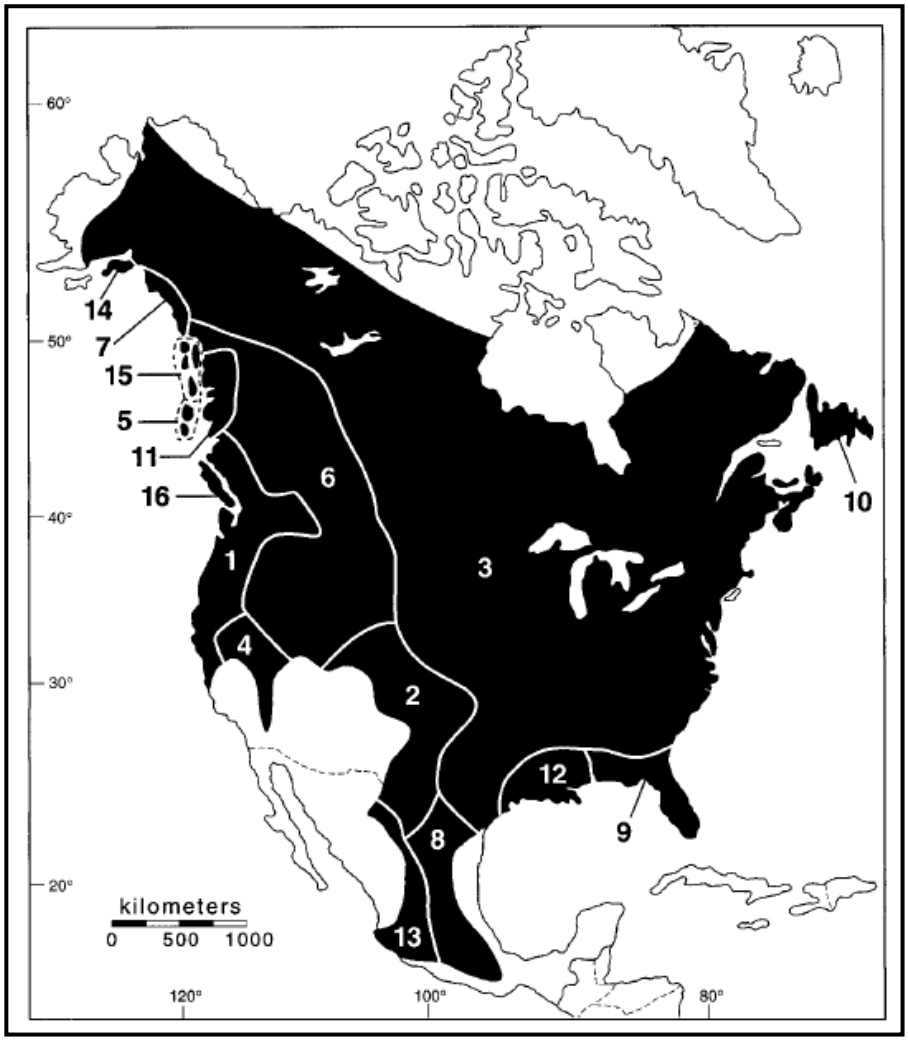
Six spots were randomly selected in the new pen. A one square meter Daubenmire-frame and a form to document the findings were used.

Vegetation composition was determined by percentage cover of grass, forbs, woody, vine, debris, and bare ground. To relocate the same spots again for the second measurement, two of the frame corners were marked with small pegs and additionally the location was registered with a GPS device. To have an accurate optical comparison of the two vegetation situations, single plants as well as the six locations were photographed.

4. Results

4.1. Step 1 – Literature research on American black bear (*Ursus americanus*)

Ursus americanus is the most common and widely distributed of the three North American bears and has 16 different subspecies. It is present in all Canadian provinces and territories except for Prince Edward Island (see Figure 2) (Larivie`re 2001).



1, U. a. altifrontalis;
2, U. a. amblyceps;
3, U. a. americanus;
4, U. a. californiensis;
5, U. a. carlottae;
6, U. a. cinnamomum;
7, U. a. emmonsii;
8, U. a. eremicus;
9, U. a. floridanus;
10, U. a. hamiltoni;
11, U. a. kermodei;
12, U. a. luteolus;
13, U. a. machetes;
14, U. a. perniger;
15, U. a. pugnax;
16, U. a. vancouveri.

Figure 2: Distribution of *Ursus americanus* in North America
[From Larivie`re (2001) - modified from Hall (1981) and Kolenosky and Strathearn (1987).]

The black bear's original range essentially coincided with forested regions throughout North America (Pelton 1982). The current range of *Ursus americanus* represents around 62% of it's historical one (Pelton and Van Manen 1994).

4.1.1. Habitat use information

In general, habitat selection by *Ursus americanus* varies seasonally and is intended by the presence of food (Larivie`re 2001). Black bear individuals who have access to abundant food achieve more growth per year, become heavier, reproduce at an earlier age, reproduce at shorter intervals, and produce more cubs per litter than those who have inadequate food sources. (Alt et al. 1980)
Existence of adequate diet is also influencing home range size, daily-, seasonal-, and annual-movements, and use of vegetative associations. Climate, soil, and topography are factors which influence the quantity, quality, and distribution of food (Rogers and Allen 1987).
Due to their ability to hibernate during winter periods of food scarcity, it's possible for black bears to inhabit a broad diversity of physiographic and vegetative associations (Hamilton and Marchington 1980).

Figure 3 shows the distribution of black bears in Alberta. The species range stretches over nearly 488 000 km² which represents almost 74% of the province. A research in 1993 estimated that the total number of black bears within Alberta is close to 40 000, whereas 36 000 of them live on provincial land. Recently sightings of black bears near Edmonton and Calgary lead to the hypothesis that *Ursus americanus* is extending its range into the southern parts of the province (Government of Alberta, Sustainable Resource Development 2007).

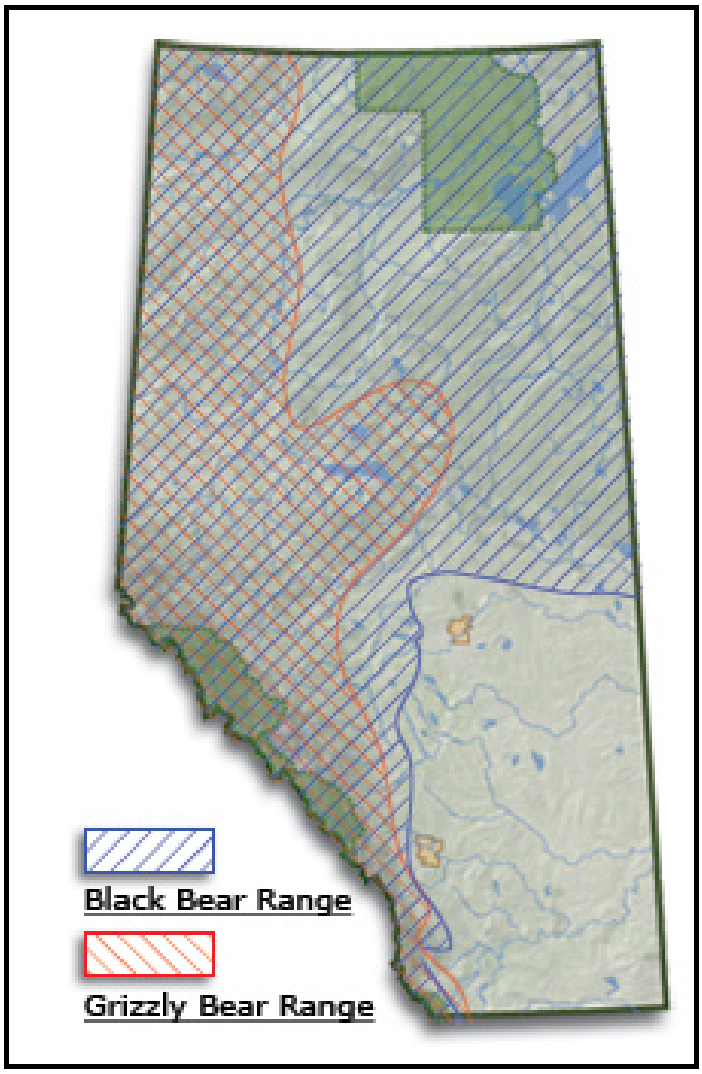


Figure 3: Black bear and grizzly bear range in Alberta, Canada
[From Government of Alberta, Sustainable Resource Development (2007)]

4.1.1.1. Natural habitat of the species

The American black bear requires a variety of habitats which are mainly characterized by relatively inaccessible terrain and dense understory, to satisfy its seasonal food requirements, as well as extensive and secluded areas for denning (Larivie`re 2001).

The prevailing characteristic of *Ursus americanus* habitat is forest cover interspersed with small clearings that provide a high degree of edges and diversity in vegetative associations and early stages of forest succession (Herrero 1979; Hugie 1979).

Costello and Sage showed that disturbed habitats, such as recently logged or burned forests, are as essential to American black bears as zones of high fruit and berry production (Costello and Sage 1994)

In the Rockies spruce-fir forest dominates much of the range of *Ursus americanus.* Wet meadows, riparian areas, avalanche chutes, roadsides, burns, sidehill parks, and subalpine ridgetops are essential nonforested areas for bears (Kemp 1979).

The territory of black bears extends all the way from sea level up through the coniferous forest zone in mountainous areas. However, heaviest black bear densities can be found in elevations between 4000 to 7000 feet (~ 1200-2100 meter) (Kemp 1979).

4.1.1.2. Food requirements

Ursus americanus has an omnivorous diet whereas easily digestible vegetation is the main component. It is the least predacious of the three North American bear species.

Preferred foods are typically low in terpenes and high in either protein or carbohydrates (Bacon and Burghardt 1983). Black bears have two limiting aspects on their feeding habits: At first a poor ability to digest cellulose which is caused by their lack of a cecum and rumen and as the second their inefficiency to capture large vertebrates.

Therefore the green vegetation is consumed mainly during the early sprouting, preflowering, or early flowering stages when it has low cellulose and high protein-contents. American black bears consume most of that new vegetative growth in spring. (Rogers 1987).

As carrion is scarce over much of the black bear's range, animal matter normally composes only a small portion of the diet, but can compose the majority of the diet for short periods (Rogers 1987).

Predation on vertebrates is uncommon and involves primarily the capture of newborn deer (*Odocoileus spp.*), moose (*Alces alces*), and elk (*Cervus elaphus*); nestling birds, spawning fish or animals whose escape is restrained (Rogers and Allen 1987).

Raine and Kansas carried out a study on the seasonal food habits of black bears in Banff National Park in which they defined 4 food seasons: green-up, ant, buffaloberry and post-buffaloberry (see figure 4).

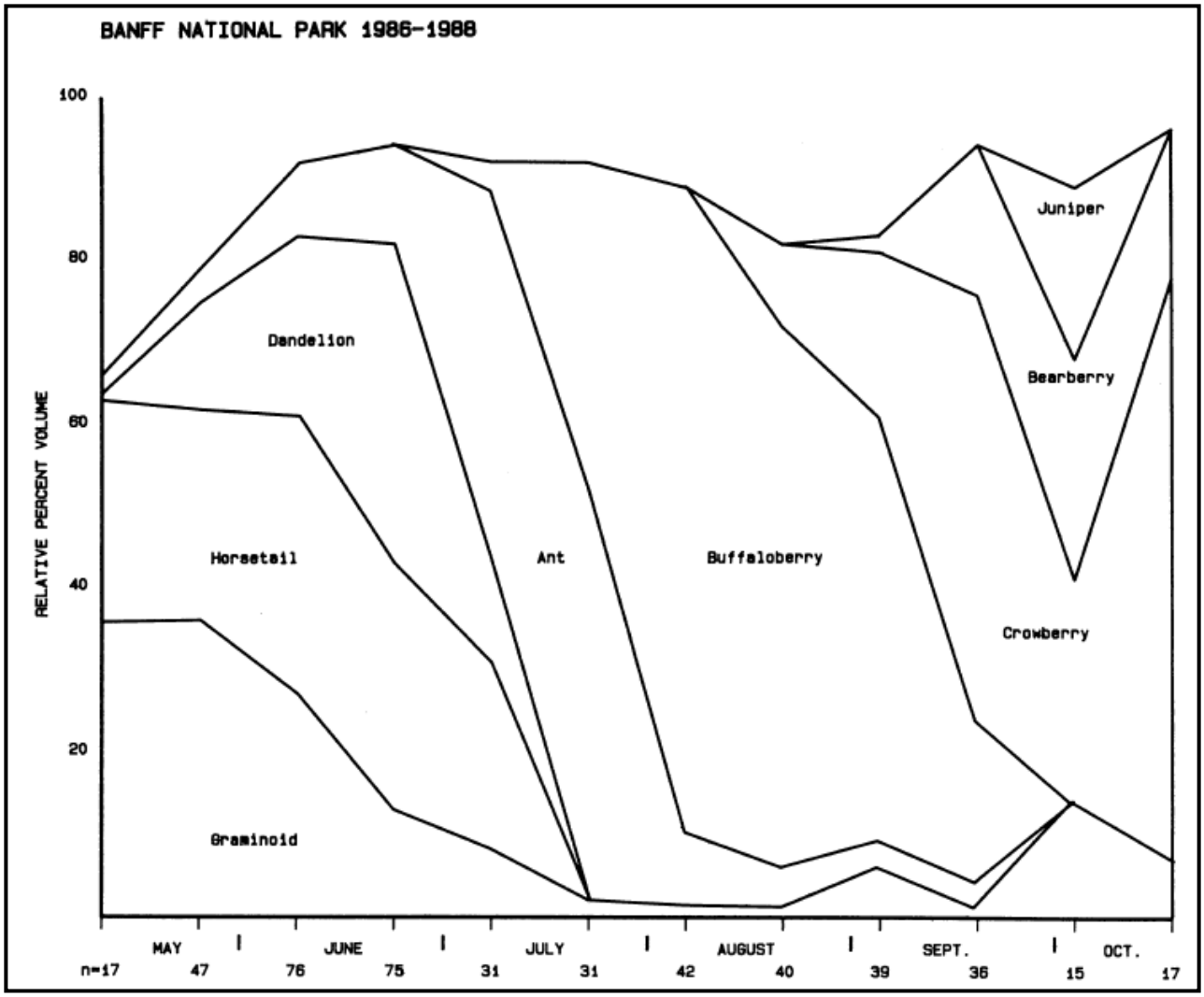


Figure 4: Percent volume of food items during the year; found in black bear scats in Banff National Park, 1986-1988. [From Raine and Kansas (1990)]

The Green-up stage includes the spring months and ends around mid-June. During that time, black bears were found to feed mainly upon dandelion (*Taraxacum sp.*) flowers and stems, horsetails, graminoid vegetation, ants, spruce, fir and pine, and cambium. Their diet is also enriched due to animal carcasses in spring (Raine and Kansas 1990).

Throughout the ant season in early summer, the cellulose content of the vegetation is rising; berries are not yet ripe and bears focus mainly on colonial hymenopterans. Ants, wasps, and bees are the most commonly eaten animal food and may compose over half of the diet (Raine and Kansas 1990). Herbaceous material and fruits are consumed as well.

Mid- to late July until mid-September is the main season for buffaloberry to be ripe and they are, where available, the predominant food source for *Ursus americanus*. In years when berries, fruits and nuts are scarce bears tent to eat a few succulents, legumes and other plants (Tisch 1961, Rogers 1987).

The post-buffaloberry stage starts from mid-September on, when buffaloberries begin to drop from the bushes. Black bears were than found to switch to alternate foods such as crowberries, bearberries, white-bark pine nuts, and juniper berries (Raine and Kansas 1990).

During the autumn months black bears must accumulate fat reserves for hibernation (Rogers 1987). In general, bears fulfil their nutritional needs for the entire year in a 5- to 8-month period throughout much of their range (Beeman and Pelton 1980). Black bears gain weight rather slowly on the spring and early summer diet of vegetation and insects (Beeman and Pelton 1980). Weight gain is most rapid with > 1kg / day, when soft mast and hard mast become available in late summer and fall (Rogers 1987). Soft mast is high in sugars and other carbohydrates, and hard mast contains a lot of fats and protein (Rogers 1987).

Scarcity of food, results in longer distances for foraging, increased likelihood of depredation on crops or killing of livestock, and attraction to human-related food sources such as dumps and residential areas. These factors increment the number of negative bear-human interactions (Rogers 1987, Hugie 1979, Beeman and Pelton 1980).

4.1.1.3. Water requirements

A good black bear habitat has to offer water sources during the whole year. *Ursus americanus* drinks frequently when feeding on vegetation, nuts or insects, but rarely when feeding on berries (Rogers 1987, Hugie 1979).
During hot days, bears wallow to cool off and prevent heat stress (Kellyhouse 1980).
Throughout the black bears range wetland and riparian habitats are used for cooling and provide essential seasonal foods, den sites, escape and security cover, and travel corridors (Kellyhouse 1980, Alt et al. 1980).

4.1.1.4. Home range

The size and shape of a black bear's home range is determined by the capability of an area to provide the individual's annual needs (Hamilton and Marchington 1980). Factors like sex, age, population density and season have also an influence on the home range characteristics. During summer and fall, while foraging activities increase, concentrations of special food items can lead to temporary movements and range expansions (Rogers 1977).

In general, mature females are territorial and males are solitary; the latter fact is caused by the social pressure practised by older adult males on younger males, causing them to disperse from the areas occupied by the older one. However, the home ranges and core areas of bears of different sexes often overlap and adult females may also allow their female

offspring to take over a part of their territory. Nevertheless male juveniles are chased off by their mothers, sometimes violently, if they don't disperse by themselves. This intolerance towards male offspring increases the genetic diversity of a population, by reducing the risk of inbreeding (Rogers 1987).
The home range size of adult male bears is three to eight times larger than that of adult females. The range of an individual male has to encompass those of several females to maximize its reproductive potential (Herrero 1979; Rogers 1987).

Young and Ruff investigated average home range sizes of *Ursus americanus* in Alberta, Canada, and came to the following Numbers:

Males: 119 km²
Females: 20 km²

(Young and Ruff 1982)

The Population density of American black bears was averaged by a study in Alaska as one bear in 3.5–11.2 km². However, bears are often difficult to census, because of their characteristic shy and secretive nature and inaccessible habitat (Larivie`re 2001).

Where food is superabundant, for example at garbage dumps or salmon streams, black bears show an adaptable social behaviour. Feeding in aggregation may occur and individuals become integrated into social hierarchies (Rogers 1976).

4.1.1.5. Den sites

In most regions *Ursus americanus* is inactive during winter months. As American black bears undergo a specialized seasonal reduction of metabolism initiated by low food availability, low environmental temperatures and snow accumulation they can be considered as

hibernators. Though, their large body size prevents a drastically drop in temperature like it occurs in smaller hibernating mammals. There body temperature is only reduced by 7-8°C. Therefore, American black bears become quickly active, if they are disturbed and they are able to care for their young in the winter den (Watts et al. 1981).

Dens may be cavities in trees or rocks, brush piles, root excavations, underground burrows, or open-ground beds (Larivie`re 2001).
Extensive logging may decrease the availability of preferred den sites due to the elimination of snags, down trees, and large, mature trees. However, a reduction of preferred sites does not necessarily cause a migration of black bears, as they are very flexible in their use of dens (Rogers and Allen 1987).
Orphans instinctively construct or use natural dens in fall, even though their mothers would normally do this. They show this innate behaviour regardless to their age when they enter a rehabilitation facility (Alt and Beecham 1984, Beecham 2006).

4.1.2. Human-related aspects

In general, human habitation and conversion of forested and wetland cover types to agriculture has forced bears to inhabit smaller geographic areas, with a resulting decline in the overall bear population (Hugie 1979).
Furthermore most black bears that die, both young and adults, are killed by humans (Larivie`re 2001). Most of this mortality is induced through hunting, trapping, poaching, and collision with vehicles (Rogers 1987).

Predominant or future land-use activities have a variety of consequences for *Ursus americanus*. Forestry activities can have positive or negative impacts on black bears and their habitat. On the one hand, logging practices help maintain essential diversity in vegetative communities and can increase or maintain the productivity and abundance of key food

plants. On the other side, large scale clearcuts can lead to a habitat fragmentation and migration of black bears caused by the lack of cover for shade and escape (Rogers and Allen 1987). Hugie (1982) reported little use of clear cuts beyond 125 m of forest cover (Hugie 1982).

Roads have also positive and negative influences on bears. Small and hardly used roads offer due to roadside vegetation additional food sources for bears. Those roads are sometimes used as travel routes by black bears and are readily crossed by them (Rogers and Allen 1987).
However highly used roads through feeding areas can limit the use of those areas and cut up parts of habitat (Kellyhouse 1980).
Road kills of black bears happen primarily on highways and paved roads with heavy, fast-moving traffic, whereby the number of road kills depends partly on the density of the road network and the amount of traffic (Rogers and Allen 1987).
The existence of roads offers people access to the area, for example for hunting or recreation. In winter, tourism can be a disturbance to bears; especially to hibernating females with cubs. But contrary to hunting the recreational needs of people won't significantly reduce the black bear population (Rogers and Allen 1987).
Yet, hunting has a significant influence on age and sex composition, and reproductive biology of a black bear populations (Beecham 1980).

Table 2: Sex and age composition of hunted and unhunted black bear populations in Council and Lowell, Idaho. Numbers in parentheses are percentages. [From Beecham (1980)]

Location	Number of males			Number of females			Total	
	Subadult	Adult	Total	Subadult	Adult	Total	Subadult	Adult
Council (hunted)	14 (58)	10 (42)	24 (51)	8 (35)	15 (65)	23 (49)	22 (47)	25 (53)
Lowell (unhunted)	20 (36)	35 (64)	55 (55)	9 (20)	36 (80)	45 (45)	29 (29)	71 (71)

Table 2 shows that the hunted bear population in Council, Idaho, has a nearly equal number of subadult and adult individuals. The unhunted population has on the contrary a 29:71 subadult:adult ratio. Beecham analyzed that hunting is most of all influencing adult males and that the hunted Council population had a higher ingress and egress of subadult bears. The sex ratios are not significantly differing from 50:50 in both cases (Beecham 1980).

Besides legal hunting, which is regulated by the sale of hunting permits, poaching can be a major threat to black bears. Stone and Brody (1986) analyzed, that areas with road densities above 0.75 mi/mi² are unsuitable as black bear habitat; as the likelihood of poaching increases proportional to the road net density. Higher densities are acceptable if there are mainly logging roads and no permanent human residents (Stone and Brody 1986).

Concerning permanent residents and other stakeholders the attitude towards black bears is an important factor for nonhunting, human-related deaths. Negative attitudes are linked to the potential danger to humans and the destruction of livestock and crops. Landowner attitudes toward bears are also greatly influenced by previous experiences with bear damages (Clark et al. 1991).

There are different attractants to human-bear encounters which often lead to killing of bears in so called nuisance situations. Such attractants are for example landfills, and unsecured garbage canisters at campgrounds, at edges of towns or on oil & gas work sites.

The conversion of forests to farmland produces even more problem cases; as bears are attracted by corn, oats, fruit, beehives, or livestock (Rogers and Allen 1987).

On the one hand, black bears become nocturnal and secretive in human-altered habitats such as orchards, campgrounds, garbage dumps, or urban areas, but on the other hand once they are habituated to human foods they will loose fear of humans (Mc Cullough 1982).

Yet, Pelton proofed that black bears are adaptable and, to an extent, can persist in the presence of humans (Pelton 1982).

Still *Ursus americanus* is much less dangerous than grizzly bears (*Ursus arctos*). Attacks to humans appear infrequently and can be classified into 3 categories:

(1) defence of food

(2) cub defence by females with cubs

(3) predatory attacks by single bears

(Herrero and Fleck 1990)

4.1.3. Special release aspects

Homing behaviour seems to be an important aspect on the release of American black bears. Beecham documented that some bears dispersed from their release sites for several hundred kilometres (Beecham 2006). Factors that may influence homing include age, sex, food availability, translocation distance, and geographic barriers. Cubs and yearlings show higher release site fidelity than adult bears (Rogers 1984). Rogers analyzed the homing behaviour of bears by reviewimg data of translocated individuals throughout North America. His results lead to the assumption that for subadult bears a distance of 32 km between the release site and the capture site may prevent the return of the released animal. For adult black bears the distances are significantly higher. The percentages of bears, older than 2 years, returning from translocation distances of <64km, 64-120km, >120-220km, and >220 km were 81%, 48%, 33%, and 20%. Returns may be further reduced, if bears are translocated across physiographic barriers (Rogers 1992).

Eastridge and Clark (2001) tried to find release techniques to overcome the problem of homing in *Ursus americanus*. There study showed that a winter-release (= hibernating bears are translocated to an artificial den at the release site) has distinct advantages over a summer-release (= bears are tranquilized and translocated to the release site), as it limited the post-release movements and increased the survival rate (Eastridge and Clark 2001).

Black bear cubs become very wary of humans, including individuals who were responsible for caring for them, within a short time (10 to 14 days) after they are released.

Therefore bears should be released in areas where it is unlikely that they will encounter people during the first two weeks after their release (Beecham 2006).

4.2. Step 2 - Release site criteria

Table 3 shows the formulated release site criteria for *Ursus americanus* which are an implication of the literature research.

The **importances** of criteria are assessed in 3 categories:

high:	If the potential release site is not fulfilling the criteria, it has to be excluded
indeterminate:	It is not certain if the criterion is a determining factor to disqualify an area
low:	The factor is less important and areas can be used for release, even if the criterion is not fulfilled

The **measurability** of criteria is also evaluated in 3 categories:

no:	It is impossible or technically not feasible to determine, if the criteria is fulfilled at a chosen site
contingent:	It is not sure, if it is practicable to prove that the potential release site fulfils the criterion / It is hard to define a clear set point that must be met by the site in order to fulfil the criterion
yes:	It is clearly verifiable, if an area will meet the criterion

The **measurement** box contains two kinds of information:
Either a suggestion on the **methodology** how and to what extent the criterion should be measured; or the **obstacle,** why it is difficult or impossible to measure the criterion.

In addition it has to be considered, that the order of the criteria in Table 2 does not reflect the overall significance of a criterion.

Table 3: Overview of release site criteria, their importance, measurability and measurement methodology or obstacles

Release site criteria	Importance (high – indeterminate – low)	Measurability (no – contingent –yes)	Measurement methodology / obstacle
Environmental factors			
area corresponds to natural habitat (e.g. forest cover)	high	contingent	• analyse of ecosystem type • no single solution due to high adaptability of bears
area offers adequate food sources	high	contingent	• vegetation analyses to prove presence of high quality food plants • hard to define a level for quantity of adequate food supply

Release site criteria	Importance	Measurability	Measurement
area offers water supply	high	yes	• locate wetlands, lakes and streams
area offers possible home range	high	no	• depends on status of existing bear population (density, age structure) • presence of potential predators / competitors plays an important role
area offers potential den sites	low	contingent	• black bears use a big variety of den sites • no guarantee that they accept provided dens

Release site criteria	Importance	Measurability	Measurement
Human related factors			
acceptable predominant and future land-use activities	**high**	**contingent**	• check planning in forestry, agriculture and oil & gas sector • unsure to which extent changes in land-use (e.g. clear cuts in forestry) can be compensated by black bears
no human settlement nearby	**high**	**yes**	• define safety margin and analyse cartographic materials

Release site criteria	Importance	Measurability	Measurement
acceptable public access to the area	high	contingent	• not possible to record all kind of access • investigate recreational use of the area (winter and summer tourism)
positive public attitude towards black bear release	high	contingent	• survey on stakeholders • take history of human-bear-interactions into account
presence/timing of hunting	indeterminate	yes	• review the sale of licences for all game species in the appropriate wildlife management units

Release site criteria	Importance	Measurability	Measurement
no attractant to human-bear-conflicts (e.g. landfills) in the area	**high**	**yes**	• define possible attractants • analyse maps by including safety margins around the attractants
legal permission for release is possible	**high**	**yes**	• contact the appropriate governmental authority
Special release factors			
distance of at least 32 or 120 km to rehabilitation facility	**high**	**yes**	• localise on map
no human disturbance for 14 days following the release	**high**	**no**	• not possible to record all kind of access

4.3. Step 3 - Jurisdiction of the government agencies

First of all wildlife rehabilitation licenses or permits are required to legally possess and work with most native species, since wildlife is a natural resource and as according to the Wildlife act of Alberta "…property in all live wildlife in Alberta is vested in the Crown" (Government of Alberta 2010).

Rehabilitation facilities often have little control or input into decisions about where to release bears; typically, that is the province of the governmental wildlife authority responsible for managing wild bear populations (Beecham 2006).

In Canada, permits are required from most provincial governments. The Canadian Wildlife Service requires a federal permit to rehabilitate migratory birds or species listed under the Endangered Species Act (Government of Alberta 2010).

Many potential release sites are located on public land or land administered by governmental authorities, and their permission must be obtained before captive animals can be released back to the wild.
In some cases, local laws may prohibit individuals from releasing captive animals to the wild, regardless of land ownership.
Beechams WSPA survey in 2006 indicated, that a lot of rehabilitator either work closely with governmental wildlife personnel in their release efforts, or the appropriate wildlife authorities take full responsibility for choosing release times and locations and carry out the releases (Beecham 2006).

A meeting with Stan Hawes, the responsible District Fish & Wildlife Officer for Cochrane, Alberta displayed that they are willing to incorporate release site suggestions of the CEI, which are based on scientific research, into their decision-making process. A main aspect for the Fish and Wildlife Division is the liability of the Province; which implies that the release of rehabilitated black bears constitutes no threat to the public.

4.4. Forage analyses of black bear cubs at the Cochrane Ecological Institute

Unfortunately, there are no results from the direct research on food habits.

As explained in chapter 3.2 it was planned to do a second vegetation analyses, two weeks after the 4 cubs were introduced to the new enclosure, but that was not feasible.
Within one week the cubs totally destroyed any ground vegetation, mainly by running it over or ripping it out for playing. Therefore it was not possible to determine which plants were used as forage.

5. Discussion

The set release site criteria from chapter 4.2 should be regarded as a hypothesis of species-habitat relationships and not as a statement of proven cause and effect relationships. Therefore the assumptions made for organizing and synthesizing the species-habitat information into formulated release site criteria need to be discussed.
Furthermore it is necessary to review the criteria which are of high importance, but there measurability is only rated as contingent or not possible at all.

- “area corresponds to natural habitat (e.g. forest cover)”

It is very important that the release site corresponds with the natural habitat of the species. But due to the high adaptability of black bears it is impossible to define a single ecosystem type that is suitable. As shown in chapter 4.1.1. black bears accept nearly 75% of the province and a variety of physiographic and vegetative associations as habitat. There is no clear preference for certain forest ecosystems.

- “area offers adequate food sources”

The most important fact for a good release site is that it offers a year-round supply of adequate food sources for black bears. The presence of high quality food plants can easily be proven by a vegetation analyses (e. g. transect method). However, it is not practicable to define, if the supply is adequate in terms of quantity. This depends partly on the existing bear population and also on the presence of other competitors for certain food source. Bears will adapt to food scarcity by increasing their home range or migration to other regions.

- “area offers water supply”

Water plays an important role for bears in terms of drinking, cooling and offering aquatic vegetation or fish as diet. The existence of wetlands, lakes and streams can easily be confirmed by the use of GIS and digital maps.

- “area offers possible home range”

It is essential that the release site offers the rehabilitated bear the possibility to establish its home range. Unfortunately, it is not possible to guarantee that by scientific measurements. The status of the existing bear population in terms of density and age structure and sex ratio determines, if the released individual is able to take over a part of the area. The presence of potential predators (e. g. dominant adult males on sub-adult males) or competitors plays an important role. Due to their secretive and shy nature, a survey of the existing population can only produce approximate values; furthermore it says nothing about the social hierarchies that are prevailing and if the population would be open for a new arrival.

- “area offers potential den sites”

It is contingent measurable, if a release site offers potential den sites. Black bears use a high variety of locations for denning, but it is unknown for which characteristics they will accept one. Even if rehabilitators provide artificial dens, as it is recommended if the ground is frozen, there is no guarantee that a bear will take it. Generally, den sites play a minor role in deciding, if a release site is suitable for black bears or not, as they find or built dens on their own as an innate behaviour.

- “acceptable predominant and future land-use activities”

Land-use activities in the sectors of forestry, agriculture or oil & gas can be easily checked, same is true for future planning. Black bears have shown that they are able to compensate changes in land-use to a certain extent. Some developments can even have a positive impact on their habitat. However, if conversion or exploitation of the area leads to a loss of adequate food sources or remote areas a habitat will become unsuitable for bears. Further research will be needed to define clear set points for acceptable land-use activities.

- “no human settlement nearby”

To avoid or at least reduce negative human-bear encounters, it will be vital that there are no human settlements in the direct surrounding of the release site. The best way for a analysis will be to define a certain safety margin that is set circular around cities, towns or other human settlements.

- “acceptable public access to the area”

As shown before, human access into wildlife habitat can lead to a lot of disturbances for bears. Initial results for evaluating public access can come from calculating the road net density and the amount of traffic in the area. If there is a history of poaching on bears and a road density above 0.75mi/mi², the site should be rejected.

Further surveys will be needed to investigate the recreational use of the site. In winter less public access is acceptable than in summer, as bears are hibernating and any disturbance can cause an awakening and therefore a high level of stress for them.

- “positive public attitude towards black bear release”

During the research project it became clear that the release of predators implies much more problems, than the release of herbivores. The public acceptance and understanding are main factors for the success of releasing those controversial species. A lot of people are afraid of black bears, misconceptions and provocations by media promote this even more.

To get a final decision, if a selected site is really suitable for the release of black bears, it would be necessary to create a survey on the public attitude of all stakeholders in this region. The history of human-bear interactions at the potential release site should also be taken into account, as it can cause negative or positive feelings.

The best approach would be to involve locals in the release process, for example in post-release monitoring, to overcome the negative perceptions.

- “presence/timing of hunting“

For this release site criteria it is complicated to decide in which degree it would exclude a certain area as potential release site.

On the one side hunting is a direct threat to released bears; the timing of releases in relation to the start of bear hunting season could have negative effects on short-term survival. Hunting in general, also on other species enhances the possibility of human-bear encounters which often lead to a deadly end for the latter.

On the other side as shown hunting changes the age and sex structure of the existing bear population. Mostly adult male bears are taken out. They would be a strong competition for released sub-adults, but if there is a surplus of younger individuals the acceptance towards the reintroduced animals will be higher. To assess the presence and timing of hunting one should review the sale of licences for all game species in the appropriate wildlife management units. Besides legal hunting poaching can be a threat to released black bears, but it is technically not feasible to evaluate the actual influence of poaching.

- “no attractant to human-bear-conflicts (e.g. landfills) in the area”

There are various attractants to human-bear-conflicts, as mentioned in chapter 4.1.2.. Similar to the analysis of human settlements, it is necessary to define safety margins and create circular safety areas around all attractants.

- “legal permission for release is possible”

Without the necessary permits, for example a transportation permit, a release of wildlife is not possible at all. But as mentioned before, in most cases the fish and wildlife division is carrying out the release and therefore organizing the jurisdiction.

- “distance of at least 32 or 120 km to rehabilitation facility”

As homing seems to be an issue for black bear release the release site should be at least 32 km away from the rehabilitation facility for sub-adult bears and 120km for adult individuals in order to lower the risk of return.

- “no human disturbance for 14 days following the release”

Another fact that is complicated to incorporate into the release site selection is that bears should be released in areas where they are unlikely to encounter people during the first two weeks after their release. First of all, it is not possible to record all kind of access into a certain area and secondly there are only a few spots where it would be possible to control or restrict public access. In situations where it might be difficult to find a remote release location, the timing of the release may become the more important consideration in choosing the site.

Based on this bachelor thesis it will be possible to carry out the remaining steps of the “Protocol development for potential release sites for rehabilitated wildlife”- program of the Cochrane Ecological Institute and to analyse the best release sites for black bears within Alberta.

Finally it is to say, that even if you are able to detect high quality habitats that are suitable for a release there is no guarantee that the released individual will accept the site as permanent home range.

Conflicts between humans and American black bears will increase as urbanization encroaches on remaining natural areas. Therefore more and more bears will be killed, injured and maybe transferred into rehabilitation facilities.

Without a fundamental change in the mind of people, there will be no chance for a successful co-existence of bears and humans in the future.

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