HUSBANDRY MANUAL FOR THE BROWN BEAR *Ursus arctos*

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1 Introduction

Brown bears in large population groups are considered fairly stable at the moment; therefore they are currently being displayed for their educational value and general interest from the public rather then for breeding purposes. Brown bears are an impressive carnivore to display due to their size and gentle looking appearance. They are an intelligent, curious and fascinating animal deserving of great respect.

Figure 1 Zoo guide educating school children

1.2 OH&S

WARNING- DANGEROUS ANIMAL

Due to its power, size and unpredictable behavior, the brown bear is considered a threat to humans. Working in the enclosure/yards with the brown bears could be harmful or fatal.

To ensure the safety of keepers, staff and public many zoos work with 2 keepers double checking locks are secure before entering a yard or den. It is important that the keepers have perfect communication when working together on a dangerous animal section to ensure there is no miscommunications.

1.2.1 Example of an effective safety procedure from National Zoo & Aquarium, Canberra.

The theory behind this safety procedure is to call out loud over the 2-way radio as you check locks are secure so that the other trained keepers can follow your security process as you enter and leave dens/enclosures. It also is a way of telling 'yourself' that you have secured locks. By only having one trained keeper working with the bears for each day there is no chance of miscommunications. Personal tags from each

extra people (volunteers, tours, maintenance) must be hung on the keeper access door as the personnel enter enclosures and removed when they exit, so the keeper knows exactly who and how many people are entering the enclosure. This is especially important if the volunteers, maintenance etc are left unattended by the keeper.

Figure 2 These tags show that there are two volunteers currently working in the enclosure.

BROWN BEAR PROCEDURES FOR <u>TRAINED</u> BEAR KEEPERS (for keepers that are training- a second trained keeper double checks the locks and holds the key to access dens and enclosure.)

<u>BROWN BEAR KEY/LOCKED BOX PROCEDURE</u>

1. Use "A" key to enter den and raceway
2. Collect "bear two" key from locked box; for slides and enclosure entry
3. Put "bear two" key chain around neck until all work finished
4. Once all work finished replace "bear two" key in locked box
5. Lock doors on the way out

<u>LOCK BROWN BEARS INTO DENS</u>

6. Call bears into dens.
7. Separate bears and close slides, check that pins are across
8. Lock padlocks when slides are down, bolt across
9. Double-check that locks are secured and call action over two way radio i.e. **"brown bears secured in den though slides 2, 4"** etc until you've checked EVERY slide that leads into the enclosure.
10. Wait for call to be copied. Repeat call if not copied.
11. Enter yard. All extra persons entering the enclosure (maintenance, volunteers, tours) MUST hang their personal tag on the access door BEFORE entering the enclosure.
12. Clean yard, enrichment, food and water (as per schedule)
13. All extra people are to REMOVE their tag as they leave the enclosure.
14. Check there are no tags left on door to ensure every extra person has left the enclosure.
15. Secure enclosure

16. Double-check that locks are secured and call action over two way radio i.e. "**brown bears enclosure secured."**
17. Wait for call to be copied. Repeat call if not copied.
18. Release bears into enclosure/rotate bears

ENTER AND CLEAN DENS

1. Close slides; to secure bears in yard; check that pins are across
2. Lock padlocks when slides are down, bolt across
3. Double-check that locks are secured and call action over two way radio i.e. "**brown bears dens secured for keeper access through slides 2, 4" etc** until you've checked every slide that leads into the dens.
4. Wait for call to be copied. Repeat call if not copied.
5. Unlock dens for cleaning
6. Clean dens/water
7. Lock den doors
8. Double-check that locks are secured and call action over two way radio i.e. "**brown bears dens secured through keeper access doors A,B…etc"** until you've check every keeper access door that leads into the dens
9. Wait for call to be copied. Repeat call if not copied.
10. Unlock slides for animal rotations.

2 Taxonomy

2.1 Nomenclature

Class: *Animalia*
Order: *Carnivora*
Family: *Ursidae*
Genus: *Ursus*
Species*: U arctos*

2.2 Subspecies

Several subspecies of brown bear are commonly recognized- however their taxonomy is disputed, and rather than being “true” subspecies, they may simply represent size variations due to disparities in food supply.

Recognised subspecies include:

Ursus arctos alascensis Merriam, 1896. Type locality "*Unalaklil, Alaska*."
Ursus arctos arctos Linnaeus, 1958. Type locality "*Sweden*."
Ursus arctos beringianus Middendorff, 1853. Type locality "*Great Shantar Island, Sea of Okhotsk."*
Ursus arctos californicus Merriam, 1896. Type locality "*Monterey, California*."
Ursus arctos collaris Cuvier and Geoffroy, 1824. Type locality "*Siberia*."
Ursus arctos dalli Merriam, 1896. Type locality "*Yakutat Bay (NW side), Alaska*."
Ursus arctos gyas Merriam, 1896. Type locality "*Pavlof Bay, Alaska Peninsula, Alaska*."
Ursus arctos horribilis Ord, 1815. Type locality "*Missouri River, a little above mouth of Poplar River, northeastern Montana."*
Ursus arctos isabellinus Horsfield, 1826. Type locality "*mountains of Nepal*."
Ursus arctos lasiotus Gray, 1867. Type locality "*interior of northern China."*
Ursus arctos middendorffi Merriam, 1896. Type locality "*Kodiak Island, Alaska*."
Ursus arctos pruinosus Blyth, 1954. Type locality "*Lhasa, Tibet, China*."
Ursus arctos sitkensis Merriam, 1896. Type locality "*near Sitka, Alaska*."
Ursus arctos stikeenensis Merriam, 1914. Type locality "*Tatletuey Lake, near head of Skeena River, northern British Columbia, Canada."*
Ursus arctos syriacus Hemprich and Ehrenberg, 1828. Type locality "*near Bischerre village, Mt. Makel, Lebanon."*

2.3 Recent Synonyms

Alternative species names: *[Genus] absarokus, [Genus] alascensis, [Genus], [Genus] albus, [Genus] alexandrae, [Genus] alpinus, [Genus] andersoni, [Genus] annulatus, [Genus] apache, [Genus] argenteus, [Genus] arizonae, [Genus] atnarko, [Genus] aureus, [Genus], [Genus] badius, [Genus] baikalensis, [Genus] bairdi, [Genus] beringiana, [Genus] bisonophagus, [Genus] bosniensis, [Genus] brunneus, [Genus] cadaverinus, [Genus] californicus, [Genus] canadensis, [Genus] candescens, [Genus] caucasicus, [Genus] caurinus, [Genus] cavifrons, [Genus] chelan, [Genus] chelidonias, [Genus] cinereus, [Genus] collaris, [Genus] colusus, [Genus] crassodon, [Genus] crassus, [Genus] cressonus, [Genus] crowtheri, [Genus] dalli, [Genus] dusorgus, [Genus] eltonclarki, [Genus] ereunetes, [Genus] eulophus, [Genus] euryrhinus, [Genus] eversmanni, [Genus] eximius, [Genus] falciger, [Genus] ferox, [Genus] formicarius, [Genus] fuscus, [Genus] grandis, [Genus] griseus, [Genus] gyas, [Genus] henshawi, [Genus] holzworthi, [Genus] hoots, [Genus] horriaeus, [Genus] horribilis, [Genus] hylodromus, [Genus] idahoensis, [Genus] imperator, [Genus] impiger, [Genus] innuitus, [Genus] inopinatus, [Genus] insularis, [Genus] internationalis, [Genus] isabellinus, [Genus] jeniseensis, [Genus] kadiaki, [Genus] kenaiensis, [Genus] kennerleyi, [Genus] kidderi, [Genus] klamathensis, [Genus] kluane, [Genus] kodiaki, [Genus] kolymensis, [Genus] kwakiutl, [Genus] lagomyiarius, [Genus] lasiotus, [Genus] lasistanicus, [Genus] latifrons, [Genus] leuconyx, [Genus] macfarlani, [Genus] machetes, [Genus] macrodon, [Genus] magister, [Genus] major, [Genus] mandchuricus, [Genus] marsicanus, [Genus] melanarctos, [Genus] mendocinensis, [Genus] meridionalis, [Genus] merriamii, [Genus] middendorffi, [Genus] minor, [Genus] mirabilis, [Genus] mirus, [Genus] myrmephagus, [Genus] navaho, [Genus] neglectus, [Genus] nelsoni, [Genus] niger, [Genus] normalis, [Genus] nortoni, [Genus] norvegicus, [Genus] nuchek, [Genus] ophrus, [Genus] orgiloides, [Genus] orgilos, [Genus] oribasus, [Genus] pallasi, [Genus] pamirensis, [Genus] pellyensis, [Genus] persicus, [Genus] perturbans, [Genus] pervagor, [Genus] phaeonyx, [Genus] piscator, [Genus] planiceps, [Genus] polonicus, [Genus], [Genus] ruinosus, [Genus] pulchellus, [Genus] pyrenaicus, [Genus] richardsoni, [Genus] rogersi, [Genus] rossicus, [Genus] rufus, [Genus] rungiusi, [Genus] russelli, [Genus] sagittalis, [Genus] scandinavicus, [Genus] schmitzi, [Genus] selkirki, [Genus] shanorum, [Genus] sheldoni, [Genus] shirasi, [Genus] shoshone, [Genus] sibiricus, [Genus] sitkeenensis, [Genus] sitkensis, [Genus] smirnovi, [Genus] stenorostris, [Genus] syriacus, [Genus] tahltanicus, [Genus] texensis, [Genus] toklat, [Genus] townsendi, [Genus] tularensis, [Genus] tundrensis, [Genus] ursus, [Genus] utahensis, [Genus] warburtoni, [Genus] washake, [Genus] yesoensis*

(Don E. Wilson and DeeAnn M. Reeder 1993).

2.4 other common names

- *Ursus horribilis - Grizzly bear (North America) (G B Corbet & J E Hill 1991)*
- *Ursus arctos arctos - Eurasian brown bear (Macdonald, D. 2001)*
- *Ursus arctos horribilis - Grizzly bear (Macdonald, D. 2001))*
- *Ursus arctos middendorffi - Kodiak bear (Macdonald, D. 2001)*
- *Ursus arctos isabellinus (Asian race)*
- *Ursus arctos marsicanus (Abruzzo race) (Mallinson, J.1978)*
- *Ours brun (French) (S.P. Parker 1990)*
- *Braunbär (German)) (S.P. Parker 1990)*
- *Barf ka rinch (Hindi) (Prater, S.N. 1971)*
- *Lal bhalu (Hindi) (Prater, S.N. 1971)*
- *Safed bhalu (Hindi) (Prater, S.N. 1971)*
- *Siala reech (Hindi) (Prater, S.N. 1971)*
- *Haput (Kashmir) (Prater, S.N. 1971)*
- *Drengmo (Baltistan) (Prater, S.N. 1971)*
- *Drin mor (Ladak) (Prater, S.N. 1971)*
- *Dub (Nepali) (Prater, S.N. 1971)*
- Red bear *(Prater, S.N. 1971)*
- Grizzly *(Pasitschniak-Arts, M. 1993)*
- Grizzly bear - usually for those in the interior of North America. *(Pasitschniak-Arts, M. 1993)*
- Griz *(Pasitschniak-Arts, M. 1993)*
- Mazaalai (Mongolian) *(Servheen, C.)*
- Roach-back *(Pasitschniak-Arts, M. 1993)*
- Silver-tip *(Pasitschniak-Arts, M. 1993)*
- Range bear *(Pasitschniak-Arts, M. 1993)*
- Great white bear *(Pasitschniak-Arts, M. 1993)*
- Old Ephraim *(Pasitschniak-Arts, M. 1993)*
- Moccasin Joe *(Pasitschniak-Arts, M. 1993)*
- Alaskan Brown Bear - Ursus arctos middendorffi *(John O. Whitaker 1996)*
- Kodiak bear *(John O. Whitaker 1996)*
- Red bear *(Roberts, T.J.1977)*
- Snow bear *(Roberts, T.J.1977)*

Name for female bears – ‘Sow’

Name for male bears – ‘Boar’

Name for new born and juvenile bear – ‘Cub’

(Debra Bourne 1992)

3. Natural History

3.1 Morphometrics

3.1.1 Mass and Basic Body Measurement

LENTH -Adult: The head and body length varies from 1.0 - 3.0 m (3ft 3 inches to 10 ft). This may be due to both genetic factors and nutrition. The tail is short, about 60 - 210 mm (2.3 - 8.3 inches).
Newborns: Newborn cubs are about 203 - 280 mm (8 - 11 inches) long *(Debra Bourne 1992).*

HEIGHT
Adults and sub-adults: Shoulder height is 0.9 - 1.5 m (3 - 4.9 ft) *(Debra Bourne 1992).*

WEIGHT
Adult: The size and weight of these bears varies considerably between populations; in any given population, male's average heavier than females. The heaviest brown bears have been recorded from populations with access to salmon in coastal Alaska. While individuals have been weighed at more that 454kg (1,000 lb), most are much lighter than this. Average weights are probably closer to 200 kg (450 lb) for males and 135 kg (300 lb) for females; however in some areas they are much smaller: in some populations in southern Europe average weight is as low as 70 kg, and in Jasper National Park, Alberta, Canada, average weights were 92 kg for males, 55 kg for females. This wide variation may be due to both genetic factors and nutrition. Weight also shows large seasonal fluctuations; brown bears gain weight rapidly during late summer and autumn (fall), reach their maximum mass just before denning, and then lose weight (up to 40% of total mass for females) over the winter hibernation.
Newborns: Cubs weigh less than 1% of maternal weight, about 285 - 600 g (9 oz to 1 lb 5 oz) *(Debra Bourne 1992).*

GROWTH RATE
Growth rate is highly variable depending on food intake. Hand-reared cubs have variously reached between about 1.7 and 2.5 kg by one month, 4.3 - 6.4 kg by two months, 7.4 - 8.5 kg by three months, 20 kg by four months and as much as 50 kg at seven months. Wild cubs may reach 15 kg at three months. In the wild, young-of-the-year may range from 2.0 - 27 kg and yearlings from 9 - 37 kg. Growth may continue after puberty (four to six years), even to 10-11 years of age in southern Alaska *(Debra Bourne 1992).*

NOTE: In zoos, bears may weigh more than wild bears because of regular feeding and limited movement *(Debra Bourne 1992).*

SPEED- Brown bears can be fast runners despite their size, capable of speeds of up to 56 km/h (35 mph) *(Debra Bourne 1992).*

SOCIAL UNIT- solitary *(Debra Bourne 1992)*

3.1.2 Sexual Dimorphism

Male bears are about 20% larger than female bears (on average) *(Debra Bourne 1992).*

At National Zoo and Aquarium Canberra, the male brown bears weight is 357kg and both the females weight is 216kg.

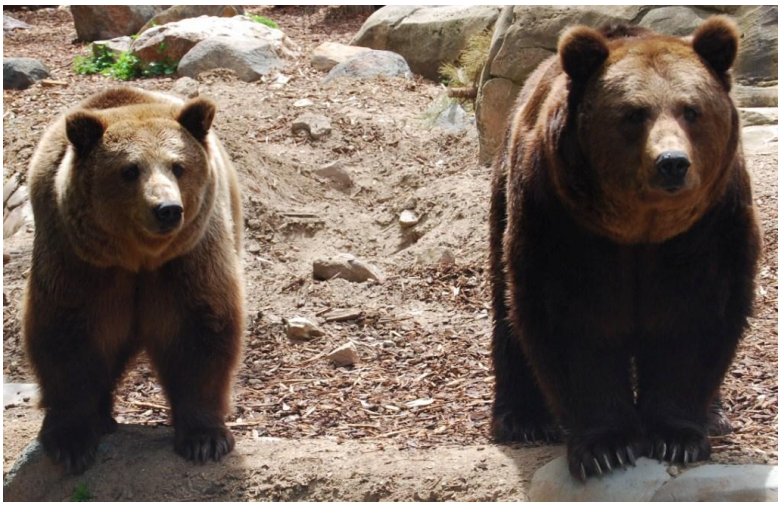


Figure 3 Female bear **Male bear**

3.1.3 Distinguishing Features

Bears are strongly built with a very short tail. Brown bears have a large and round concave facial profile bearing short round ears and relatively small eyes.
The lips are protrusible, the molars are broad and nearly flat.
They are plantigrade, with five toes, approximately equal in length, to each paw; the paws are wider than those of canids (Canidae - Dogs, foxes (Family)), and the curved, non-retractile claws are longer and stronger *(Debra Bourne 1992).*

The brown bear has a prominent muscular hump on the shoulders.
The fur is variable in colour, from blond or creamy tan through gold, grey, silver, cinnamon, light yellowish brown, reddish brown and dark brown to nearly black. There are geographical variations in the normal coat colour. In Eurasia, western bears are generally paler and eastern bears darker. In North America, grizzled bears are common in the Rocky Mountains for example, while Alaskan and Kodiak bears are uniform in colour. The coat of an individual bear may change colour during the year, with the new coat in summer a dark rich brown, while the worn coat becomes tawny or reddish brown. Guard hairs may have a white or silver tip and a white protrusible band, giving a grizzled or frosted appearance. The pelage includes a dense inner fur layer and outer guard hairs. The winter fur is thicker and coarser than the summer fur and appears shaggy. During summer the old inner fur and guard hairs are shed; by autumn there is a fully developed coat, with guard hairs about 10 cm long, underfur about 8 cm long.

Adult Colour variations: Some adults have a pale band around the thorax behind the front legs and some have a pale band round the neck, in front of the shoulders.

Newborn/Juvenile**:** Cubs have short grey-brown hair. There may be a pale band round the neck.
The brown bear has powerful legs, five digits on each foot and long, strong, curved claws (those of the front feet may be nearly 10 cm/four inches long) which are usually white to horn-coloured. The soles of the feet are hairy.
The forefoot print may be 175 - 200 mm wide (7 - 8") and half that in length. The hindfoot print may reach 250 - 300 mm long (10 - 12") and 175 - 200 mm wide (7 - 8"). Prints left in soft mud can be larger *(Debra Bourne 1992).*

Figure 4 Female European brown bear front paw

Figure 5 Female European brown bear rear paw

3.1.4 Basic Anatomy

In General: Bears do not have any major anatomical specialisations.

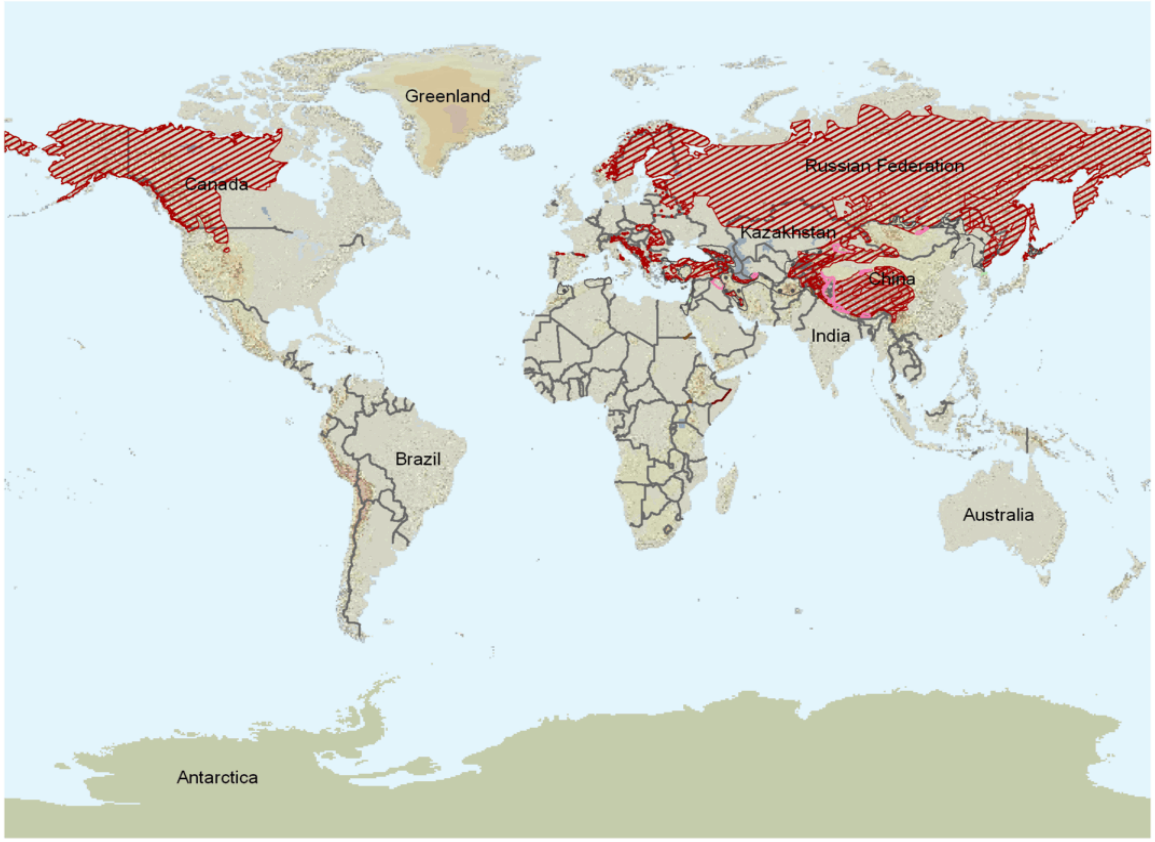
MUSCULO-SKELETAL: Robust jaw muscles, Muscular shoulders. The skeleton is large and robust.
Neck vertebrae: much rotational movement is possible.
Limbs: front and hind limbs are nearly equal in length. The radius and ulna are separate, as are the tibia and fibula. This allows powerful twisting movements of the limbs *(Pasitschniak-Arts, M. 1993, Macdonald 2001).*

DENTITION: Adult- The dental formula is i 3/3, c 1/1, pm 4/4, m 2/3 x2 = 42. The incisors are unspecialised, the canine teeth are long. The first three premolars are reduced or lost. The molars have broad, flat crowns and there are no carnassials *(Debra Bourne 1992).*

3.2 Distribution and Habitat

DISTRIBUTION

The brown bear is distributed across much of northern Eurasia and North America. Its principal range countries are Russia, the United States (especially Alaska), Canada, and Finland where it is the national animal.



Ursus arctos

range type

- Historical
- Introduced
- Native (resident)

- national boundaries
- subnational boundaries
- lakes, rivers, canals
- salt pans, intermittent rivers

data source:
IUCN and Wildlife Conservation Society

NE DD LC LEAST CONCERN NT VU EN CR EW EX

gall stereographic central point: 0°, 0°

map created 05/21/2009

0 8,000

kilometer

THE IUCN RED LIST OF THREATENED SPECIES™

European Regional Assessment

HABITAT

Habitats must provide areas for feeding, sanctuary (cover) and denning, with sufficient habitat diversity to allow flexible responses to environmental changes and, in particular, both a sequence of abundant food resources and alternate foods. There must also be corridors for travel between required areas.
In North America they are found mainly in open areas (but with some dense cover available). In Europe, remaining populations are in mountainous woodlands. In the Himalayas they are found in alpine meadow and sub-alpine scrub above the tree line, sometimes at lower altitudes in remote valleys *(Debra Bourne 1992).*

3.3 Conservation Status

WILD POPULATION - IMPORTANCE:
The world population may total 200,000 - 250,000, but many populations are small. The largest populations are in Russia (more than 123,800), Alaska (25,000 - 39,100) and Canada (about 25,000), but only about 800 - 1020 in the lower 48 states, less than 25 in each of Spain, France, Italy and Greece, perhaps 25 - 30 in Mongolia and low populations elsewhere in Eurasia *(Debra Bourne 1992).*

GENERAL LEGISLATION**:**
Legislation varies widely across countries. In some areas brown bears are totally protected, in others there are various limits on legal hunting and on the extent to which they can be killed to control damage to crops or livestock *(Debra Bourne 1992).*

CITES LISTING**:**
The populations of Bhutan, China, Mexico and Mongolia are in Appendix I; all other populations are included in Appendix II *(Debra Bourne 1992).*

RED-DATA LIST STATUS**:**
Ursus arctos is listed as Lower Risk (least concern); the subspecies *Ursus arctos nelsoni* (Mexican brown bear) is classified as extinct *(Debra Bourne 1992).*

THREATS**:**
The main threats are excessive legal hunting, poaching for gall bladders and other body parts, habitat disruption and killing of "nuisance" bears *(Debra Bourne 1992).*

PEST STATUS / PEST POPULATIONS**:**
Individual brown bears sometimes become pests where they are attracted to human food and garbage, and where they damage agricultural crops or beehives, preys on livestock, or attack humans *(Debra Bourne 1992).*

CAPTIVE POPULATIONS**:**
More than 440 brown bears of various subspecies are kept in zoos round the world (based on ISIS data) *(Debra Bourne 1992).*

3.4 Longevity

Brown bears potentially may live to 25 or 30 years in the wild (36 has been recorded, although the average is much lower) and the record for a brown bear in a zoo is 47 years *(Debra Bourne 1992).*

3.5 Techniques Used to Determine Age in Adults

On close examination age can be determined by examining the bears' teeth as the teeth condition usually gives us an estimation of the age of the bear *(Debra Bourne 1992).*

3.6 Physiology Notes

Metabolism (temperature): The normal rectal temperature of adult bears is 36.5 - 38.5 °C (97.7 - 101.3 °F) *(Debra Bourne 1992).*

Respiratory System: The normal respiratory rate is 15 - 30 breaths per minute. During hibernation this may decrease to as low as one breath per minute *(Debra Bourne 1992).*

Circulatory System (Pulse/Heart rate): The normal heart rate in active brown bears is 40 - 50 bpm, or higher in cubs. During hibernation it decreases to about 8 - 10 bpm *(Debra Bourne 1992).*

Haematology/Biochemistry: Values are similar to those of the domestic dog *(Debra Bourne 1992).*

Gastrointestinal system (Faeces and Gut Motility): Scats (faeces) are usually cylindrical, but may be rounded or massed. They may be more than 50 mm (2 in) wide. Animal hair, husks or vegetable fibres may be visible. Food passes through the short gastro-intestinal system quickly *(Debra Bourne 1992).*

Special Senses: Brown bears have quite good vision, but better hearing and a superb sense of smell *(Debra Bourne 1992).*

3.7 Hibernation / Aestivation

Wild bears

Brown bears hibernate during the winter period when food is unavailable or of greatly reduced availability, entering their dens in September to December and emerging in March to May. Hibernation lasts three to seven months.

In some areas it appears all bears enter their dens at about the same time. Other studies have found that pregnant females entered their dens earlier than other bears. Individuals which have fed sufficiently, laying down enough fat, den earlier than those which do not have sufficient fat reserves; these stay active and feeding until forced to den by low temperatures and snowstorms.
In spring, adult males and females leave their dens first, then females with yearlings and last females with cubs.
During hibernation, body temperature is reduced by about 4 - 5 °C, the respiratory rate decreases to about one breath a minute and the heart rate to 8 - 10 bpm. Blood is redistributed, going mainly to the heart, lungs and brain. During hibernation the bears do not eat, drink, defecate or urinate. Water needs are satisfied by metabolic water from fat. Blood total protein, uric acid and urea remain constant; the creatinine concentration rises to about twice normal. Males lose about 22% of their autumn mass over the winter hibernation, females about 40%, due to the demands of reproduction *(Debra Bourne 1992).*

In captivity

The brown bears at National Zoo and Aquarium Canberra, do not go into true hibernation during the winter period (June, July, August) as the temperature does not get cold enough. Instead, the bears “semi-hibernate” which means they do eat a lot less and sleep most of the time but can still often be seen foraging for favourite foods such as meat, grapes and lettuce in their enclosure. *(Personal Observation)*

4 Housing requirements

4.1 Exhibit/ Enclosure design

NOTE: Bear enclosures made of concrete, rock and water only are no longer considered appropriate, since an enclosure of this type does not simulate the natural environment or encourage natural behaviour *(Partridge 1992).*

Bears are intelligent, curious and adaptable. They are predominantly diurnal, as seen in undisturbed habitats in the wild, and are mainly solitary.
The behavioural, social and psychological requirements of bears must be taken into consideration in enclosure design and husbandry (*Van De Helm, F 1995).*

While even a very large zoo enclosure cannot provide the space of a wild bear home range, **functions** provided by that range should be provided within the enclosure, including:

- Feeding areas, including places where food can be hidden (i.e. opportunities for foraging).
- Resting areas.
- Substrates in which bears can make day and night nests/beds.
- Pathways.
- Various microclimates, including dry, sunny, sheltered areas for cool weather and shady areas open to the wind for warm times.
- Warm, sheltered outdoor areas must be available for tropical species, to encourage use of the outside enclosure even in colder weather.

- In hot climates, areas are needed in which the bears, particularly those from colder climates, can cool down.
- Visual barriers and hiding places on the ground, allowing bears to hide both from conspecifics and from visitors.
- Visual barriers which allow bears within an enclosure to get out of one another's sight may reduce stress.
- Obstacles deterring attacks by one bear on another bear.
- Opportunities for climbing.
- Opportunities for walking and running.
- Opportunities for social interaction, **and for avoiding one another.**
- Areas/places to which small and newly introduced bears can retreat to escape from conspecifics.
- Vantage points which are protected but have a good view out of the enclosure;
- Elevated areas for bears, particularly semi-arboreal bear species, to rest in.
- Multiple levels/steep topography.
- Pools; opportunities for swimming

(*Partridge, J.1992, Kolter, L. & J. Usher-Smith, U. 1998 Meyerson, R. 2007)*

Multiple enclosures

- Ideally, there should be multiple, linked enclosures, with at least one enclosure per adult bear, plus if possible an additional enclosure for housing offspring after separation from their parents but before re-homing *(Partridge, J.1992).*

- If only one outside area is available for two or more bears, temporary (e.g. due to illness, or after the birth of cubs) or longer term incompatibility may mean bears can only have access to the outside area alternately. This undesirable situation can be avoided if more than one outside area is available *(Partridge, J.1992).*

4.2 Holding area design

EAPA Clause 7 Off-exhibit Holding Enclosures

1) Holding facilities for ursids must include denning facilities so that all individuals in the holding facility may be denned separately.
2) Dens must be weatherproof and kept dry.
3) Animals held off-exhibit (not including short term holding yards) for periods up to 90 days (medium term holding enclosure) must be held in enclosures that have a surface area no smaller than that indicated for the species by the bracketed figure in the second column of Appendix 1. Animals held off exhibit for periods greater than 90 days must be held in enclosures that meet exhibit size area requirements as outlined in Appendix 1.

4.3 Spatial requirements

Large enclosures are preferable for bears; enclosures should be as large as possible within constraints such as the area available for bears.

- "Large enclosures" have been defined as "*those which provide more than 1000 m² per individual and where the animals are not regularly locked indoors, either because daily cleaning of the outdoor enclosure is not necessary or because the animals can be moved to another outdoor enclosure during cleaning.*"
- "*Large enclosures provide better possibilities for occasional integration of new animals and for ethological research.*"
- Small enclosures do not allow bears the option of increasing their distance from conspecifics, keepers, or members of the public.

In general, bears show less stereotypic behaviour in larger enclosures *(Exhibited Animals Protection Act 1986).*

Standards for Exhibiting Carnivores
in New South Wales
Exhibited Animals Protection Act 1986

name	SURF. AREA (SQ.M)	MAX. NO. ANIMALS FOR ENCLOS. SIZE	ADDIT. AREA FOR EACH EXTRA ANIMAL IN EXHIBIT (m^2)	ADDITION. AREA FOR EACH EXTRA ANIMAL IN MEDIUM TERM HOLDING YARD (m^2)
Syrian brown bear	**300(30)**	**2**	**20**	**15**
Kodiac brown bear	**300(30)**	**2**	**20**	**15**

4.4 Position of enclosure / 4.5 weather protection

- Various microclimates, including dry, sunny, sheltered areas for cool weather and shady areas open to the wind for warm times.
- In hot climates, areas are needed in which the bears, particularly those from colder climates, can cool down *(Kolter and Usher-Smith 1998).*

Dens, shade sails, trees, shrubs and mock rock caves are used to provide shade and shelter for the bears at National Zoo and Aquarium, Canberra.

4.6 temperature requirements

Heating

- While bears are generally cold-tolerant, heating should be available if required. Heating needs will vary depending on the climate and the construction of the dens. Older bears require heating during the colder months even if they are from a colder natural environment.
- Either under floor heating or infra-red lamps or both may be useful.
- Under floor heating can only be used if there is excellent ventilation and drainage, since it will increase nitrogenous wastes being volatised.
- Plastic flaps over the doorways can be used to prevent excessive loss of heat while allowing bears to move freely between the indoor and outdoor areas - Flaps may need to be replaced periodically, particularly if used for juveniles *(Partridge 1992, Kolter and Usher-Smith 1998).*

Cooling off

- During the warmer months, pools and shade should always be provided. Bears at National Zoo and Aquarium Canberra, also enjoy getting a hose off by their keepers.

4.7 Substrate and 4.8 Nesting and/or bedding

A variety of substrates should be provided, giving opportunities for digging, bedding/nest building, foraging etc (*Kolter and Usher-Smith 1998).*

Use of concrete- In general, concrete is not a good substrate for bears and should be avoided wherever possible.
However, concrete is useful in some particular locations for specific uses.

- For securing fencing and as a strip to prevent bears digging out.
- To support steep slopes, preventing these from being washed away.
- At the bottom of steps or a steep slope, to increase ease of cleaning where bears tend to defecate (*Kolter and Usher-Smith 1998).*

Grass/Natural ground vegetation – Having multiple enclosures can limit the amount of time grazing/ digging in the grassed enclosure to preserve the vegetation.
Most of the enclosure substrate should be natural ground cover.
Natural earth and ground cover allows bears to dig and make pits for resting in, as well as providing an area over which scatter feeds can be given for the bears to search for food.
A grass/herb mixture can be sown if there is no natural ground vegetation present; areas may need to be re-seeded on occasion.
In a concrete-based enclosure, an area can be built, bordered with wooden logs and filled to 10-20 cm deep with soil, then a grass/herb seed mixture sown in it; reseeding may be necessary periodically (*Kolter and Usher-Smith 1998).*

Additional substrates-Bears enjoy digging; concrete enclosures should be modified by provision of one or more areas of sand, bark, wood chippings or soil (*D.A. Field 1998).*

Substrates such as bark can be used to cover areas of concrete.
Bark chippings and sand or soil areas may be used for digging, foraging, rolling, resting and making nests. Soft substrates also provide a softer, preferred area in which bears can play (*Kolter and Usher-Smith 1998).*

At National Zoo and Aquarium, Canberra, nesting and bedding materials can include straw, branches, wood shavings, wood chip/bark and leaf litter. It is important to monitor the bear's health after providing new nesting/bedding materials as materials may cause skin/eye irritation to some individual bears. If this occurs materials should be removed immediately. In one particular case a brown bear was given wood

shavings as a source of bedding/ enrichment. The bear loved it so much that she rolled in the shavings repeatedly which as a result, gave her eye irritations. The shavings were removed and replaced back with straw and her eye irritations diminished.

Note: When areas of natural substrates such as sand pits and bark are provided, the number and position of such areas should be chosen so that all bears, not just those most dominant, can make use of them *(Meyerson 2007).*

Substrates provided should have different characteristics from one another, including varying thermal properties, as outlined below.

- Bark litter conserves humidity-

This should be provided in shady areas and should be dampened on hot days to reduce dust. Bark and chippings from conifers should be mixed with those from deciduous trees to reduce possible skin irritation. Do not use bark and chippings which may have been treated with insecticides or fungicides, as these are poisonous (*Kolter and Usher-Smith 1998).*

- Sand or fine gravel drains well and heats up quickly.

This should be provided in sunny locations. Keep at a distance from any artificial pool or water moat to reduce the risk of excessive transfer to the water resulting in outlet pipes becoming blocked. Sand pits provide opportunities for bears to dig (*Kolter and Usher-Smith 1998.)*

- Wood shavings/wood chips are useful anywhere; they absorb water well (*Kolter and Usher-Smith 1998).*

- Autumn leaves, if dry, provide good insulation (*Kolter and Usher-Smith 1998).*

- Wooden planks provide good insulation (*Kolter and Usher-Smith 1998).*

- Straw or hay (usually given indoors) provide good insulation, if dry (*Kolter and Usher-Smith 1998.)*

- Shredded newspaper (usually given indoors) provides good insulation, if dry (*Kolter and Usher-Smith 1998).*

- Stable mats, made from recycled polyethylene (usually indoors) provide insulation (*Kolter and Usher-Smith 1998).*

Note: Provision of these substrates is most important in enclosures which are not primarily covered with natural ground cover (*Meyerson 2007).*

Suitable substrates for making nests/beds should be available in both outdoor and indoor areas, and in off-show areas as well as the main exhibit (*Meyerson 2007).*

Check the suitability of substrates with veterinary and curatorial personnel before use (*Meyerson 2007).*

Monitor bears initially when they are given access to new substrates, to check they are not ingesting them, with resultant health problems *(B.K Gupta 2007).*

Cleaning of substrates

- Substrates need to be cleaned or replaced as required to prevent build-up of pathogenic organisms and organic matter. Hard substrates should be cleaned daily and disinfected regularly, substrates such as soil and grass should be spot-cleaned; substrates which cannot be cleaned need to be replaced periodically (*Meyerson 2007).*

4.9 Enclosure furnishing

Pools and water features

A pool or other water area sufficient for bathing is an essential feature in a bear enclosure.

- Bears will play in a pool in summer; they may use it less often in winter, but some use may be made (e.g. a male *Ursus arctos* - Brown bear "fully immersed and playing with large blocks of ice" in cold spells in winter (in Scotland).
- In hot weather, bears will make use of a pool to cool down. Pools are important to allow bears to keep cool in hot weather.
- A bathing pool must be provided if there is no water moat in which the bears can bathe/swim.
- A large pool with gently sloping sides is suggested to make access to and from the pool easy and allow its use by more than one bear at a time.
- Pools should have at least one side with a shallow slope to allow bears to enter and exit the water easily.
- If the pool is relatively small, providing more than one pool reduces competition for this resource, particularly when it is highly desired, such as on hot summer days.
- Pools may be made more interesting for the bears by e.g. providing a sandy, flexible bottom, and by placing boulders in the pool.
- Note: where several outdoor enclosures are provided and bears may have access to only one enclosure at any time, there should be at least one pool in each enclosure.
- Consider providing a stream and/or waterfall for added interest

(Kolter and Usher-Smith 1998, Partridge 1992).

Plants and vegetation

All plants (growing or offered as browse) should be evaluated for potential toxicity, ability to cause physical irritation, as well as any possible exposure to noxious chemicals such as herbicides or pesticides.
The following list indicates natural and artificial items which can be provided, and their functions.

Shrubs

- Provide different microclimates.
- Provide shelter and shade.
- Act as obstacles to attacks by conspecifics.
- In relatively small enclosures, thorny shrubs or those which regenerate well after damage may be advantageous. In very large enclosures, a wider variety of bushes may survive.
- Some bushes and shrubs may provide food at certain times of the year.

Bushes which have been provided with at least some success in bear enclosures include gooseberry bush *(Ribes uvacrispa)* elder *(Sambucuc niger)*, osier *(Salix viminalis)*, blackberry *(Rubus fruticosus)* and hawthorn *(Crataegus mongyna).*

DO NOT include oleander *(Nerium oleander)* in or near the enclosure; this is poisonous *(Meyerson 2007).*

Trees

- Provide climbing opportunities.
- Provide different microclimates, e.g. shade in summer (*Meyerson 2007, Gupta 2007).*
- Act as obstacles to attacks by conspecifics.
- Provide an object for scratching, keeping the nails from becoming too long *(M.E Fowler 1986).*
- Provide vantage points.
- May provide visual barriers.
- Small branches provide escape routes for small individuals.

Note: Trees should be at least 4 m from the enclosure boundaries.
It is important to ensure that trees (including large branches fallen from trees) do not give bears opportunities to escape; they should be checked and trimmed as necessary. Where practical, tree species native to the bears' natural habitat can be planted *(Gupta 2004).*

In an enclosures where living trees could not be planted (e.g. on solid rock), conifer plantation thinning (200-300 mm diameter, 5-7 m high) were provided, installed in steel pipes which were attached to the bedrock by large steel plates. The trees were changed about every six to eight weeks *(Partridge 1992).*
The bears enjoyed playing with and breaking off branches, and tearing bark from the trunks *(Partridge 1992).*

Protection of some trees with metal guards, electric fencing or other barriers may be required to prevent excessive damage *(O'Grady 1990)*.

Note: DO NOT include yew (*Taxus spp.)* in or near the enclosure; this is poisonous.

Note: When using dead trees or large branches/logs arranged as climbing frames there should be at least two exit routes.

Small branches provide escape routes for small individuals; ropes and/or narrow planks can also be used to provide escape routes.
Tree trunks as big as 5 - 6 m tall can be fixed by placing in a drainpipe (0.6 - 0.8 m diameter bedded in a mixture of sand and gravel) and fixing with wooden wedges. This allows the trees to be replaced easily when required due to damage by the bears. Once bark is stripped and the trunk becomes slippery, ropes wound around the trunk will permit heavier individuals to climb.

Note: Trees should be at least 4 m from the enclosure boundaries.

In old, small enclosures, providing climbing frames can considerably increase the useable space. However, unless they are made interesting, for example by providing a platform at the top for sunbathing, and/or providing food rewards to climb for, they will be used only as a lookout point or for a place to escape to when harassed by conspecifics *(Kolter and Usher-Smith 1998).*

Rocks/boulders (too large to be moved by the bear(s)):

- Climbing opportunities.
- Provide vantage points.
- Provide shelter and shade *(Meyerson 2007).*
- Provide a site for bears to dig under to make a resting place (therefore must be placed or secured such that they will not collapse on the bear).
- A large rock pile can provide a sight barrier between bears and reduce social stress *(Partridge 1992).*

Note: a study found that placing large numbers of rocks and boulders in an enclosure decreased stereotypic pacing in *Ursus arctos* - Brown bear *(Van Keulen-Kromhout 1978).*

Earth banks:

- Provide different microclimates.
- Act as obstacles to attacks by conspecifics.
- Allow bears to dig and create dens.
- Given the opportunity, bears may excavate their own dens, including maternity dens, in earth banks *(Boone 1999).*
- Digging under a large root or rock may be preferred *(O'Grady 1990)*.

Horizontal tree trunks or large logs:

- Provide different microclimates.
- Act as obstacles to attacks by conspecifics.
- Hiding places for food.
- Provide a site for bears to dig under to make a resting place (therefore must be placed or secured such that they will not collapse on the bear).
- Allow scratching, keeping the nails from becoming too long *(M.E Fowler 1986).*
- Provide a climbing opportunity *(Gupta 2004).*
- When rotting, provide insects for the bears to search for *(Gupta 2004).*

Elevated nest baskets or fire hose hammocks:

- Provide vantage points *(Kolter and Usher-Smith 1998).*

Climbing frames and platforms:
provide an opportunity to climb *(Ames 1994).*

Note: smooth poles or trunks can be made easier to climb by winding a spiral of rope (e.g. hemp rope) around the pole/trunk. Shallow ramps should be provided to allow less agile bears to reach platforms. Different species may vary in their use of climbing frames if available, but bears of all species will climb *(Ames 1994)*.

- Provide vantage points *(D.A field 1998).*
- Allow bears to watch approaching keepers and visitors *(O'Grady 1990)*.
- Visitors may provide a form of enrichment if the bears can choose to watch them from a good, secure vantage point.

Note: careful placement of a platform allows bears to feel secure and watch visitors, and allows visitors to see the bears *(O'Grady 1990).*

- Allows placement of food items - wooden pegs can be fitted at various heights for food items to be speared onto *(Partridge 1992).*
- Provides an area for sunbathing.
- Provide a means of escape from possible aggressive interactions *(D.A field 1998).*

Raised wooden shelters (provided in addition to the main house):

- Provide resting areas *(Partridge 1992).*
- Provide different microclimates;
- Provide hiding places.
- Note: these should be open on two sides to **prevent** a bear becoming trapped by another bear.

Piles of branches:

- Provide hiding places for food;
- Material for constructing nests.

Pipe in the ground (vertical, 40 - 60 cm deep):

- Hiding places for food.
- Gravel at the bottom of the pipe improves drainage (2.5 cm/one inch of gravel is sufficient) *(O'Grady 1990.)*

Rotten logs:

- Bears enjoy destroying these.
- May provide some insects.
- Rocks and logs small enough for the bears to move (these may need to be chained to a fixed point to prevent their being moved e.g. into a moat):
- Hiding places for food.

Outside dens/shelters, such as artificial caves, wooden "cabins" built from railway sleepers, culvert pipes, etc *(Gupta 2004).*

Shade cloth:

- Shade from hot sun in the summer.

Limitations: It should be remembered that older animals which have not previously had the opportunity to climb may be reluctant to climb steep or vertical structures. For *Ursus arctos* - Brown bear, which do not climb vertical structures as adults, care must be taken to keep climbing structures at shallow angles and to ensure that steeper structures are surrounded by soft substrates, not concrete or rocks, to minimise the risk of injury if a bear falls *(Kolter and Usher-Smith 1998).*

Figure 6 Fire hose hammock, hollow log and climbing structures.

Figure 7 mock rock cave built from a pipe and concrete

Figure 8 log pile with pine trees with food placed in branches and wood bark substrate.

Figure 9 Male European brown bear resting on rock boulder

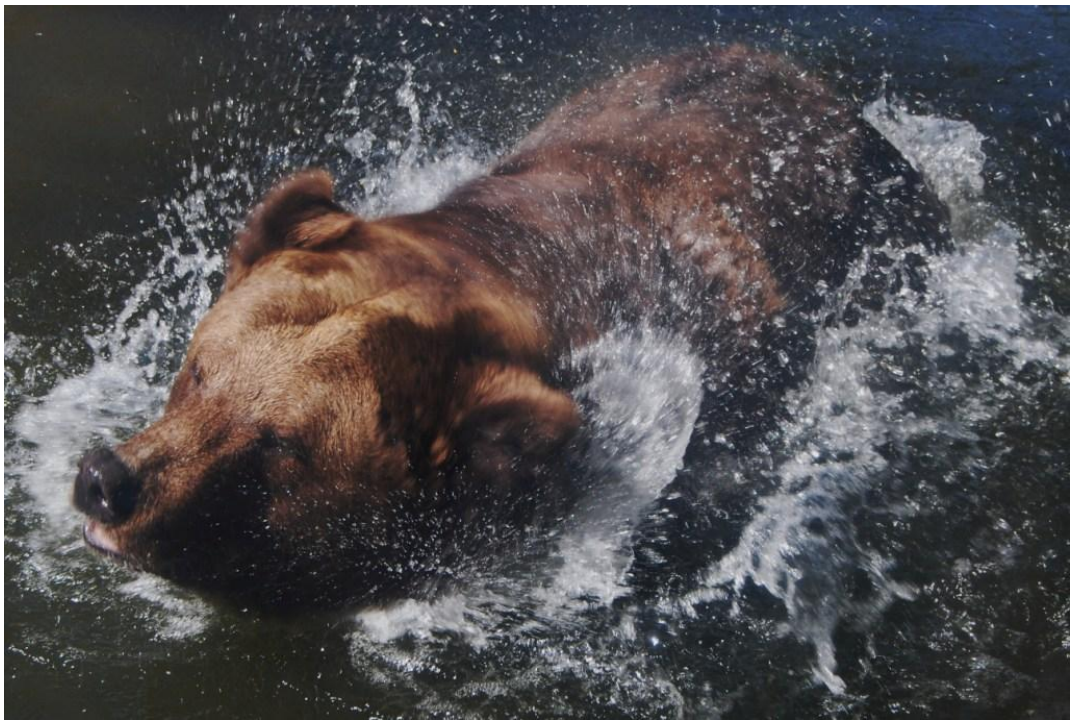


Figure 10 A bear loving a splash around in his pool.

Figure 11 Brown bear playing in pool with a ball

5 General Husbandry

5.1 Hygiene and Cleaning

Cleaning and disinfection are an important part of animal husbandry to remove urine, faeces, uneaten food etc.
The frequency of cleaning and disinfection required will vary depending on the size of the enclosure, substrate type and the animals kept (species and stocking density). Excessive cleaning may remove important chemical cues used by animals to indicate territory; this may result in chronic stress *(Gibbons 1995).*

Recommendations from American Zoo and Aquarium Association (AZA):
Dirt substrates should be raked and spot-cleaned daily, while hard surfaces should be cleaned and disinfected daily and resting boards/shelves should be cleaned daily. It is also recommended that food containers and drinking water containers be cleaned and disinfected daily.
Bedding material (straw, wood shavings etc) need to be cleaned or replaced as required to prevent build-up of pathogenic organisms and organic matter. Hard substrates should be cleaned daily and disinfected regularly, substrates such as soil and grass should be spot-cleaned; substrates which cannot be cleaned need to be replaced periodically

In large bear enclosures, daily cleaning is not required *(Kolter.L.1995).*
It should be remembered that while daily cleaning and regular disinfection will reduce parasites, normal cleaning will not eliminate nematode infections since it will not remove eggs of parasites such as ascarids in soil *(Kolter and Usher-Smith 1998).*
Following worming, re-contamination of the enclosure can be minimised by keeping indoor accommodation very clean for the following 24 hours, removing faeces from outdoor enclosures and, in concrete dens, by hosing down and applying disinfectant *(Kolter and Usher-Smith 1998).*

The benefits of disinfectant use need to be balanced against the loss of scent marks and general odours, and the potential adverse behavioural effects this may have on the animals. Use of disinfectants can be reduced in large enclosures, particularly outside enclosures exposed to sunlight, frost etc., with a relatively small population of animals, but are required more in small, particularly inside, enclosures and those with high population densities *(Partridge 1992).*

- Disinfection should be seen as an **adjunct** to removal of animal wastes etc., **not** as a replacement for general cleaning.
- The efficacy of most disinfectants is greatly reduced by the presence of organic matter; surfaces to be disinfected need to be cleaned thoroughly with hot water and detergent before the disinfectant is applied.
- Disinfectants require time in which to act.
- Disinfectants generally work better at higher temperatures.
- Disinfectants should be used **at the manufacturer's recommended dilution**: stronger does not necessarily mean better, and efficacy may be greatly decreased at too low concentrations.

- Disinfectants may be toxic, irritant, corrosive and in some cases potentially carcinogenic.
    - **Note:** Felids (Felidae - Cats (Family)) are susceptible to poisoning from contact with **Phenolic** disinfectants.
- Appropriate precautions (e.g. wearing impermeable gloves, other protective clothing, face protection) should be used when handling disinfectants.
- Disinfectants should be used and disposed of with regard to potential deleterious environmental effects.
- After disinfectants have been applied and left for the required time for effect, they should be rinsed away **thoroughly**; this requires provision of adequate drainage so than animal's dens are not left wet or damp when the animals return to them.
- Not all disinfectants are equally effective against all agents. **The following indicates the general sensitivities of micro-organisms:**
    - **Susceptible to most chemical disinfectants:** mycoplasmas, enveloped viruses, gram-positive bacteria, gram-negative bacteria, rickettsiae
    - **Moderately resistant to chemical disinfectants:** non-enveloped viruses, acid-fast bacteria.
    - **Highly resistant to chemical disinfectants:** bacterial endospores, coccidial oocysts.
    - **Extremely resistant to chemical disinfectants:** prions
- If a particular disease organism is known to be present, care should be taken to choose a disinfectant known to be effective against that organism.
- **Hypochlorites** (household bleach) are effective or highly effective against a wide range of infectious agents and may be used as a general disinfectant in many circumstances. They are not effective against coccidial oocysts. Care must be taken in the use of concentrated bleach solutions.

- In collections, the use of disinfectant footbaths on the way into and out of enclosures may greatly reduce the risk of cross-contamination between enclosures.

List of disinfectants that can be used under manufacturers recommendations-

Bisphenols
Calcium Oxide
Chlorhexidine
Copper Sulphate
Cresols
Formalin
Hypochlorites
Imidazoles
Iodophors
Phenol
Pine Oil
Quaternary Ammonium Compounds
Sodium Hydroxide

- NOTE- where a particular infectious agent is known to be present, a disinfectant which is recognised as being effective against that agent should be used.

- Some organisms are extremely resistant to disinfectants. Elimination of these organisms (e.g. *ascarid ova*) may require application of direct heat, for example using a blowtorch. Use of direct heat is limited because many materials will be damaged *(Debra Bourne 1992).*

5.2 Record Keeping

It is imperative that records are of a high standard, updated regularly and easily accessible. Every brown bear held within a facility needs to have an individual record. These records need to be stored in a way that can be easily analyzed and accessed for comparisons to the records of the same species from other facilities.

The following information needs to be provided:

- Identification number, common name, scientific name, any personal name, and any distinctive markings
- origins; the details of the parents, their origin and any previous locations
- dates of acquisition and disposal, details of circumstances and addresses
- date of birth
- Breeding information including mating, reproductive and behavioral cycles, parenting ability and details of offspring
- Date and cause of death including results of post-mortems
- normal diet
- Any other relevant information about the individuals for example any behavioral or dietary changes.

Veterinary records, results of physical examinations, details and dates of any treatments, results of routine health checks should include:

- Species, sex and age of animal treated
- Details of animal's identification
- Details of the nature of the illness
- Veterinary diagnosis, recommended treatment and treatment carried out
- Care and rehabilitation processes
- Outcome of treatment

('General Standards for Exhibiting Animals in New South Wales'(2004) Part 7,Claus 33, Exhibited Animals Protection Act, Director General, NSW Agriculture)

5.3 Methods of Identification

- Microchips
- Tattooing
- Photo ID of physical differences such as size, colour, sex, age and individual features
- Identification of different personalities of individual bears *(Debra Bourne 1992).*

5.4 Routine Data Collection

Data should be collected and recorded on a regular basis. This forms a record of everything that happens within an institution and can be used as a guide or reference and accessed when necessary.

ACQ: ACQUISITION

Any importation from outside the collection, public donation, or capture from grounds or from the wild

B/H: BIRTH/HATCHING

Birds: generally recorded as hatch date. If date of leaving the nest is used it must be noted as such under Information column
Marsupials: The day on which the animal is permanently out of the pouch or the day a juvenile is thrown from the pouch
Placental: The day on which they are born

D/30: DEATH WITHIN 30 DAYS

Death/Euthanasia within 30days of birth hatching or acquisition

D/E: DEATHS ESTABLISHED

Death/Euthanasia of any animal which has been resident in the collection for longer than 30 days

DIS: DISPOSITION

Includes exports from the collection, releases, sales, escapes

BRD: BREEDING

Reproductive details/observations: Any nesting, laying of eggs, oestrus, menstruations, mating, courtship, pouch checks, sexing of previously unsexed individuals or any other reproductive matter

INT: INTERNAL MOVEMENT/TRANSFER

Any movement of an animal from its residing enclosure be it within a section or to a different section.
Transfers/exports out of the collection NOT included

TAG: TAGGING

Animal identification by banding, tagging, notching, tattooing, naming or any other method of identification

W/L: WEIGHT/LENGTH

Weight or length measurement

Rx/Tx: TREATMENT

Any medical treatment administered to animals, either by Vets, or continuing treatment administered by animals care staff. Include observations of anything related to treatment. Flag if veterinary examination is required using VET code.

VET: VET EXAMINATION REQUIRED

Note if veterinary treatments/examination require

OTH: OTHER

Any notable observations made in reference to daily

routine or animals, e.g. behavior, change to routine ect. Also anything else of interest e.g. animal management procedures, diet change, maintenance etc (Keeper Daily report diary)

6 Feeding

6.1 Wild Diet

Bears take fruit, berries, nuts, grass and grain from the ground, tear up berry patches, overturn rocks and tear up rotting logs to get insects, walk through standing grain crops and draw the grain towards them with their forepaws.
As well as eating carrion, they actively prey on a variety of ungulates, particularly calves, but also adults. Calves and yearlings rather than adults of livestock are taken most commonly, and in forests rather than on open range.
During the salmon run they may gorge and eat only a bite of each fish caught. The method used for catching fish - teeth, paws, or teeth and paws - is learned by cubs from their mother.
Brown bears also dig for ground-dwelling rodents, and can get substantial amounts of food in this manner.
Brown bears sometimes cache carcasses of prey, remaining near the cache. Caching may reduce decomposition and hide the carcass from competitors *(Debra Bourne 1992).*

6.2 Captive Diet

Bears, although in the order Carnivora - Carnivores, are omnivorous; they are the largest omnivorous mammals. In the wild, bears have a very varied diet *(Wilson, D.E. & Ruff, S. 1999).*

Food intake of the brown bear usually decreases during the winter time. It is important to remember that zoo bears may easily become obese. **Frequency of feeding**

- Rather than feeding once a day, more frequent feeding with smaller amounts of food, by different means of presentation, more closely matches food availability in the wild.
- In general, bears should be offered food at least three times a day, with most being offered scattered in the outdoor enclosure.
- Brown bears may be offered six feeds a day in autumn.
- Fast days are inappropriate for bears.
    - Anticipation of food appears to be an important stressor on captive bears (with stereotypic behaviours increasing prior to provision of food) and starve days appear to increase this stress *(Kolter and Usher-Smith 1998, Meyerson 2007).*

Recommended diets

- The diet for bears in captivity should be as varied as possible and reflect the range of plant and other food types eaten by wild bears.
- Different requirements should be noted for different species, reflecting their diet and seasonal variations of feeding in the wild.
- To promote oral health in bears, soft foods should be fed first and items with skin/hair or bones last.

- **Note:** meat from pigs (swine) should **not** be given to bears since bears are susceptible to Aujeszky's Disease and *Trichinella* infection *(Kolter and Usher-Smith 1998, Partridge 1992).*

For individuals which have put on fat prior to the winter and then have voluntarily decreased their food intake, a seasonally varying diet can be provided:

- **Spring.** Mainly green vegetables (**not** iceberg lettuce), including items such as dandelions (with roots), wheat shoots, fresh cut grass, clover or alfalfa, willow branches, grass and weeds, hay (i.e. grass from the previous year), root vegetables such as carrots or kolrhabi, plus occasional meat (including bone and skin if possible).
    - Normal or possibly increased vitamin/mineral supplements should be given.
    - **For lactating females**, a protein- and energy-rich diet is required to prevent them weaning their cubs early.
- **Summer.** Gradually change to increase fruit, bread and other more nutritious items.
    - Items suggested for spring can be given sometimes for variety.
    - Normal or possibly increased vitamin/mineral supplements should be given.
- **Autumn.** Provide fruit, carrots and mast - nuts and seeds - together with occasional fatty meat.
- **Winter.** Bears should be fat, have decreased food consumption, and become less active. They may even hibernate if the weather and facilities provide suitable conditions. Water should be provided at all times.*(Kolter and Usher-Smith 1998)*

Note: These bears may hibernate over winter, or semi-hibernate for weeks at a time, if provided with ample food over summer and autumn (fall), but will remain more active, not hibernate, if they have been fed less during the late summer and autumn *(Partridge 1992).*

Do NOT feed bears:

Chocolate.
Highly seasoned or spicy foods.
Any food which has gone mouldy - nuts should be checked carefully before being given.
Excessive quantities of sweets *(American Bear Association).*

The brown bear diet at National Zoo and Aquarium Canberra, includes:

*Meat products- horse, deer, beef, goat, kangaroo, chicken, rabbit, fish and eggs (includes whole food animals, heart, liver, kidneys etc)
*Variety of fruits and vegetables including fresh grass.
*Bread
*Dog kibble of a high quality.

*Enrichment foods occasionally in small proportions- weetbix, oats, rice, pasta, honey, peanut butter, dried fruit, coconuts, peanuts.

The bears at National Zoo and Aquarium Canberra, eat approximately 5 times the amount during the summer in comparison to the winter (approximately 2-3kg of fruit/vegetables per bear, I also find red meat will almost always be consumed no matter what time of year although keep in mind the bears do not go into true hibernation.) The bear's appetite constantly changes as the season changes should be monitored closely. Eg- if there is lots of leftover food in the enclosure reduce the food until there is just a few pieces of food left in the enclosure. Alternately, if there is no food left in the enclosure and the bear is stressed (pacing etc) increase the diet (unless the bear is over weight) until there are just a few pieces of food left in the enclosure.

6.3 Supplements

The captive diet provided to bears should meet all the nutritional requirements needed, however breeding females, sick or older bear can be provided with vitamin and mineral supplements. Pet-vite is occasionally sprinkled on meat at National Zoo and Aquarium Canberra, for added nutrients.

6.4 Presentation of Food

Options for feeding enrichment of bears

Maximum stimulation of foraging behaviours may be obtained by a combination of manipulable permanent furnishings in which small foods can be hidden and novel manipulable objects containing food (American Zoo and Aquarium Association (AZA)).

- Food can be scattered around the enclosure; in a relatively bare enclosure it will be easy to find, but in long grass etc. the bears have to search for it more *(Partridge 1992).*

- Bears are very good at finding even very small pieces of food in long vegetation *(Partridge 1992).*

- Even in a bare enclosure, scattering food can be beneficial. In one study of *Ursus arctos* - Brown bear, providing clover (one of the main summer foods) scattered, rather than in one place, resulted in increased time spent feeding (from 4% to 13% of the day), and decreased time spent in context-free behaviours during the period after this food was provided. The bears also developed a more natural rhythm of alternating feeding and sleeping *(Morimuta, N.1999).*

- Keepers may hand-feed bears as part of a process of building up trust and mutual respect. Hand feeding also provides a way to give oral medication *(Partridge 1992, Kolter and Usher-Smith 1998, Meyerson 2007).*

- Bury clay or PVC pipes in the ground vertically and then drop pieces of food into the pipes for the bears to hook out *(Partridge 1992).*

- Plant edible plants in the enclosure, allowing the bears to forage for natural foods. Suitable plants will vary depending on climate but include clover, dandelions, oats and tender young grasses as well as fruit-bearing vines (e.g. blackberry (bramble), grapes, melon), fruit trees (apple, plum, cherry), nut trees and bushes (e.g. hazelnut, oak, walnut) (*The American Bear Association).*

Examples of enrichment used at National Zoo and Aquarium:

- Hiding places for food items can include hollow logs, wood piles, branch piles, leaf litter, straw, cardboard boxes, inside rolled up carpet, underneath plastic tubs, hung up tyres , hessian sacks, egg cartons, toilet rolls, buried etc

- Scatter feeding with whole, unshelled peanuts

- Honey can be put into holes in climbing structures or into holes drilled in small logs and hung up with chain. See figure 13 and 14 p

- Food can be put into cardboard pipes from the inside of carpet rolls

- PVC pipes can also be used to put food in or drill holes in the pipe and fill with crickets or dried fruit.

- Food can be cooked and mashed into a smear and put around the enclosure at random heights.

- Food can be frozen in tubs of water to make ice blocks

- Food such as grapes, peanuts and dried fruits can be put inside plastic bottles

- Honey can be drizzled onto branches

- Whole foods such as watermelon, rock melon-or alternatively give whole frozen melons

- bones cut so bears can access the marrow

- Stuff large pine cones with foods such as dried fruit or peanut butter/honey.

- Put small pieces of food such as dried fruit in toilet rolls or egg cartons and fold the ends. You can also leave some with nothing in it so the bears rely on there sense of smell.

- Put foods that float and sink in the pond or tub of water (apples, peanuts float and carrots, sultanas sink.)

Note: When hand feeding bears its important for safety to use utensils such as tongs, spoons etc to ensure no hands enter the bear's space or alternatively the bear can stick its tongue through the barrier and lick food such as honey off the persons hand safely.

Figure 12 Brown bear licking honey off tourist's hand

Figure 13 Food stuffed in hanging logs with the drilled holes and weaved fire hose.

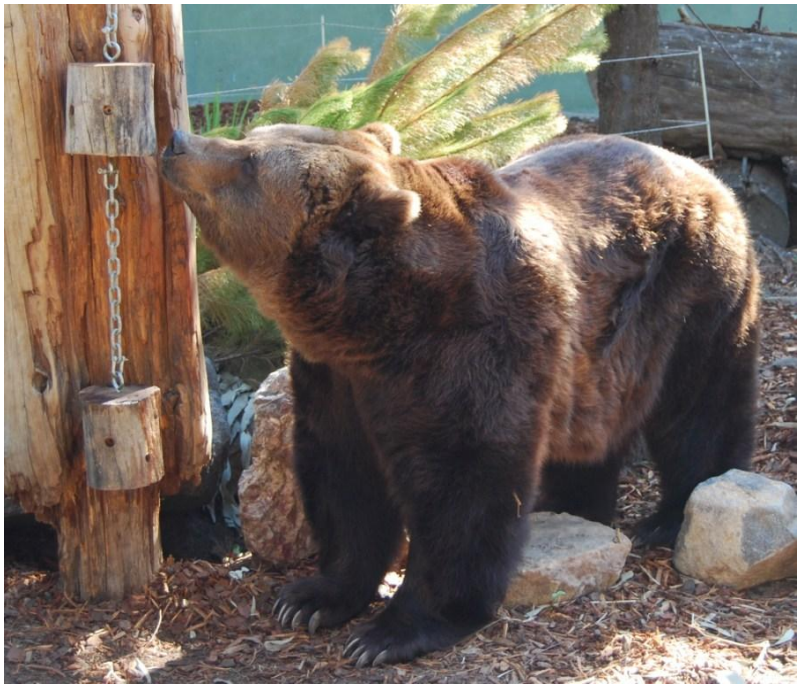


Figure 14 Bear licking honey from holes in hanging logs.

Food provided in a single meal, in one location, e.g. as a pile or in a trough, does **not** give the bear the opportunity to use foraging activities to obtain the food, nor does it stimulate foraging activities.
Keepers throwing food to bears from a certain point (e.g., an enclosure outlook) may lead to development of associated stereotypic behaviour in bears anticipating this feeding *(Montaudoin, S. & Le Pape,, G. 2002).*

7 Handling and Transport

Introduction

Bears are large, strong carnivores. They have the potential to severely injure and even kill humans. Both the teeth and the claws are dangerous. Bears have well-developed, extremely strong jaw muscles. The claws can rip and tear; their strength makes bears dangerous to handle. Despite their clumsy appearance, bears can move very fast and are extremely agile and a large bear can kill a human with a single paw swat *(M.E. Fowler 1995).*

Whenever possible, animals should be managed without the need for any form of handling or restraint.
When mammals are to be caught, handled and moved, it is important that potential problems are considered beforehand, to minimise the risk of injury to the mammals and to the people involved.
Enclosures should be designed with handling in mind. This may involve:

- design ensuring that animals can easily be shut into a small holding area (indoor area, cage etc.) when required;
- outdoor enclosures including a small handling/isolation yard
- incorporation of a squeeze cage facility in carnivore areas.
- design to allow attachment of a travelling crate to the indoor area or a specified outdoor site.
- elimination of sharp or protruding items which could injure the animal, particularly during capture or when partially sedated.
- Where features such as a handling yard or race are included, animals should go through these as a normal part of their husbandry routine. *(Kleiman 1996, Sausman 1982).*

Essential considerations for capture and restraint

Bears are very strong and have compact bodies; physical restraint of these species is difficult.

Care should be taken whenever entering a work area around a bear enclosure. It is important to know where the bear(s) are in the enclosure and which doors are open or closed *(M.E. Fowler 1995).* (See page 2 for an example of a safety procedure)

7.1 Husbandry Training

- Husbandry training for bears should involve:

  *Positive reinforcement;
  *Gradual changes, one step at a time;
  *Avoidance of negative associations;
  *Patience;
  *Cooperation, not competition with the bear;
  *Clear signals;

*Avoiding tricking or deceiving: this may produce a short-term gain but is detrimental in the longer term, as bears will remember the deception.
*Remembering that each bear is an individual and should be treated as an individual, allowing for variation and not expecting all bears to act alike *(Kolter and Usher Smith 1998).*

- In large enclosures, it is important that bears respond to a signal so that they can be visually checked daily to ensure they are healthy. Bears should be rewarded for responding to this signal, by being given a treat *(Kolter and Usher Smith 1998).*

- Positive reinforcement training to enter a holding area can ensure that bears can be shifted into this area when required for example to clean an enclosure or replenish enrichment in the enclosure, and that this behaviour can be accomplished if needed at a different time than usual *(Frederick 1997).*
- Protected contact training and operant conditioning can assist with veterinary examinations and procedures *(Meyerson 2007).*
- Positive reinforcement training has been used in bears for procedures including:
  *Routine movements between cages;
  *Crate training;
  *Weighing;
  *Measuring heart rate;
  *Examination and cleaning of the mouth;
  *Examination and basic treatment of feet (e.g. claw trimming);
  *Reproductive cycle monitoring;
  *Collection of semen samples;
  *Application of topical medication (e.g. using a spray).
  *Cleaning wounds;
  *Injections;
  *Venipuncture.

(Frederick 1997)

To avoid unpleasant experiences which may discourage wanted behaviour:
- Avoid situations in which a bear is held in close confines with another more dominant individual.
- Avoid giving a large meal in a den (or other area) if it is desired that the bear(s) will be brought back out of the area after just a short time; since the bear(s) may be more inclined to stay where the food is.
- If holding indoors for a long period or overnight is required (e.g. while major maintenance is carried out on the outdoor enclosure), consider giving a large and complex meal, such that the bears take some time to finish the food and are then willing to "sleep it off".
- Encourage dispersal when bears are let out of the dens, by providing a scatter-feed some distance from the doors, thereby decreasing the risk of encounters between bears at the exit from the dens *(Kolter and Usher-Smith 1998).*

For more detailed information on conditioning and training, I recommend reading "Don't shoot the dog" by Karen Pryor which can be purchased online at www.amazon.com

Figure 15 Keeper target training brown bears

7.2 Timing of Capture and Handling

It is advisable not to handle carnivores immediately after they have eaten, since they may regurgitate food and could then inhale particles, leading to aspiration pneumonia.

Capture, restraint and transporting bears should be undertaken in the coolest periods of the day-early morning or throughout late evening. This will reduce heat stress of the animal, especially during summer months.

There is a risk of bears becoming hyperthermic during restraint and immobilisation and this can be fatal. See: Hyperthermia
Bears start panting when they become hyperthermic. In *Ursus americanus* - American black bear, panting began once the rectal temperature reached 42.0 °C. Death was reported in a bear whose temperature reached 43 °C.

NOTE: A bear whose body temperature (measured by rectal thermometer) reaches 40 °C during physical or chemical restraint should be actively cooled: shelter the bear from direct sunlight, wet the bear down, and if possible antagonise anaesthetic drugs to reduce the time for which the bear is anaesthetised and has compromised thermoregulation *(Hellgren 1989).*

Before initiating any physical capture or restraint procedure, check that:

- Sufficient skilled personnel are available and that "onlookers" are kept away (*Kleiman 1996).*
- It is recommended that capture, restraint and moving dangerous animals in public zoos is not carried out during opening hours to reduce risk to the public *(National Zoo and Aquarium, Canberra).*
- The facilities and equipment will permit the capture/restraint.
- The procedure can be carried out without compromising the health of the animal.
- The procedure can be carried out without compromising the safety of personnel involved *(M.E. Fowler 1986, Kleiman 1996).*

- The procedure for which the animal is to be restrained does not involve significant pain (if it does, then use of an anaesthetic drug should be considered).Physical restraint is generally used for short, minor procedures such as blood sampling or giving an injection (*Kleiman 1996).*

- If handling is essential in hot or humid conditions, ensure that cooling fans and/or ice water are available for cooling the animal.
- Stress (which may be minor or cause physiological changes which are life-threatening). Touching of the animal by humans and by objects causes stress, and should be minimised once the animal is safely captured. Noises, including mechanical noise, harsh voice tones etc. are stressful and should be reduced *(M.E. Fowler 1986).*
- **Note:** Transportation (in crates, by plane, truck etc.) is stressful; restraint of a recently transported animal should be avoided if possible, particularly after a long journey (*M.E. Fowler 1986).*

Psychological tools in restraint

- Reduce sight: a darkened environment may be used (*M.E. Fowler 1986).*

7.3 Catching equipment

- Heavy gloves or blankets may be used for cubs under 9 kg.
- Nets or snares (catch poles) may be useful for restraining small (young) bears.
- Squeeze cages are required for physical restraint of large bears.
- Cargo nets may be used for carrying sedated bears (*M.E Fowler 1995, Cattet 1998,).*

7.4 Capture and Restraint Techniques

Cubs/juvenile bears

- Wear heavy clothing, fully covering the arms and legs, when handling bears.
- Small cubs (under 9 kg) may be caught by hand, with either heavy gloves or thick blankets for protection from the cub.

- Small (young) bears may be caught using a net of an appropriate size; a heavy animal-handling net is preferable (withstands more wear and tear) but a good salmon net can be used.
- To about 18 kg, cubs can be restrained in a strong net, then injected (with chemical restraint drugs) using a pole syringe *(Convy, J.A. 2002).*

Adult bears

- Physical restraint requires the use of a squeeze cage.
- Bears can be trained by positive reinforcement to walk into a squeeze cage.
- A stronger squeeze cage is required for bears than for large cats (Felidae - Cats (Family)) (*M.E Fowler 1995, Klieman 1996, L.A.Dierauf 1990).*
- Construction must minimise the risk of the bear harming itself, e.g. by biting at the cage.
- Squeeze cage construction must withstand the attentions of bears without being damaged or destroyed.
- A squeeze cage may be used also for handling small or immature bears (*M.E.Fowler 1995, L.A.Dierauf 1990).*
- Restraint in a squeeze cage allows a basic physical examination but not a thorough examination; it also allows intramuscular injections to be given.

- Chemical restraint is required in order to carry out most procedures on adult bears (*L.A.Dierauf 1990, Klieman 1996, Wallach 1983).*

7.5 Weighing and Examination

Bears should be weighed regularly and can be conditioned to stand on scales using positive reinforcement and target training.
Positive reinforcement training may be used to allow physical examination of the paws, mouth etc without the need for physical or chemical restraint.
However for a more thorough examination the bear must be anaesthetized (National Zoo and Aquarium, Canberra).

7.6 Release

After the release of a bear into a new environment it is important to keep the environment as stress free as possible (keep noise level at a minimum and have hiding places were the bear can feel secure etc) (National Zoo and Aquarium, Canberra)

Transportation (in crates, by plane, truck etc.) is stressful; restraint of a recently transported animal should be avoided if possible, particularly after a long journey (*M.E. Fowler 1986).*

Ensure the crate is well secured to the doorway using chains/bolts so that there is zero risk of the bear pushing the crate to one side and exiting other than into the intended holding area *(L.A. Dierauf 1990).*

7.7 Transport requirements

7.7.1 Box Design and Transportation Requirements

Note: If animals are to be transported by air it is important to consult the International Animal Transport Association (IATA) regulations on crates http://www.iata.org/

Specific requirements for a transport container for bears are set out in the IATA regulations. These include:

- "*For bears and other strong clawing animals, the container must be totally lined with sheet iron or other hard metal sheeting, with through ventilation holes.*"
- If the crate plus occupant weighs over 60 kg (132 lb), it must be reinforced with metal bracing and provided with forklift spacer bars.
- The crate must be sufficiently high to allow the bear to stand upright (on all four feet) with its head extended, with at least 10 cm (four inches) clearance.
- The crate must be sufficiently long to allow the bear to lie prone.
- The crate must be large enough to allow the bear to turn around.
- The crate must have adequate ventilation. To ensure this, there must be air inlets providing ventilation at all levels, particularly when the animal is lying prone. There must be ventilation holes, minimum about 2.5 cm (1 inch) diameter along the sides(one row near the top, one row low down, on each long side) and along the top (three rows along the length of the crate). The ventilation holes may be screened with mesh on the outer surface of the crate.
- The crate must have sliding or hinged entry and exit doors.
- The front exit door must be made from strong iron bars, spaced close enough together to stop the occupant putting its legs between them, or steel welded mesh.
- The doors must have secure fastening with screws or bolts, preventing accidental opening of the doors.
- The front of the container must have a sliding light wooden shutter, either with 10 cm (four inch) ventilation holes or with slatting (7 cm i.e. 2.75 inch, and 3/47 inch between the slats) over the upper two thirds of the shutter. This provides protection for the handlers and privacy for the animal in the container.
- The floor of the container must be constructed as a grill over a liquid-proof tray, so that the occupant's excreta can fall into the tray, or the floor must be liquid-proof and be covered with enough material to absorb the excreta.
- There must be food and water containers at the front of the container, off the floor to prevent the containers becoming soiled, and accessible safely from the outside of the crate.

7.7.2 Furnishings

Warm bedding materials should be provided on long journeys especially in cold weather.
If shipping between countries, check beforehand as importation of some materials, such as straw, may not be permitted.

7.7.3 Water and Food

Crates must allow watering and feeding of the animal in transit safely (no risk of either personnel being harmed by the animal or the animal escaping).
Food and water containers need to be non-toxic, have rounded edges, be attached to the inside of the crate and have their access ports clearly marked on the outside of the crate.

Except in the case of very short journeys, provision must be made for feeding and watering: for longer journeys, food should be sent with the animal to allow feeding. Food intake may be reduced for two to three days before transportation to decrease contamination of the crate with faeces. This will depend on the length of time the bear is to be in transit, and on veterinary, curatorial and nutritionist approval. *(M.E Fowler 1999)*

7.7.4 Animals per box

In general, only one animal is shipped per crate or per division within a crate. Exceptions include e.g. young littermates *(Kolter and Usher-Smith 1998).*

7.7.5 Timing of Transportation

Do not move bears in crates in hot weather due to the risk of overheating, which may be fatal *(Kolter, Usher-Smith 1998).*

7.7.6 Release from box

Ensure the crate is well secured to the doorway using chains/bolts so that there is zero risk of the bear pushing the crate to one side and exiting other than into the intended holding area *(L.A. Dierauf 1990).*

Figure 16 Transport crate

Figure 17 Locked crate getting lifted onto truck

8- HEALTH REQUIREMENTS

8.1 Daily Health Checks

All individuals should be visually inspected at least twice daily; this is not always easy for bears in large naturalistic enclosures *(Partridge 1992).*
Behavioural training can be used to facilitate observation, with a signal requesting the bears show themselves including opening their mouth to show teeth, gums etc and rewarding for this behaviour *(Partridge 1992, Kolter and Usher-Smith 1998).*
There should be several vantage points around large enclosures, offering good views of the exhibit so that it is possible for caretakers to observe the bears and check their health (*Kolter and Usher-Smith 1998).*
For northern bears which may become very lethargic in winter and even hibernate, there needs to be a system in place allowing the bears to be checked without being disturbed (*Kolter and Usher-Smith 1998).*

For mothers with cubs in the den, a microphone and/or close circuit video monitoring can be used to allow the health of the cubs to be assessed without disturbing the bear.

- The general demeanour of the individual should be noted, also its food and water intake, and the quantity and appearance of urine and faeces produced. Abnormalities in behaviour, feeding, defecation etc. should always be noted and the veterinarian informed *(Partridge 1992).*

- Abnormal faeces, vomit, and other discharges should be collected so that they can be examined if necessary (*Partridge 1992).*

- Sudden apparent changes in personality (changes in behaviour or temperament) may indicate the development of medical problems - illness or injury (*Kolter and Usher-Smith 1998).*

- Gait, dentition, skin condition and parasite detection should be considered in daily, monthly and annual health checks (*Curtis Eng 2007).*

- Body weights should be monitored. For thick-coated animals such as bears, in which changes in body weight may not easily be visible, a weighing platform incorporated into a passageway or onto a shelf used by the bears is advantageous (*Partridge 1992).*

- Significant change in weight may indicate illness (*Curtis Eng 2007).*

8.2 Detailed Physical Examination.

8.2.1 Physical restraint

Only small cubs can be physically restrained using gloves. Physical restraint can be performed on adult bears by using a crush or squeeze cage in order to give injections *(M.E Fowler 1978).*

8.2.2 Chemical restraint

POTENTIAL RISKS TO BE CONSIDERED WHEN ANAESTHETIZING BEARS:

Risks to the bear from the anaesthetic

- Bears are monogastric and may vomit during induction or recovery, or regurgitate while anaesthetised. If possible, avoid anaesthetising bears which have eaten recently *(Caulkett, N. & Cattet, M.R.L. 2002).*
- There is a potential risk that the bear may need to be killed to protect human life if there are problems with inadequate anaesthesia *(Caulkett, N. & Cattet, M.R.L. 2002).*

Note: Risks are increased when the bear is not healthy.

- **Physical injury, sometimes severe or even fatal, can occur when bears are darted *(Jonkel, J.J. 1993).***

Risks to the bear from the environment:

- Consider the risks of the anaesthetised bear being attacked if other bears are nearby *(Caulkett, N. & Cattet, M.R.L. 2002).*

- Bears are at risk of injury if they can reach a hazard between injection of the anaesthetic drugs and the time they become recumbent. This may occur in captivity as well as in the wild. Hazards to be considered include water (ponds, streams, water troughs etc.), cliffs and trees (which the bear could climb and then fall off/out of) *(Jonkel, J.J. 1993).*
- It is important to consider the risks of the bear becoming recumbent against a fixed object (e.g. a wall or door, or in the soil) in a posture that will restrict its breathing *(Jonkel, J.J. 1993).*
- It the bear's breathing is compromised so that it in danger of suffocation, but it is not sufficiently anasethetised to handle, it may be possible to reposition the bear's head from a distance using a stick. Unless it is danger of suffocation, leave it alone *(Jonkel, J.J. 1993).*

- Additionally, if a bear is in an inside area, consider whether it will be possible to get into the area with the bear if it is recumbent against the door, and whether it is possible to do so **safely.**

Risks to humans:

- There is always a potential risk to personnel when dealing with bears *(Caulkett, N. & Cattet, M.R.L. 2002).*

- Particular care must be taken when the bear appears to be anaesthetised and is first approached.
- **Note:** With some drug combinations (xylazine-ketamine and medetomidine-ketamine) bears may arise suddenly with little or no warning *(Caulkett, N. & Cattet, M.R.L. 2002).*

Consider the risks of other nearby bears attacking personnel. This is a particular concern if a cub is anaesthetised and its mother is nearby.

PRE-ANAESTHETIC PREPARATION

Whenever possible, the bear should be moved to a safe, quiet, well-controlled situation such as an indoor den with good lighting and ventilation, to allow a quiet induction and recovery, without the risk of the bear encountering hazards such as ponds or trees (which can be climbed then fallen out of) while semi-sedated, and where there will be no interference from other animals in the enclosure *(Partridge 1992).*
It is important to ensure that it will be possible to get into the den after the animal becomes recumbent *(Partridge 1992).*

Preventing/reducing vomiting:
Avoid anaesthetising immediately after the bear has eaten, to reduce the risks associated with vomiting and regurgitation during induction, anaesthesia or recovery *(Caulkett, N. & Cattet, M.R.L. 2002).*

Withhold water for eight hours and food for 24 hours before immobilization *(Kolter and Usher-Smith 1998).*
In one study with, vomiting was seen in four of eight *Ursus americanus* - American black bears fed within four hours of anaesthesia, but not when fed 12 hours prior to anaesthesia *(Addison, E.M. & Kolenosky, G.B 1979).*
Administration of 2-30 mg metaclopramide (depending on the size of the bear), five minutes before induction or mixed with the anaesthetic agents, may prevent vomiting during induction; a second dose may be given just before recovery/reversal to prevent or reduce vomiting during recovery *(Morris, P.J. 2001).*
If there is a suspected gastrointestinal obstruction and metaclopramide is contraindicated, acepromazine, 0.01 mg/kg given with medetomidine-tiletamine-zolazepam has been used successfully to minimise or prevent vomiting *(Morris, P.J. 2001).*

Anesthetic drugs for bears include:

- Carfentanil

- Etorphine
- Medetomidine-Ketamine
- Medetomidine-Ketamine-Midazolam
- Medetomidine-Tiletamine-Zolazepam
- Oral Carfentanil
- Tiletamine-Zolazepam
- Xylazine-Ketamine
- Xylazine-Tiletamine-Zolazepam

The choice of anaesthetic drug or drugs to use will depend on what the bear is being anaesthetised for (e.g. physical examination, surgical procedure) and personal choice - what the person carrying out the procedure is most comfortable with *(Curtis Eng 2007).*

Sites for darting/intramuscular injections

- For intramuscular injections it is important to be aware of the anatomy of bears, in particular the large quantities of subcutaneous fat which may be present over the rump and hind legs of hibernating species in late summer and winter, and polar bears at any time of year. Therefore injecting into the shoulder or neck muscles is preferable *(D. Heard 2002).*
- Injection into the fat may be ineffective *(Wallach, J.D. & Boever, W.J. 1983).*
- A needle length of at least 7.5 cm (3.0 inches) is required to reach through the subcutaneous fat layer on adult bears *(Wallach, J.D. & Boever, W.J. 1983.)*
- A preferred site is the triceps muscle area of the forelimb, dorsal to the elbow and caudal to the humerus and scapula *(M.E Fowler 1995).*
- The hind limb should be avoided in captive bears since there may be a lot of fat present resulting in the drug being deposited in the adipose tissue rather than muscle *(Wallach, J.D. & Boever, W.J. 1983).*
- Fat deposits over the rump and thighs may be several inches thick *(Wallach, J.D. & Boever, W.J. 1983).*

In captive bears at short range, injection into the muscles of the forearm can be used, delivered by blowpipe; standard 5 cm 18 gauge or 19 gauge needles can be used *(Partridge 1992).*

Note: The time to induction varies depending on the injection site *(Partridge 1992).*

8.3 Routine Treatments.

Vaccinations: Bears are susceptible to Rabies, Leptospirosis, Infectious Canine Hepatitis, Canine Distemper and parvovirus. It has been suggested that bears should be vaccinated against some or all of these diseases. Different authorities vary in their interpretations of which diseases bears are truly susceptible to and which diseases they should be vaccinated against *(Philippa, J. 2006).*

Worming: Bears with persistent ascarid infections should be treated routinely with Anthelmintics (de-wormers)
Ascarid infections may be detected by standard faecal flotation to detect ova *(Wallach, J. 1978).*
In areas where canine heartworm is endemic, consider placing bears on preventative medication for this disease *(Ramsay, E.C. 2003).*

8.4 known health problems

Viral Diseases:

Note: for many of the diseases here, evidence of infection in bears is solely from detection of antibodies to the virus, without any associated clinical disease.

Canine distempter

Ursids are susceptible to infection with canine distemper virus, but clinical disease is rare.

Signs: This disease should be considered as a possibility in bears presenting with gastrointestinal, respiratory and neurological Infection is by aerosol droplets or direct contact, from secretions of infected animals.
Prevention: The use of live vaccines in species other than the domestic dog has been known to produce active disease with a high mortality rate and should be avoided unless the vaccine to be used is known to be safe in a particular species.

Lepto spirosis -Infectious canine hepatitis Ataxia
Signs:

- Excessive salivation.
- Vomiting.
- Diarrhoea.
- Lethargy.
- Signs of abdominal pain, such adopting the foetal position.
- Nystagmus
- Hind limb ataxia.
- Seizures.
- Paralysis.
- Anorexia.
- Death within 12 hours of the firsts clinical signs.
- The surviving bears from an epizootic showed neurological signs and lethargy for 60 to 90 days.

Treatment: Euthanasia.
Prevention: Killed vaccines are suggested for use in bears kept in zoos and exhibitions.

Note: Bears have been reported to be infected with canine adenovirus type 1 after been vaccinated with live MLV vaccines. Therefore the use of live vaccines is not recommended.

Parvo virus

Signs: Vomiting, anorexia, lethargy, diarrhoea (often haemorrhagic), rapid dehydration. Variable elevation in temperature. Leucopaenia

Treatment: Euthanasia

Prevention: vaccinations can be taken out.

Pseudorabies
Signs:

- These have included:
- Death without previous clinical signs.
- Lethargy and depression.
- Nervousness, agitation.
- Tremors
- Incoordination
- Aggression
- Anorexia, inability to drink, inability to swallow.
- Excessive salivation
- Excessive perspiration
- Vomiting
- Diarrhoea
- Localised or generalised pruritus leading to self mutilation
- Dyspsnoea
- Paralysis
- Haematuria, passing of dark urine containing protein and bile pigments.

Treatment:

- Acyclovir 10 mg/kg orally in cod liver oil, every five hours in several bears (and intravenously in a bear which refused oral medication).
- Symptomatic treatment
- Euthanasia when nervous signs were refractory to treatment with diazepam *(Banks, M. 1999).*

Bacterial Diseases

Salmonellosis
NOTE: ZOONOTIC
Signs:

- Variable.

- Sudden death to chronic.
- Diarrhoea *(John W Davis 1981)*

Treatment: Broad-spectrum antibiotics parenterally to treat septicaemia.
Prevention: Ensure good general hygiene and pest control around animal accommodation; protect foodstuffs from contamination by droppings of wild rodents and birds. *(J.F. Timoney 1988)*

Abcesses

Treatment: Antibiotics, drain/disinfect wound, remove foreign bodies (if any)
Prevention: To minimise the risk that a debilitating abscess will form following darting, particularly with a powder-charged dart, give antibiotic cover as for a wound *(Kreeger, T.J 1999)*

Fungal Diseases

Ring worm
NOTE: ZOONOTIC
Signs: may include matting and crusting of the coat, or localised hair loss and skin inflammation anywhere on the body *(Partridge 1992)*
Treatment: Microsporum canis has been treated with 500 mg/day oral griseofulvin in the diet for 30 to 60 days *(Wallach, J.D 1983).*
Note: griseofulvin can cause low leucocyte count. Check the blood count every two to three weeks during treatment, or if the bear shows any adverse clinical signs *(Gage, L.J. 2002).*

Parasitic Diseases

Audycoptic Mange
***Signs*:** Alopecia, particularly during the winter.
Pruritus, with rubbing, scratching or chewing at affected areas.
Self-mutilation may cause open, ulcerated lesions.
Treatment: can be treated with a variety of insecticides such as ivermectin, amitraz or pyrethrin *(Debra Bourne 1992).*

Baylisascaris Infection
NOTE: ZOONOTIC
***Cause*:** Infection with ascarid worms in the intestines.
***Signs*:** Diarrhoea, coat dry and rough, Anorexia, Presence of ascarids in the faeces, Severe infection may result in poor body condition. Death may occur due to gut obstruction in overwhelming infections *(M.E Fowler 1978).*
Treatment: A variety of different anthelmintics can be used. Repeated treatment every 4-8 weeks may be required due to the difficulty of eliminating the parasite from the environment *(Moran, J.F 1994).*
Ivermectin has also been very successful *(Kuntze 1988).*
Prevention: Regular anthelmintic treatment can be used for control *(M. Fowler 1979).*

Hookworm Infection
Signs: Blood in faeces, Anorexia, Weight loss, severe infection may result in poor body condition. Infection in young cubs can cause severe clinical signs *(Partridge 1992).*
In juveniles, hookworms may cause diarrhoea, anaemia and debilitation, and can be fatal *(M.E Fowler 1993).*
***Treatment*:** Ivermectin, 0.3 mg/kg subcutaneously (can also be used orally) once, repeated at eight-week intervals *(M.E Fowler 1993).* Levamisole, 11 mg/kg subcutaneously (can also be used orally), repeated as required *(M.E Fowler 1993);* 10 mg/kg orally or subcutaneously. Note: doubling the dose reaches toxic levels *(M.E Fowler 1993).*
Prevention: Regular anthelmintic treatment can be used for control *(M. Fowler 1979).*

Gastro-Intestinal Nematode Infection
Signs: Blood in faeces, Anorexia, Weight loss, severe infection may result in poor body condition. Infection in young cubs can cause severe clinical signs *(Partridge 1992).*
Treatment: Suggested treatments for roundworms include pyrantel pamoate, 12 mg/kg per day orally for three days, or fenbendazole 25 mg/kg daily orally for three days, or ivermectin 200 micrograms per kg once orally, or Mebendazole 20 mg/kg daily orally for three days. Treatment may need to be repeated at intervals of six to eight weeks (*Meyerson 2007).*
Prevention: Regular anthelmintic treatment can be used for control *(M. Fowler 1979).*

Trichinella

NOTE: ZOONOTIC-Humans have been reported to be infected with trichinosis after consuming bear meat *(M.E Fowler 2003).*

Signs: Infection is usually asymptomatic *(M.E Fowler 1986).*Clinical signs, if present, may be similar to those seen in humans and in other carnivores: fever, facial oedema, muscular pain, dyspnoea, anorexia and eosinophilia *(M.E Fowler 1986).*

Treatment: Thiabendazole, 25 - 50 mg/kg *(Wallach 1983).*
Prevention: Avoid feeding meats which could contain the parasite such as pork, or cook the meat *(Meyerson 2007).*

Sarcoptic Mange
NOTE: ZOONOTIC
Signs: The clinical signs reported include pustular dermatitis, itching and loss of hair *(M.E Fowler 1978).*
Treatment: Ivermectin could be used, or appropriate topical sprays/dips etc. as used in dogs *(Meyerson 2007).*

Prevention: Bears should be checked for mite infections while in quarantine and any infection eliminated before they are translocated, reintroduced or introduced to a new enclosure or collection *(Partridge 1992).*

Other common diseases

Arthritis and Skeletal Disease
***Cause*:** Lack of an appropriate level of activity in zoo bears may be associated with the development of skeletal diseases in captive bears.
***Signs*:** Bears with erosion of the articular cartilage would have severe pain, and would have loss of movement, stiffness and difficulties in walking, sitting and rising.
Treatment: Anti-inflammatory and analgesic drugs. Euthanasia should be considered for elderly bears with severe lesions and which are likely to be, or showing signs of being in severe pain.
Prevention: Comparison with skeletons of wild bears (which generally lack such lesions) and limited data from other large carnivores in zoos, suggests that ensuring an appropriate level of activity in zoo bears may be important to minimise the development of skeletal diseases (*Kitchener, A.C., Kolter, L. & Brownstein, D. 2000).*

Hepatic and Bile Duct Neoplasia
Signs: Clinical signs can last for many months, but a bear may be found dead without any previous clinical signs *(M.E Fowler 2003).*
Signs may include weakness, lethargy, vomiting, weight loss, abdominal distension and coma *(M.E Fowler 2003).*
Treatment: Euthanasia is opted in many cases due to the extent of the tumour when the diagnosis is made *(M.E. Fowler 2003).*

Dental Disease
Cause:

- The most common causes of dental disease in carnivores are trauma and periodontal disease *(M.E Fowler 1986).*
- Unnatural/inappropriate diet *(Kolter and Usher-Smith 1998):*
- Unnatural diets affect the self-cleaning mechanism of the ova cavity *(M.E Fowler 1993).*
- Bears fed too much soft, prepared food may develop more soft dental plaque, leading to gingivitis and periodontal disease *(M.E Fowler 1986).*
- Further development of this condition involves mineralization of the plaque; the microenvironment at the margin of the gingiva is conducive to pathological changes.
- In advanced cases, damage to the periodontal ligament and alveolar bone results in loss of teeth (dental exfoliation) *(M.E Fowler 1986).*

Diagnosis:

- In some cases damage to teeth will be easily visible on general observation of the bear. Signs of pain, draining fistulae, changes in eating habits etc. may be

noted on daily observation. Physical examination of the oral cavity and teeth may be sufficient for diagnosis *(M.E Fowler 1986).*

- Thorough examination of the mouth is recommended to detect all dental problems; this should be carried out at every opportunity, and proper dental records should be kept *(M.E Fowler 1986).*
- Thorough examination of the mouth is carried out under general anaesthesia *(Kaya, M. & Dorrestein, G.M. 1994).*
- Dyes such as erythrosine sodium may be used to stain dental plaque, making it easier to judge the degree to which plaque has built up on teeth. Radiography may be required to confirm the extent of pathology, for example to visualise dentoalveolar abscesses. Intraoral films and a bisecting angle technique can be used to radiograph the canines. Differential diagnosis of general signs such as weight loss and anorexia include a wide range of diseases such as neoplasia and parasitism *(M.E Fowler 1986).*

Treatment

- Treatment required will vary (e.g. removal of dental calculus to filling, root canal therapy or even tooth removal) depending on the type of dental disease and on the bear's circumstances (e.g. whether it is in a well-equipped zoo with frequent checks or a rehabilitation or rescue situation where follow-ups may not be possible) *(M.E Fowler 1993).*
- Dental treatment must be carried out to high standards, in as short a time as possible, and using the appropriate equipment *(Kolter and Usher-Smith 1998).*
- Dental treatment should be carried out as early as possible, while the dental problem is still minor and the animal is systemically healthy *(M.E Fowler 1993).*

Prevention

- Bears should be provided with an appropriate diet to reduce build up of plaque. The diet should include hard materials such as large bones to chew; this may assist in removing plaque and stimulating the gingiva.
- Mouth checks and removal of hard plaque should be carried out frequently as a routine part of bear preventative medicine whenever bears are being handled (under anaesthesia) *(Debra Bourne 1992).*

List of Symptoms with possible causes:

In bears with diarrhoea- A variety of diseases must be considered, including inappropriate diet and:

- Rotavirus Infection (particularly in colostrum-deprived neonates)
- Hookworm Infection
- Baylisascaris Infection
- Bacterial Gastroenteritis
- Clostridium difficile Infection (haemorrhagic faeces)
- Clostridium perfringens Infection

- Elokomin Fluke Fever
- Infectious Canine Hepatitis
- Leptospirosis
- Salmonellosis
- Salmon Poisoning
- Pseudorabies

Lack of faeces may be noted with:

- Constipation
- Gastritis

Vomiting has been noted associated with:

- Brucellosis
- Gastritis
- Hepatic and Bile Duct Neoplasia
- Infectious Canine Hepatitis
- Pseudorabies
- Oleander Poisoning
- Salmon Poisoning
- Yew Toxicity in Bears (although the bear which died did not vomit)

Urinary problems:

- Haematuria has been noted with Pseudorabies
- Chronic urinary incontinence was noted in female bears with cystitis

General depression or lethargy may be noted in bears with:

- Anthrax
- Blastomycosis
- Bacterial Gastroenteritis
- Clostridium perfringens Infection
- Elokomin Fluke Fever
- Gastritis
- Hepatic and Bile Duct Neoplasia
- Hypothyroidism
- Intestinal Volvulus
- Neoplasia
- Pancreatic Necrosis
- Pseudorabies
- Sarcocystosis
- Salmon Poisoning
- Tick Toxicosis
- Trichobezoars
- Trypanosomiasis

Depression and cough may be noted with:

- Bordetella bronchiseptica Infection

Anorexia may be noted with:

- Anthrax
- Bacterial Gastroenteritis
- Elokomin Fluke Fever
- Blastomycosis
- Hookworm Infection
- Infectious Canine Hepatitis

- Intestinal Volvulus
- Oral Foreign Bodies (also salivation, pawing at the mouth)
- Various tumours
- Pancreatic Necrosis
- Pseudorabies (with inability to drink or swallow)
- Salmon Poisoning
- Tick Toxicosis
- Trichinella Infection (although infection is usually asymptomatic)
- Trichobezoars
- Trypanosomiasis
- Scratching or other signs of pruritis may be noted with:
- Dermatophilosis
- Pythiosis
- Vitamin A-responsive Skin Disease
- Trichinella Infection
- Pseudorabies (localised or generalised pruritis leading to self mutilation)

Reluctance to enter the water has been noted in bears with:

- Dermatophilosis

Respiratory:

- Panting is indicative of high body temperature.
- Respiratory signs may indicate distemper

Snoring noises may be noted with:

- Respiratory Disease

Hyperpneoa was an initial sign in:

- Ruptured Intervertebral Disk

Occasional coughing and intermittent stertorous breathing were noted in:

- *Ursus americanus* - American black bear which was found to have a laryngeal squamous cell carcinoma.

Tachypnoea and dyspnoea were present in:

- bears with trypanosomiais

Pain may or may not be evident with:

- Calcium-Vitamin D Metabolism Imbalance

- Dental Disease

Abdominal pain is evident with:

- Acute Gastric Dilatation
- Gastritis
- Infectious Canine Hepatitis
- Intestinal Volvulus
- Oleander Poisoning
- Trichobezoars

Paralysis and/or aggression may be associated with:

- Rabies

Nervousness and agitation has been noted in:

- Pseudorabies

Excessive salivation has been noted in:

- Pseudorabies

Ataxia may be seen with:

- Infectious Canine Hepatitis
- Tick Toxicosis
- Trypanosomiasis

Cessation of urination was seen in a bear with:

- Urolithiasis

Seizures may be seen in bears with:

- Epilepsy and Convulsions
- Hydrocephalus
- Strychnine Poisoning

(Debra Bourne 1992)

NOTE-Changes in the bear's normal activity level and behaviour may indicate illness. Sick or injured bears may show dramatic changes in behaviour or temperament (*Curtis Eng 2007, Kolter and Usher-Smith 1998).*

8.5 Quarantine Requirements.

Basic recommendations for quarantine of bears include:
Quarantine should be carried out for a minimum of 30 days *(Miller, R.E. 1999).*

Quarantine of bears from a rabies area may be increased to six months *(Woodford, M.H. 2001).*
During quarantine it is important to provide environmental enrichment.

Required testing -

- Faecal examination (direct and flotation) *(Miller, R.E. 1999).*
- Haematology and serum biochemistry *Miller, R.E. 1999).*
- Urinalysis *(Miller, R.E. 1999).*
- General physical examination *(Miller, R.E. 1999).*
- Recommended testing *(Miller, R.E. 1999).*
- Urinalysis *(Miller, R.E. 1999).*
- Blood zinc levels *(Miller, R.E. 1999).*

- Skin scrapings should be taken if the bear has any skin lesions which suggest possible mite infection, so that any infection can be treated immediately *(Partridge 1992).*
- Consider whether vaccination against Rabies should be carried out *(Miller, R.E. 1999).*

Bears in quarantine should be treated for parasites before entering their new enclosure *(Rietschel, W. 1994).*

9 Behaviour

9.1 Activity

Activity Patterns: Brown bears mainly walk but also gallop and leap *(Debra Bourne 1992).*

Speed: Brown bears can be fast runners despite their size, capable of speeds of up to 56 km/h (35 mph) *(Debra Bourne 1992).*

Circadian Rhythm: Daily patterns of activity vary with area, season and human disturbance. These bears may be crepuscular or nocturnal, but in Alaska may be active through the day. In summer they may forage during the night and rest in the day, but they may be active for much of the day and night in spring, when there is little food available, and in fall (autumn) when maximising food intake. Daily time active may vary from e.g. 14 hours in summer to 20 hours in late fall, with about 80% of active time spent foraging. In Europe, most adult bears are nocturnal, but this is probably a learned behaviour; yearlings show a more diurnal pattern of activity (*Debra Bourne 1992).*

Navigation: Brown bears have a holarctic distribution, being found in both North America and Eurasia within the coniferous and deciduous forest zones, except for eastern North America, lowland China and most of western Europe (where they have been exterminated).
Brown bears may make seasonal movements associated with food resources, with bears of some populations moving hundreds of kilometres.
Brown bears appear to have a strong homing instinct; many will return to their home range after translocation *(Debra Bourne 1992).*

9.2 Social Behaviour

9.2.1 Social Structure/Relationships and 9.2.2 Social Interactions

- Brown bears are non-territorial; there is extensive overlap between home ranges and no evidence of territorial defence. Large numbers of bears may gather at rich food sources.
- Young females tend to stay near their mother's home range, while males move away.
- Bears may show "defensive threat" behaviour.
- Brown bears are generally considered solitary except for females with cubs, and pairs which may form briefly in the mating season. This may be an over-simplification. Littermates may continue to associate with one another for as long as 4.5 years, playing and feeding together. In general, spacing and mutual avoidance reduces aggressive encounters between individuals. Adult males are aggressive and intolerant of one another during the mating season. At seasonal high concentrations of food, large numbers of bears may aggregate.
- Dominance hierarchies form in these situations; dominant adult males are highest ranking, females with cubs are below these, and subadults are below

these. Fights sometimes occur and occasionally the smaller bear in such a fight is killed. Females with young avoid crowded areas, since aggressive dominant males may attack cubs and even the female. Females defending cubs may attack and even occasionally kill males which approach too closely *(Debra Bourne 1992).*

9.2.3 Communication

- Vocalisations include distress calls from both adults in pain and from hurt, hungry, separated or cold cubs, huffs and snorts of apprehension, growls and roars in aggression and chuffing as a close contact call *(Debra Bourne 1992).*

9.2.4 Predation/Competitors

- Brown bears compete with *Ursus americanus* - American black bear where their ranges overlap; they are dominant to black bears and may kill and eat them. Hybrids have been reported in captivity. Little is known about the interactions of brown bears with *Ursus maritimus* - Polar bears where they share ranges, but one wild hybrid has been confirmed as well as zoo hybrids. Other competitors include *Puma concolor* - Puma, *Lynx rufus* - Bobcat, *Canis lupus* - Wolf, wolverine (*Gulo gulo* (Mustelidae - Weasels (Family))) and foxes (*Vulpes* - (Genus) and *Alopex* - (Genus)). Brown bears hunt a variety of wild ungulates and various ground-dwelling rodents; they also kill domestic livestock.
- These bears generally try to avoid humans. Most attacks on humans have been shown to be provoked by harassment or efforts to shoot the bear. Bears startled close to, particularly if with young, or while feeding, are unpredictable. Siberian and interior North American brown (grizzly) bears can be dangerous, particularly when defending cubs or a carcass. Eastern
- European bears appear to be more aggressive than Western European bears.
- There are few predators on brown bears. Attacks by tigers (*Panthera tigris* (Felidae - Cats (Family))) occur occasionally in the former USSR and predation of a 6 kg cub by a golden eagle has been reported. Large male brown bears in the breeding season may prey on young cubs and even occasionally on females *(Debra Bourne 1992).*

9.2.5 Learning

- Young bears learn from their mothers, which improves survival. It has been noted that the ability of brown bears to dig a den increases with experience *(Debra Bourne 1992).*

9.3 Reproductive Behaviour

- Brown bears are promiscuous, particularly in areas of high density; females may mate with two males in one day and with several males over the breeding season. In lower-density areas, a male may defend a female from other males and the two bears may form a brief pair bond, lasting while the female is in

oestrus. The male mounts the female from behind and clasps her with his front legs around her body. The male may remain mounted for 10 - 60 minutes, with periods of thrusting and short rests. Mutual ear chewing and nose sniffing have been observed between a pair of bears after mating *(Debra Bourne 1993)*

- A male and female were observed from 12 May, when the male first joined the female and her offspring (yearlings or two-year-olds) left, to 26 May. The two bears rested and fed, then moved towards an area which the researchers designated the "mating area". Here they several times engaged in play for 2-3 minutes, wrestling head to head, pawing at each other etc. The cubs returned to near the female on four occasions, fleeing each time, in one instance apparently in response to low-intensity threats from the male. From 14 May to 26th May, the pair remained in an area about 2-3 hectares - a length of 200 m along a summit ridge, and about 10-50 m wide, plus the sides of the ridge. The male herded the female, placing himself across her path whenever she started moving away from this area. Most of the time he remained 5-10 m from the female, standing, sitting or lying. Other interactions included courtship, afternoon rest, precopulatory behaviour and copulation. Throughout the 15 days, the female appeared to control contact. She would sit and look back at the male, who would then approach and e.g. lick her vulva, make gentle contact head-to-head, or bite at her ear or neck, for up to 2 minutes at a time and 10-20 times per day. During the afternoon, the female would lie down and the male would gradually approach, lying several times, until he came next to her and lay side by side or with his muzzle touching her. two episodes of mounting without copulation were observed, lasting 20 and 5 minutes, on 19th May, with the female sitting and looking back at the male, after which he licked/smelled her vulva and mounted. Copulation was observed on 26th May, starting as for mounting, but continuing to full copulation for 43 minutes, initially both animals moved little, then after 12 minutes the female appeared to "struggle and squirm", moving her body from side to side; eight minutes later the male engaged in vigorous pelvic thrusting for about 10 seconds. Three minutes later a series of vibrations ran the length of the male's hindquarters, for 1-4 s each, 11 times over 10 minutes. After a final ten minutes of only minor shuffling movements, the female lurched forward and ran off. Following this, the male's herding behaviour gradually subsided over the rest of the day and the following day they had separated. Another pair also were observed with similar herding behaviour *(Herrero 1977).*

9.4 Bathing

At National Zoo and Aquarium Canberra, brown bears love to bath in water especially in the warmer months so therefore bathing pools should always be available to bears.

Brown bears lick and groom themselves. While moulting, they rub themselves *(Debra Bourne 1992).*

9.5 Behavioural problems And 9.6 Stereotypical Behaviour and Stress

Animals may show abnormal levels of behaviours in captivity, either reduced activity or hyperactivity. Stereotypies are a common form of abnormal behaviour *(Kleiman 1996).*

The presence of stereotypies in zoo animals should be taken as a warning sign of potential suboptimal conditions and welfare problems. However, once an animal has developed stereotypic behaviour, this behaviour may continue even if the animal is provided with an appropriate enclosure, social environment and behavioural enrichment. Stopping such a behaviour may be very difficult and the presence of such a behaviour does not necessarily indicate that the animal's current enclosure, management and well-being is substandard *(Swaisgood, R.R. 2005)*

Stereotypic behaviour develops due to primary behaviour patterns that the animal is motivated to perform but in an environment in which this primary behaviour cannot reach a normal endpoint, for example because the external environment lacks the stimuli necessary to couple the behaviour with its appropriate consequences *(Shepherdson, D.J 1998).*

Stereotypies in many animals are commonly associated with anticipation of feeding (seen before the usual feeding time), and may also be seen post-feeding related to food caching behaviour *(Shepherdson, D.J 1998).*

Stereotypies may be associated with the inability to seek out mates, or lack of means to hide from perceived predators (whether other animals or humans) or dominant conspecifics.

Environmental enrichment may act to reduce stereotypic behaviour by different means: by increasing the animal's sensory stimulation, making the environment less predictable and increasing the animal's overall level of activity, by reducing its motivation to perform a given behaviour, or by providing it with the opportunity to engage in more appropriate behaviours (e.g. by providing it with the stimuli it is naturally motivated to seek).
In order to maximise the likelihood that enrichment will eliminate stereotypic behaviours, it is necessary to determine the types of behaviours which the animal(s) are motivated to perform and then consider what external stimuli can be provided to functionally satisfy the motivation *(Shepherdson, D.J. 2003).*

A recent meta-analysis indicate that provision of enrichment substantially reduces stereotypic behaviour *(Shyne, A. 2006).*

While practically all forms of enrichment may reduce negative behaviours initially, a continuing effect is likely to depend on appropriate enrichment which continues to stimulate animals over a period of time *(Shyne, A. 2006).*

- Common stereotypic behaviours in bears include "pacing, head swinging, weaving, rubbing against or gnawing bars, circular or to-and-fro swimming, and excessive grooming." *(Hennessy,C.L. 1996).*

- A survey of zoo bears in the 1970s found that for the most commonly kept species, begging was most commonly seen in Ursus arctos - Brown bear while stereotypic behaviours were seen more in *Ursus maritimus* - Polar bear and *Ursus thibetanus* - Asiatic black bear *(Van Keulen-Kromhout, G. 1978).*

- A study of *Ursus maritimus* - Polar bear noted that stereotypic behaviour in this species was "particularly common and resistant to change." While the routine followed by different individuals varied, the stereotypic bouts of each bear were very predictable and change-resistant; to-and-fro pacing was most common, but stereotypical behaviour also occurred in water. The level of such behaviour varied seasonally but the seasons in which stereotypical behaviour was greatest or lowest varied between bears; males generally showed the highest levels of stereotypy in spring, possibly associated with the breeding season. Individual variation extended even to twin sisters, with one female exhibiting much more stereotypical behaviour than the other, suggesting there may be individual differences in susceptibility to the development of stereotypy. Past experiences were also considered to influence stereotypy, with a male which had been in a circus continuing to perform stereotypic behaviour as if in the travelling wagon, despite being in a better enclosure *(Ames, A 1993).*

- It has been suggested that stereotypies in zoo *Ursus maritimus* - Polar bears are related to migratory activity of wild bears. However, it has also been suggested instead that they are due to frustrated appetitive behaviour *(Wechsler, B. 1991).*

- Stereotypies in bears in zoos may result from husbandry methods which fail to give the bears adequate opportunities for foraging and food handling *(Duncan, A.E. 1994).*

- A study of individually-caged *Ursus thibetanus* - Asiatic black bears and *Helarctos malayanus* - Sun bears found that stereotypic behaviour was inversely correlated with inactivity, increased with ag locations from which the bear could view the arrival of food. It also occurred near another bear (particularly in the Asiatic bears) *(Vickery, S. & Mason, G.2004).*

- A study of an *Ursus americanus* - American black bear found that stereotypic behaviour peaked in the three hours before daily feeding (with smaller peaks at other times of the day). Further study showed that while there was an overall pre-feeding peak and an afternoon, peak, there were seasonal differences: in June and July (normal time for mating in the wild) the behaviour peaked after feeding, in the afternoon and evening, while in September to November, it peaked mainly before feeding *(Shepherdson, D.J 1998).*

- In *Ursus maritimus* - Polar bear, stereotypic behaviour in males may increase in the breeding season; this may be associated with the unnatural social system - bears being kept as a pair *(Partridge 1992).*

- A careful study may be required to determine the cause of stereotypic behaviour in individual bears. In a study with three *Tremarctos ornatus* - Spectacled bears in a large, complex exhibit at Zurich Zoo, observation indicated that one female bear performed stereotypic behaviour when environmental conditions (temperature, wind, rain) prevented her from resting on her preferred platform after feeding (stereotypic behaviour ceased in summer once trees provided shaded resting sites). The male bear paced during the breeding season once a female would no longer copulate (an apparent reaction to social frustration). It was noted that neither the large, complex enclosure nor enriched feeding methods prevented these bears from undertaking their (previously-developed) stereotypies, but no stereotypies were found in the third bear, a younger female *(Fischbacher, M. & Schmid, H. 1999).*

- In two *Helarctos malayanus* - Sun bears, while provision of specific enrichment such as a browse feeder did reduce stereotypic behaviour while the bears were actually making use of the device, observation and comparison of the bears suggested that provision of opportunities for nesting off the ground might be important for the bears *(Landrigan, D 2001).*

- Stereotypic behaviours are very common in bears rescued from bear bile farms. Swaying, pacing, circling, rolling, head rolling, sucking paws and tongue flipping are some of the more common behaviours. Occasionally a bear will self-mutilate by pulling out its fur or chewing on a limb *(Gail Cochrane, Animals Asia Foundation).*

Prevention and treatment of abnormal behaviours in bears

- Preventing the development of abnormal behaviours, including stereotypic behaviours and begging, requires an understanding of the factors which lead to the development of such behaviours, and provision of keeping conditions (enclosure design, provision of enrichment, social grouping and visitor education) which promote natural behaviours and do not encourage the

development of unnatural behaviours.
Example: At San Diego Zoo, when a pair of orphaned *Ursus maritimus* - Polar bear cubs arrived, considerable investment was made in the development and use of a variety of enrichment, particularly non-food enrichment items, allowing the bears (the new bears and two older bears) to entertain themselves. Additionally, daily training based on positive reinforcement was used for routine management and to allow e.g. veterinary monitoring. A key element was communication, both between keepers to maintain consistence, and between the keepers and the animals, to make it very clear to the bears what was being asked of them *(Murphy, K. 2005).*

- While bears may develop stereotypies due to time spent in inappropriate enclosures with inadequate management and enrichment, unfortunately treating and reducing such behaviours is not simple; a bear may not cease stereotypic behaviour simply because it is moved to a larger, more complex enclosure with multiple enrichment opportunities *(Montaudoin, S. & Le Pape,, G. 2002).*

- Other abnormal behaviours may develop in response to external stimuli - for example begging behaviours in response to food offered by the public. It is important to consider that multiple factors may be leading to stereotypic behaviour in a given individual - e.g. inadequate opportunities for foraging in combination with lack of availability of preferred nest sites, insufficient opportunities for climbing, inability to get out of sight of other bears, general boredom and/or lack of choice *(Poulsen, E.M.B. 2000)*

- Treatment of stereotypies and other abnormal behaviours may involve combinations of enclosure modification, feeding modification, other enrichment and use of behaviour-modifying drugs.

- Because many bears show stereotypical behaviour when expecting food, and increased stereotypic behaviour on days when they are not fed, "bears benefit if their food expectations are met promptly (as early in the morning as possible), and regularly (no starve days) *(Ames, A 1993).*

- An experiment in a large enclosure (two hectare forested enclosure) found that active and foraging behaviours increased significantly when feeding was increased from three to six times daily *(Grandia, P.A., Van Dijk, J.J. & Koene, P. 2000).*

- Providing bears with choice and an element of control over their environment may reduce stereotypic behaviour *(Ross, S.R. 2006).*

- When adult sibling polar bears were given access to their holding dens during the day (where they could not be seen by visitors), they showed decreased pacing and increased social play; they also increased swimming (significant only in the male). Time out of view of the public increased from 2.1% to 4.3%

of the time; both bears were out of view at the same time for only 2.1% of the time. The bears also showed an increased frequency of social play. The fact that the bears spent only a little time in the dens indicated that the benefits were probably associated with the provision of the choice to enter the dens, rather than the actual time which there bears spent in the dens *(Ross, S.R. 2006).*

- It should not be assumed that a single form of enrichment will remove all stereotypic behaviour from a bear *(Landrigan, D 2001).*

Treatment of abnormal behaviours in bears using behaviour-modifying drugs

Fluoxetine (a selective 5-HT reuptake inhibitor) was used successfully to treat stereotypical pacing behaviour, facial tic and huff/cough in a 26-year-old captive born female *Ursus maritimus* - Polar bear which had been pacing to varying degrees for more than 20 years. The bear was housed with another female polar bear in a concrete-floored enclosure enriched by partial covering with boulders, rocks, tree trunks, wood chips and pebbles, with access to a pool and with various foods offered. Fluoxetine was given at 1.32 mg/kg for the first seven days, then reduced (on advice) to 0.62 mg/kg (determined by allometric scaling) once daily for 77 days then increased to 1 mg/kg once daily (a daily dose of 260 mg, with capsules, 20 mg each, given hidden in herring - placing through the gill slits) for the final 21 days of treatment. Stereotypic pacing initially was exhibited for 68.6% of the day; in the sixth week this was notably reduced and had ceased by week 16 and stayed at zero while treatment continued. However, 14 days after treatment finished, pacing recurred sporadically, and by 104 days after cessation of treatment, it was back to pre-treatment levels *(Poulsen, E.M.B., Honeyman, V., Valentine, P. & Teskey, G.C. 1995).*

It was noted that while on the treatment she was "spending more time walking about the enclosure, watching activity outside of the enclosure, and manipulating objects." It was noted that the response to the pharmaceutical treatment (with a serotonin-uptake inhibitor) suggested a role for the serotonergic system in stereotypic behaviours. At the higher dose levels (260 mg and above), the metabolite norfluoxetine was present at higher levels than the parent drug *(Poulsen, E.M.B., Honeyman, V., Valentine, P. & Teskey, G.C. 1995).*

Fluoxetine was used successfully to treat a rescued bear with severe behavioural problems. A 12-year-old male *Ursus arctos* - Brown bear had been kept, since a cub, first on the end of a short chain for two years and then in a small, dark, concrete-floored cage for a further eight years. When rescued, the bear was unable to interact with other bears (too frightened to leave the den if they were in the same enclosure) and spent 80% of his time pacing (all the time except when eating or sleeping) in a small area (20% of the 200 m² enclosure provided). He was treated with 0.62 mg/kg fluoxetine daily (capsules were hidden in bread). Observation revealed no change in pacing behaviour for the first 30 days of treatment, but a decrease in the number of pacing bouts on days 30-120, while during days 120-180 of treatment the pacing bouts became shorter and finally ceased. After 180 days, fluoxetine treatment was stopped and the bear was able to be transferred to a larger enclosure with other, very

peaceful, bears, where he soon developed good relationships with other bears. No return to pacing was observed in the following year *(Yalcin, E. & Aytug, N. 2006)*

Medical treatment has been used in bears, rescued from bear bile farms, which have severe disturbance considered likely to threaten their health and safety, shown by behaviours such as self mutilation, uninterrupted stereotypic activity and anorexia. Medical management is used alongside the provision of plentiful food and water, enrichment, and a "consistently kind environment." The combined management has been "highly successful in helping these bears recover normal behaviors." *(Loeffler, L.K. & Cochrane, G.M. 2005)*
The following regime has been used by Animals Asia Foundation to treat severely disturbed bears considered likely to threaten their health and safety: Zuclopenthixol (Trade name Clopixol) at an initial dose of 12.5 mg (1/2 a tablet) orally (for bears of about 90-150 kg body weight) once daily; the bear is observed for a week at this dose. If the bear shows no signs of sedation and the stress behaviour has not changed, then the dose is increased to 25 mg once daily orally. The dose may be increased incrementally up to 50 mg, to effect. If the bear becomes drowsy (the main side effect), the dose is reduced slightly (12.5 or 6.25 mg less). Once an effective dose is found, this is given for six weeks to several months. If the bear's behaviour appears stable for several weeks, the dose is decreased slightly and the bear is observed carefully. The medication is withdrawn incrementally, with five days between each dose decrease *(Gail Cochrane, Animals Asia).*

Stereotypical behaviour in Brown Bears at National Zoo and Aquarium Canberra

There are currently 1 male and 2 female brown bears (Ex- Circus) being housed together at National Zoo and Aquarium. Stereo typical behaviour takes place in the form of pacing. This only occurs during the breeding season and is mainly from the male brown bear. In this case, the male brown bear paces as a result of sexual frustration. The female brown bears will sometimes pace if they are harassed (followed around where ever they go) by the male brown bear and cannot get away from him.

At National Zoo and Aquarium, stereotypical behaviours by the brown bears are significantly reduced through:

1-Rotations -Constantly rotating bears in enclosures and holding yards throughout the day so that they have some time away from each other which works well (bears are in holding yard for only an hour and meat on the bone/enrichment is always provided which keeps them content and busy)

2- Contraceptive implants and progesterone medications
The male brown bear paces as a result of sexual frustration. Progesterone medications such as Regumate (currently 8ml orally per day, mixed in peanut butter/grated apple/pear smear and spoon fed) is given during the breeding season which reduces his pacing. This year we have also given the females a contraceptive implant (Deslorlon) to prevent them from coming into oestrous. So far (18th November 2009), this seems to be working with the male brown bear only pacing for very brief periods during the day and some days without pacing at all.

(NOTE: This is only early days and I will continue to monitor the bears throughout the next 3 months and update the results at the end of the breeding season.)

3-Enrichment- Enrichment reduces the time the bears are pacing although this is usually only a temporary solution.

Enrichment that works best with these bears is:

- deer, horse or cow ribs
- Bread scatters
- Grapes and lettuce scatters
- Smears
- Vegemite smeared on hessian sack
- Scents
- Obstacles such as log pile/rocks place in common pacing areas with favourite foods put in it.
- Food Scatters- Entering yards twice daily to scatter/hide food items keeps the bears busy for longer.

NOTE: Enrichment activity feeds are also given at random times to ensure bears don't anticipate feed times.

9.7 Behavioural Enrichment

The goals of enrichment activities include:
"Increasing environmental novelty, change and complexity, to provide animals with meaningful interactions with their surroundings, diversify their behaviour and mediate social interactions.
"Presenting cognitive challenges, such as learning what a trainer is requesting or solving a problem.
"Meeting specific behavioural needs, such as a need for shelter/hiding or foraging, to encourage the expression of species-appropriate behaviour.
"Stimulating and mediating social interactions by providing social groupings of appropriate sex ratio, age class, genetic relatedness and experience" *(Shepherdson, D.J. 2003).*

Stress and abnormal behaviours may be reduced by providing animals with an environment which is of a biologically appropriate complexity and with control over their environment.
Examples include:

- The presence of substrates such as soil, leaf litter, vegetation.
- These increase the environment's "information content", concealing smells, food, naturally-occurring insects etc, and eliciting exploratory and forging behaviours.
- Provision of hiding places (by use of landscaping and/or barriers), vantage points, escape routes etc. which the animals can choose to make use of.
- Varying microclimates - temperature gradients, shaded and sunny areas etc. - allowing animals to move to an area which is at a comfortable temperature at a particular time.

- Providing buttons, ropes or other means by which animals can manipulate light, turn on a shower etc.
- Providing objects (toys) which animals can interact with.
- Adapting feeding methods to increase foraging and food handling times (scatter feeding, hiding food, use of puzzle feeders, whole food which require manipulation prior to eating, etc.).
- Puzzle feeders and other cognitive challenges, including training, which can act as cognitive enrichment.
- Providing access to different areas, e.g. access during the daytime to holding pens/night accommodation in addition to the main enclosure.

Provision of Manipulable Objects/Toys

- Bears should be provided with a variety of moveable objects which they can manipulate and play with. The objects should be changed regularly to provide novelty, stimulating exploratory and play behaviours *(D.A. Field 1998).*
- Bear species may vary in their responsiveness to play objects, and young bears are more likely to play with objects than are older bears, but objects should be available whatever the bear's species and age *(Ames, A. 1994).*
- Bears particularly like objects which they can put their head or paws into, and objects which give when bounced on *(D.A. Field 1998).*

Suggested objects include:

- Dry rotten wood, such as large branches or logs, which stimulate natural exploratory and foraging behaviour *(Copenhagen Zoo 1990)*. These may naturally contain insects and insect larvae for the bears to eat.
- Mealworms or other insect larvae could be placed in the rotten wood for the bears to find *(Copenhagen Zoo 1990)*.
- Whole large tree roots: these encourage exploratory behaviour, particularly of young bears, and may contain insects *(Copenhagen Zoo 1990).*
- Branches, which the bears can manipulate to form nests *(Frew, L. 1994).*
- Hanging objects such as tyres or fenders; these may be played with and may encourage the practice of hunting techniques *(Copenhagen Zoo 1990)*.
- Boomer Balls® - these can be made more interesting by being scented with a carcass or a spray-on scent, or filled with warm water, water mixed with blood for scent, or small pieces of food (the food pieces can fall out of small holes as the ball is moved) *(Partridge 1992).*
- Branches for bears to browse on and chew *(Rosenthal, M.A. 1986)* Suitable browse species may include e.g. Willow *(Salix spp.)*, pear *(Pyrus communis)* and mulberry *(Morus rubra)(Environmental Enrichment Scrapbook 2007).* Check that no insecticides or fungicides have been sprayed on the browse, and that they do not have any toxic browse species attached or mixed in.
- Empty beer kegs *(Duncan, A.E. 1994).*
- Traffic cones *(Winhall, W.R. 1998)*.
- Boat bumpers, buoys *(Winhall, W.R. 1998)*.
- Tyres or large balls, loose or hung from trees. *(Winhall, W.R. 1998)*.
- Boughs or vines hung over the pool for the bears to reach up for while bathing. *(The American Bear Association 2006)*.

- Floating toys such as dried gourds can be provided in the pool *(The American Bear Association 2006).*
- Christmas trees - bears may use these in various ways. They may be stripped, lain on, the needles used to line a nest, or the tree used to block wind coming into a den *(Winhall, W.R. 1998).*
- It is important to make sure that trees donated by the public have not been sprayed with chemicals such as fire retardants *(Winhall, W.R. 1998).*
- 20-litre plastic containers *(Partridge 1992).*
- Old telephone books. Note: these can produce a lot of paper mess when they are torn up *(Environmental Enrichment Scrapbook 2007).*
- Hides, either fresh or frozen, e.g. from road-killed deer or domestic cattle, for the bears to tear up *(Pappas, T. 1993).*
- Plastic barrels *(Winhall, W.R. 1998).*

Scent Enrichment

- Bears have an excellent sense of smell, which is used for finding food as well as for detecting danger. Scent-based enrichment is an important part of enrichment provision for bears.
- Natural substrates provide more olfactory stimulation than do concrete enclosures *(D.A. Field 1998).*
- Place smells such as sardines, hunting lures, material from other animals, around the enclosure *(Duncan, A.E. 1994).*
- Place scents on trees or scratching posts. Suggested scents include animal odours and herbal fragrances or flavourings such as anise, peppermint, ginger, cinnamon, butterscotch, fennel, cloves, maple, pecan, almond, vanilla, apple, pine, or nutmeg; perfume can also be used *(Environmental Enrichment Scrapbook 2007).*
- Scents can also be placed on a Boomer Ball® or other toy, to increase interest *(Winhall, W.R. 1998).*
- A cardboard box can be sprayed with a scent such Christmas pine tree scent and small amounts of food such as raisins or cereals placed in the box *(Winhall, W.R. 1998).*
- Liquid flavourings such as vanilla, aniseed, pineapple, strawberry, maple etc. can be diluted with water, placed in small plastic spray bottles and sprayed onto enclosure furnishings *(Environmental Enrichment Scrapbook 2007).*
- Herbs which could be used (fresh or dried) include dill *(Anethum graveolens),* chives *(Allium spp.),* tarragon *(Artemisa dracunculus),* coriander *(Coriandrum sativum),* fennel *(Foeniculum vulgare),* peppermint *(Menta spp.),* basil *(Ocimum basilicum),* oregano *(Origanum spp.),* sage *(Salvia officinalis)* and thyme *(Thymus spp.) (Environmental Enrichment Scrapbook 2007).*
- Drag meat or smelly fish such as herring around the enclosure to provide a scent trail for the bears to follow. Sometimes (but not always) leave food at the end of it *(Partridge 1992).*
- Trails can be created using highly scented substances such as Marmite, Bovril or tomato ketchup; bears will rub their faces and shoulders along such smears *(Underwood, J. 1996).*

- Sawdust from an aromatic wood, or provision of loads of fresh pine needles, provides a scent experience for the bears as well as a tactile experience and a place to dig or rest. Always check for any respiratory reaction and remove the sawdust or needles if any bear does have an adverse reaction *(The American Bear association 2006).*
- Woodchips can be scented by being placed into a container which has held seasonings *(Environmental Enrichment Scrapbook 2007).*
- Provide aromatic boughs such as cedar or pine near a pool, platform, scratching post or sawdust pile, for the bears to play with or rub against *(The American Bear association 2006).*
- Aromatic boughs can be placed high up partially inserted into scratching posts, so the bears have to stretch for them *(The American Bear association 2006).*
- Aromatic browse can also provide scent enrichment *(Environmental Enrichment Scrapbook 2007).*
- Logs can provide olfactory enrichment *(Environmental Enrichment Scrapbook 2007).*Check that the logs are not contaminated with e.g. insecticide, and that they do not contain any metal pieces.
- Flowers of non-toxic species can be hung up around the enclosure *(Environmental Enrichment Scrapbook 2007).*
- Honey, chunky peanut butter or fruit jam can be smeared onto platforms, trees or branches, encouraging climbing, stretching and general exploration *(The American Bear association 2006).*
- Pieces of cloth can be scented e.g. with fruit scents then hung up around the enclosure.Care must be taken that the cloth will not obstruct the gut if torn down and eaten *(Environmental Enrichment Scrapbook 2007).*
- Logs can be placed in enclosures with other species such as camels or goats, then into bear enclosures. Care must be taken that bears do not become frustrated by smelling prey species without any outlet for hunting or foraging. Care must be taken that bears are not upset by scents of other large carnivores *(D.A. Field 1998).*

Sound Environment

Several polar bears have appeared to be stressed by loud noises, such as fun fairs, or construction sites, near their enclosures *(Partridge 1992).*
Natural sounds, including recordings of conspecifics and other species may be used in enrichment *(D.A. Field 1998).*
Music can be used *(D.A. Field 1998).*
Objects can be provided which may a noise when the bear interacts with them: it was noted that *Tremarctos ornatus* - Spectacled bears appeared to enjoy banging plastic jugs, containing stones and hung up in the enclosure, so that they made a noise *(Willms, E. 2001).*

(For food enrichment, see section 6.4 Food Presentation-page no. 41)

Environmental enrichment may act to reduce stereotypic behaviour by different means: by increasing the animal's sensory stimulation, making the environment less predictable and increasing the animal's overall level of activity, by reducing its motivation to perform a given behaviour, or by providing it with the opportunity to engage in more appropriate behaviours (e.g. by providing it with the stimuli it is naturally motivated to seek).

- In order to maximise the likelihood that enrichment will eliminate stereotypic behaviours, it is necessary to determine the types of behaviours which the animal(s) are motivated to perform and then consider what external stimuli can be provided to functionally satisfy the motivation *(Shepherdson, D.J. 2003).*
- A recent meta-analysis indicate that provision of enrichment substantially reduces stereotypic behaviour *(Shyne, A. 2006).*
- While practically all forms of enrichment may reduce negative behaviours initially, a continuing effect is likely to depend on appropriate enrichment which continues to stimulate animals over a period of time *(Shyne, A. 2006).*

Stress can be reduced by giving bears some control over their environment, including their ability to get away from perceived danger as well as to move about freely and be able to explore their environment *(The American Bear Association 2006).*
Bears in "traditional", unenriched enclosures are often inactive and may be considered "bored" by visitors *(Forthman, D.L 1992).*
Several polar bears have appeared to be stressed by loud noises, such as fun fairs, or construction sites, near their enclosures *(Partridge 1992).*

Treatment and prevention of abnormal behaviours in bears by enrichment

When *Ursus maritimus* - Polar bears were provided with apparatus allowing them to "order" fish by vocalising near a microphone, begging behaviours were reduced. Added benefits of this included:

- Increased the visitors' appreciation of the bears' activities and abilities (e.g. diving into the pool and swimming to retrieve fish they had "ordered");
- Decreased aggression between two bears (when the apparatus delivered food in two different areas of the enclosure simultaneously);
- Increased fitness and improved, more normal fat deposition in one of the bears;
- Reduced offering of junk food to the bears by visitors *(Markowitz, H. 1982)*

A female *Ursus maritimus* - Polar bear at Sea World Australia, showed stereotypic behaviour (developed prior to her arrival at this collection) despite a large enclosure incorporating several different enclosures.
It was considered that anxiety was a major factor resulting in this behaviour. Changes were made including increasing the water temperature (since she appeared not to like cold water), ensuring that substrates were available on which the bears could dry off after emerging from the pool, keeping fans on to provide a breeze and providing access to all areas most of the time. These changes resulted in a decrease in the stereotypic behaviour to "negligible" levels.

Polar Bear Shores, Sea World Australia, Simulates a natural summer arctic environment and provides enrichment by:

- Enclosure design: natural furnishings such as logs, rocks, digging pits, natural foliage, salt water and freshwater pools, varying artificially generated "weather".
- Sensory stimulation: olfactory, tactile, taste and visual.
- Provision of novel objects: natural (moveable logs, bamboo, tree stumps, browse) and non-natural (toys), ropes, containers etc.
- Feeding methods: scatter feeding, hidden foods, food in iceblocks etc.
- Social groupings: rotation of bears between main exhibit and back of house areas, allowing solitude or close proximity; naturalistic exhibit with visual barriers such as large logs and rock formations;
- Behavioural training (operant conditioning).

At Auckland Zoo during a four-week trial, a variety of enrichments - logs smeared with Marmite in week one, novel objects (plastic bucket, tractor tyre, plastic barrel) in week two, food logs in week three and live food (catfish and eels), novel objects and obstacles on a pacing route in week four, were provided for two polar bears. It was found that the female's level of stereotyping decreased in three of the four weeks, while the male's stereotypic behaviour, which was more frequent and less variant, decreased only when live food was given *(Hennessy, C.L. 1996).*

A study of Kodiak bears, Polar bears and Asiatic black bear at Zoo Atlanta, found that in general, provision of enrichment (feeding enrichment in the form of browse for the *Ursus thibetanus* - Asiatic black bear and food frozen into ice blocks for the other bears) resulted in higher levels of active behaviours, lower levels of inactive behaviours and reductions in abnormal activities *(Forthman, D.L. 1992)*

A study on Malayan sun bears (*Helarctos malayanus* - Sun bear) at Taipei Zoo found that changing the feeding pattern so that, instead of one feed of dog pellets in the early morning and the rest of the feed in the late afternoon, some foods were hidden in and scattered over the enclosure, with less food being given as a main meal at the end of the day, resulted in increases in the times spent in feeding (4.51% increased to 25.69%), exploratory behaviour (20.84% increased to 31.52%) and locomotion (increased from 5.45% to 9.64%), and decreases in the times spent inactive (24.22% reduced to 19.55%) and in stereotypic behaviours (31.83% reduced to 8.43%). *(Cheng, J.S.C. 2001)*

At San Diego Zoo considerable investment was made in the development and use of a variety of enrichment, particularly non-food enrichment items, allowing two adult polar bears (as well as two newly-arrived orphaned cubs) to entertain themselves. Additionally, daily training based on positive reinforcement was used for routine management and to allow e.g. veterinary monitoring. A key element was communication, both between keepers to maintain consistency, and between the keepers and the animals, to make it very clear to the bears what was being asked of them; this was particularly important for the adult bears. Implementation of the new routines and enrichment (over the period 2001-2003) produced a large reduction in pacing and repetitive swimming (stereotypic behaviours which the bears had carried out much of the time) to zero, as well as an increase in time spent playing from less

than 10% to over 27%. The training also decreased stress of both bears and keepers, and improved the ability to manage the bears (e.g. in moving from the main exhibit to the "bedroom" area) *(Murphy, K. 2005).*

Activity increased and time spent inactive decreased in *Ursus arctos* - Brown bear, *Ursus thibetanus* - Asiatic black bear and two *Ursus maritimus* - Polar bear, each kept separately, when they were provided with enrichment (appropriate food items frozen into ice blocks. Frequencies of abnormal behaviours (which for most of the bears were present only at low levels) also decreased, significantly for one of the polar bears *(Forthman, D.L., 1992).*

In a solitary housed male *Ursus americanus* - American black bear, stereotypic behaviour associated with feeding was reduced by most of the food ration being hidden throughout the enclosure, providing increased foraging opportunities, while stereotypic behaviour not associated with feeding and thought to be related to the urge to find mates in summer was reduced when male and female bear urine-based hunting lures were sprayed on objects in the enclosure *(Shepherdson, D.J., 1998).*
For two *Tremarctos ornatus* - Spectacled bears, providing a climbing structure and introducing ice blocks containing food, and tyres containing food, both being hung on chains from the climbing structure, resulted in both bears spending less time stationary with their eyes closed, less time pacing for the male and more time foraging by both bears (particularly the male). Overall, they showed a wider use of the space in the enclosure and a more varied pattern of behaviour than was seen before the changes *(Renner, M.J. 2002.)*

For a rescued *Tremarctos ornatus* - Spectacled bear (confiscated from a circus) at the National Zoo in Chile, a variety of enrichment including adding various substrates and wooden logs, scent enrichment, food-based enrichment and provision of novel objects resulted in a significant ($p<0.05$) decrease in pacing behaviour and significant increases in times spent searching and interacting with enrichment items *(Cubillos, G. 2005).*

For *Helarctos malayanus* - Sun bears at Adelaide zoo, provision of elevated sleeping opportunities (e.g. in trees or a fire hose hammock) appears to be helpful *(Baskerville, R.M. 2004).*

At the Agra Bear Rescue Facility in India, 41 dancing bears are kept in three large, naturalistic enclosures with soil substrate, a pool, elevated wooden platforms natural vegetation including trees, and tree logs. Additional enrichment, including a hanging wooden log and scattered fruit, or a honey log, dry hay and green grass, or climbing branches and cage furnishings, all produced only a small increase in the amount of time spent foraging (from 12.7% to 14.5% with the scattered food), but reductions in the times spent on aggressive behaviour and fighting (19.9% reduced to 8.2-8.7%), and on stereotypic behaviours (30% reduced to 13.7-18.2%), while time spent in social interactions increased from 1.7 to 6.2-8.9% *(Gupta, B.K 2004).*

Behavioural training can also be used as a form of enrichment for bears. It relies on the voluntary cooperation of the bears [which provides them with the choice of cooperating or not] and offers mental stimulation, as well as assisting with husbandry, preventative medicine and veterinary treatment, and reducing stress [since bears can

be trained for routine husbandry and veterinary procedures] *(American Zoo and Aquarium Association 2006).*

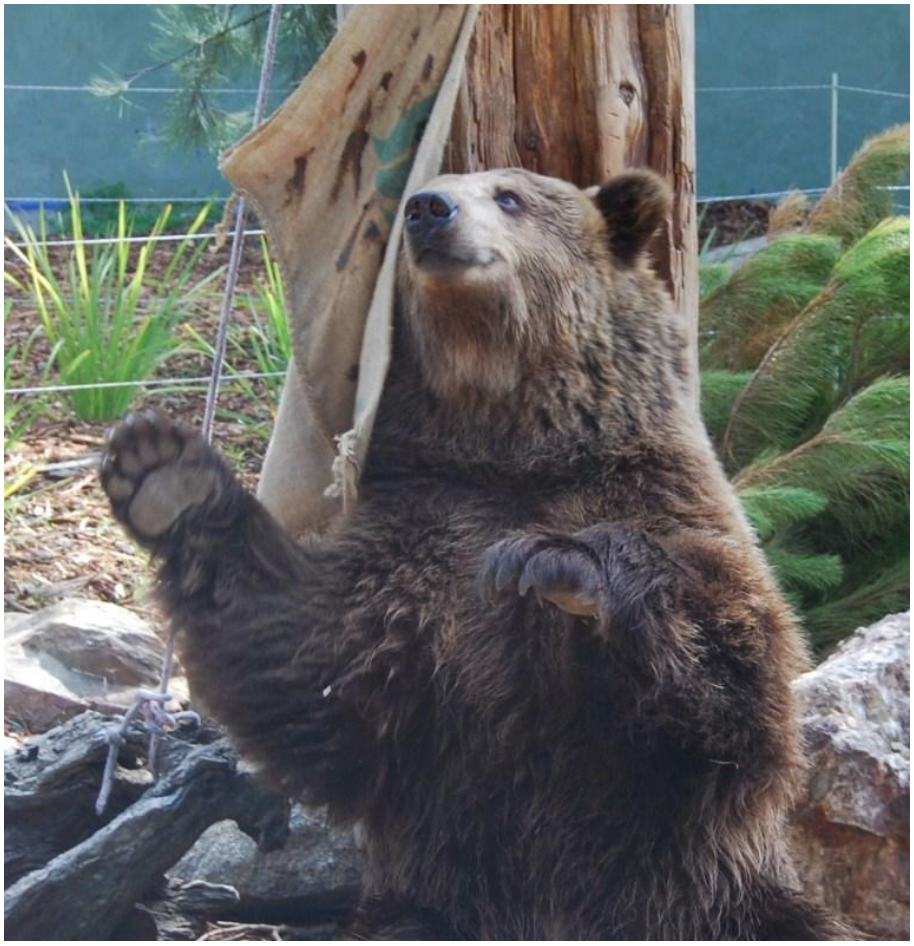


Figure 18 Bear rubbing on a hessian sack smeared with vegemite

Figure 19 brown bear enjoying some scented branches

9.8 Introductions and Removals

Because of the potential for serious or fatal injuries to the bears, all introductions should be well planned, not rushed, and intensely monitored. Bears do have the ability to kill each other with little or no warning. Management challenges usually center on animal incompatibility. The personality of the individual bear can prolong the steps of the introduction. When introducing more than two bears, it is advisable to introduce two at a time before putting the whole group together. The individual's previous experience with conspecifics can influence the rate of introduction. Basic steps for introducing bears should include the following:

1) Staff working with bears should establish a familiar routine when a new bear comes into a facility. Diet changes should be introduced gradually. Before introductions are started, the staff and new bears should become familiar with each other.

2) Sufficient time should be allowed for each new animal to adjust to its new surroundings before beginning the introduction process. This period can take a month or more depending upon the individuals involved. The bear should shift, eat regularly, and respond to its trainers before starting introductions. All bears need to be familiar with the entire exhibit and holding areas as individuals, before starting introductions to new animals.

3) Only two bears should be introduced at a time.
4) Animals should be kept in adjacent areas for introductions. The bears should have olfactory and visual access to each other without the possibility of injury. They should not be able to get paws, or other body parts through the access portal during the early stages of the introduction. Staff members do not need to be in the immediate area for the entire time during this stage of the introduction, but do need to be there to observe initial interactions-even from afar. Positive signs at this stage include chuffing and bouncing on front legs. Negative signs are roaring, growling, and biting at the barrier. Individuals may exhibit their own signs of stress. If any negative signs are seen, end the introduction at that point. It is best to go back to the previous step and allow the bears to acclimate further before proceeding. If the female is in estrus, as demonstrated by presenting her hindquarters to the male at the door and urinating in the area of the male, the bears can be put in the same space. Breeding bears are usually not aggressive, but this can vary. Diligence in observation of all introductions is critical.
5) When doing physical introductions limit the number of people present and keep disturbance in the area to a minimum. If the bears are disturbed by the presence of staff, a remote video set up may be used to monitor the introduction.
6) Introductions should take place in a resource-rich environment. During both off-exhibit and subsequent on-exhibit introductions, the area should be over-stocked with enrichment, especially food. It is critical that enough is offered so that there is not competition for the items, while at the same time providing both bears the opportunity to engage in safe activities, in addition to interacting with each other.
7) When selecting an area for physical introductions, make sure there are no dead ends where one animal can corner another.
8) When the pair appears to be at ease at the visual access point, as demonstrated by lying side-by-side, nose-to-nose, or one animal presenting itself in a vulnerable position while the other animal reacts non-aggressively, they are ready for physical introductions. A partial introduction, allowing bears to get a paw or part of their muzzle, through the access point may be done, if the facility allows. All parts of the enclosure should be clearly visible to both animals. Ample escape routes should exist for both bears so that neither can be trapped or cornered by the other. This full access should only be done with staff members present to separate the animals if necessary. Fighting bears can sometimes be separated with water, CO2 fire extinguishers, or any object that makes a loud noise. Introductions should be done in places where the animals can be separated if things go awry. If possible, areas in the exhibit that are out of reach of water cannons dart guns, or other tools to break off negative encounters, should be excluded from introductions *(Meyerson 2007).*

Reintroductions
Care must also be taken when reintroducing pairs that have been separated for prolonged periods of time, such as when a female has been separated with a cub. Usually, reintroductions of bear's familiar with each other take less time. A short visual introduction will tell the staff if the animals are ready to be reintroduced *(Meyerson 2007)*

9.9 Intraspecific Compatibility

Bears commonly are kept in pairs or sometimes larger groups in zoos *(Partridge 1992).* In sanctuaries holding rescued bears, often large numbers of bears are present in one enclosure.
If a new group of bears is to be formed in a zoo, bears should be of similar ages, perhaps with the male being older. If the group is to be added to, it is better to add two young bears at the same time, rather than one individual; they may be able to support each other during the introductory period *(Debra Bourne 1992).*
Great care is required when forming groups and adding new bears in sanctuaries. The physical and mental status of the bears should be considered in deciding which bears can be housed together *(Loeffler, L.K. & Cochrane, G.M. 2005).*
The age of the bears should be considered: young bears may dominate older bears and be aggressive towards them *(Gupta, B.K. 2004).*

9.10 Interspecific Compatibility

Ursus arctos - Brown bear have been kept in a two hectare enclosure with a pack of wolves *(Grandia, P.A., Van Dijk, J.J. & Koene, P. 2000)*

9.11 Suitability to Captivity

Brown bears require very large enclosures which not all zoos are able to provide. Bears in captivity with stereo typical behaviours are common, therefore may not do as well in captivity as other carnivores *(Personal opinion).*

10 BREEDING

When deciding whether or not bears should be bred in captivity, it should be remembered that five of the seven *Ursus, Melursus, Helarctos* and *Tremarctos* bear species are red-listed as Vulnerable *(Melursus ursinus* - Sloth bear, *Tremarctos ornatus* - Spectacled bear, *Ursus maritimus* - Polar bear and *Ursus thibetanus* - Asiatic black bear)or Data deficient (*Helarctos malayanus* - Sun bear). *(The Red List of Threatened Species 2006).*

10.1 Mating System

Brown bears are polygamous/ promiscuous in the wild. In zoos, bears which are intended to breed are commonly maintained either as a pair or in a group with several females and one male *(Debra Bourne 1992).*

10.2 Ease of Breeding

Breeding brown bears in captivity has been successful in comparison to other bears such as the sun bear.

10.3 Reproductive Condition

- Male brown bears show distinct seasonal changes in reproductive function. The testes reach their maximum size and weight during the breeding season, regress following the breeding season and recrudesce in the late hibernation period *(Debra Bourne 1992)*
- Females may show genital swelling *(Debra Bourne 1992)*

10.4 Techniques used to control breeding

Physical separation

Separating males and females during the breeding season may be considered as a method of reproductive control for northern bear species with a defined breeding season. Separation may be required for as long as five months. Separated individuals should be kept in enclosures well away from one another; if they remain within range of olfactory communication this could act as a stressor and promote stereotypic behaviours *(Kolter and Usher-Smith 1998)*

Hormonal contraception

- Hormonal implants have been used in various bear species including *Helarctos malayanus* - Sun bear, *Ursus americanus* - American black bear, *Melursus ursinus* - Sloth bear, *Ursus arctos* - Brown bear and *Ursus maritimus* - Polar bear *(Porton 1990)*
- Implants containing 500 mg melengestrol are effective for at least two years.
- The bear has to be immobilised (anaesthetised) and the implant placed surgically *(Kolter and Usher-Smith 1998).*

Note: After use of an implant, the bear should then be given at least one season without contraception, to reduce the risk of adverse health effects *(Kolter and Usher-Smith 1998).*

- Oral contraceptives can be used although care is required to ensure that the dose is swallowed and has not been spat out. In a female *Ursus maritimus* - Polar bear at Cologne Zoo, 400 mg medroxyprogesteronacetate (two pills of Clinovir 200, Upjohn) were given weekly, crushed and mixed with honey which was then presented to the bear on the end of a spoon. No side effects were noted with this contraception *(Kolter and Usher-Smith 1998).*

- In a female Kodiak bear (*Ursus arctos* - Brown bear), oral megestrol acetate was given at 200 mg daily (0.25 mg/lb bodyweight) for 64 days, in fish, starting 1st April - about two weeks before oestrus was expected, and appeared effective: the female, which had cubbed for the previous seven years, did not produce cubs *(Whitlock, B. 1978).*

Note: Long-term progestin treatment of felids (Felidae - Cats (Family) has been associated with the development of uterine and mammary pathology, including neoplasia.. Additionally, progestins may enhance the onset of signs of diabetes mellitus. Therefore synthetic progestins, with or without oestrogen, are not recommended for long-term use in carnivores *(Meyerson 2007).*

- Progestins should not be used in pregnant females as they may inhibit uterine contractions and therefore interfere with the normal progression of parturition.
- Use of progestins during the period of embryonic diapause could stimulate the onset of active gestation, resulting in an earlier than normal birth date. Progestins may or may not interfere with the development of normal oestrous behaviour *(Meyerson 2007).*

Immunocontraception using Porcine Zonae Pellucidae (PZP)

- This involves two vaccinations in the first year, one at one to two months before the start of the breeding season and the second one to two weeks before the breeding season. For seasonally breeding species, a single vaccination is then required yearly, four weeks before the breeding season. In *Helarctos malayanus* - Sun bear, which does not have a defined breeding season, a booster would be required every eight months.

- The vaccine can be given by darting (remote injection). However, until more is known about the effects, it is preferable to immobilise the bear so that a blood sample can be taken to check antibody titres.
- The vaccination should not affect the reproductive behaviour of the bears *(Kolter and Usher-Smith 1998).*

Castration, ovariectomy/ovariohysterectomy and sterilization (vasectomy/tubal ligation)

- These methods are surgical and require anaesthesia *(Kolter and Usher-Smith 1998).*
- These methods are irreversible *(Kolter and Usher-Smith 1998).*
- Castration affects reproductive behaviour, and castrated males tend to gain weight *(Kolter and Usher-Smith 1998).* Some castrated males continue to show breeding behaviour. *(Meyerson 2007).*
- Vasectomy is not recommended because vasectomised males are likely to continue normal sexual behaviour and copulation with females, which can induce ovulation followed by pseudopregnancy *(Kolter and Usher-Smith 1998).*
- Castration or ovariohysterectomy are preferred for permanent sterilisation. *(Meyerson 2007).*

Antiprogestin to prevent implantation

- Antiprogestins competitively displace progesterone at the cellular receptor and thereby prevent implantation or induce abortion. Because bear reproduction involves a period of embryonic diapause prior to implantation, and progesterone levels increase at the end of the embryonic diapause, displacement of progesterone using an antigestagen (AG) has been considered as a means of preventing the blastocyst from implanting. In seasonally breeding bears, antiprogestins can be given parenterally during diapause (October) or in the early post-implantation period *(Goritz, F 2002).*

Note: If the antiprogestin is given too late after implantation (e.g. one month after implantation) there may be incomplete resorption of embryos, or fetal abortion. It is therefore important to give the treatment in the late diapause/early implantation period *(Goritz, F 2002).*

- Antiprogestins given orally were ineffective *(Goritz, F 2002).*

- Oral (four doses each 10 mg/kg) or low-dose (1 mg) intramuscular administration of antiprogestin J956 did not prevent implantation and pregnancy *(Jewgenow, K 2001)*
- Antiprogestin J956 can be delivered intramuscularly by remote injection (darting) *(Jewgenow, K 2001)*

- At a dose rate of 10 mg/kg by intramuscular injection, plasma levels of antiprogestin J956 were sustained (6.4 +/- 1.3 ng/mL) for nearly two months in *Ursus americanus* - American black bear. *(Jewgenow, K 2001)*

- Full information on fertility following antiprogestin treatment has not yet been gathered. However, one bear treated with J956 and ethinyloestadiol became pregnant a year after treatment *(Goritz, F 2002).*

GnRH agonist in males
An initial trial in a bear (*Tremarctos ornatus* - Spectacled bear) indicated that this may be a useful method for contraception in bears in the future *(Briggs, M.B. 1994).*

A GnRH agonist, leuprolide acetate (Leupron® Depot, TAP Pharmaceutical, Chicago, Illinois, USA), injected subcutaneously at 0.075 mg/kg/28 days in a male *Tremarctos ornatus* - Spectacled bear produced a reduction in testosterone levels in blood from 1.75 ng/mL to less than 0.156 ng/mL, i.e. a 91% reduction. Within eight weeks of cessation of treatment, levels returned to pre-treatment values. The male was held adjacent to a female bear *(Briggs, M.B. 1994).*

If a GnRH agonist is used in seasonally-breeding bears, it needs to be implanted about two months before the onset of the breeding season, certainly at least six weeks before, so that any sperm produced have been eliminated from the male before the female will ovulate *(Meyerson 2007).*
This treatment may reduce male aggression *(Meyerson 2007).*

GnRH agonist in females
This is particularly suitable for use in seasonal breeders. Because of the initial stimulatory effect, the agonist needs to be implanted about two months before the earliest possible onset of the breeding season. Initial ovulation may be prevented by treating with a progestin short term (e.g. oral contraceptives for about ten days) at the time of the insertion of the GnRH agonist implant *(Meyerson 2007).*
Oestrous behaviour should be eliminated by use of a GnRH agonist *(Meyerson 2007).*
Note: GnRH agonists may cause abortion if used in pregnant females. *(Meyerson 2007).*
The effects of GnRH agonist use on lactation have not been properly tested. *(Meyerson 2007).*

10.5 Occurrence of hybrids

Bears should not be kept in an enclosure with other bears in circumstances allowing hybridisation (i.e. there should not be a reproductively capable male of one bear species sharing an enclosure with a reproductively capable female of another bear species).
Hybridisation has been reported in bears where more than one bear species has been kept in a single exhibit. Reported hybrids include:

- *Ursus maritimus* - Polar bear x *Ursus arctos* - Brown bear *(DeMaster, D.P 1981) (Gray, A.P. 1972).*
- *Ursus arctos* - Brown bear x *Ursus americanus* - American black bear, including back cross to *Ursus arctos*

- *Melursus ursinus* - Sloth bear male x *Helarctos malayanus* - Sun bear female *(Asakura, S 1969).*
- *Tremarctos ornatus* - Spectacled bear x *Ursus thibetanus* - Asiatic black bear) *(Weigl, R. 2001).*
- *Ursus arctos* - Brown bear x *Ursus thibetanus* - Asiatic black bear *(Jill Robinson, Animals Asia Foundation).*

A single instance has been confirmed, following DNA tests, of a *Ursus maritimus* - Polar bear x *Ursus arctos* - Brown bear hybrid bear in the wild, which was shot in the Northwest Territories, Canada *(Alertis 2006).*

10.6 Timing of breeding

BREEDING SEASON in the wild: The mating season may occur between late April and early August. In North America it is mainly mid-May to mid-July, in India May or June, in Western Europe, July. Autumn (mid-September to early October) courtship and mating has been seen, rarely, in British Columbia, Canada *(Debra Bourne 1992).*

In captivity the breeding season can vary depending on when the spring and summer period takes place-example: At National zoo and Aquarium Canberra Australia, the brown bears breading season is from approximately November to February.

10.7 Age at first breeding and last breeding

SEXUAL MATURITY: Sexual maturity varies between populations, with first litters born to females as young as three years (rarely) up to as old as nine or ten years. Males in the continental USA reach sexual maturity at about 5.5 years, those in Alaska at about 4.5 years *(Debra Bourne 1992).*

10.8 Ability to breed every year / 10.9 Ability to breed more than once per year

TIME BETWEEN LITTERS / LITTERS PER YEAR: Litters are born at least two years apart, but three or four years is more usual and the interval may reach six years in some areas *(Debra Bourne 1992).*

10.10 Nesting, dens and other requirements

For bears to rear their cubs successfully it is necessary for the female to be provided with appropriate facilities: a concealed den in which she feels safe and undisturbed *(Crandall, L.S. 1964).*

Individual bears vary in temperament, including within a given species. Some individuals may successfully produce and rear cubs in situations which other female bears would find too disturbed by conspecifics in the enclosure or by members of the public outside the enclosure. The degree to which individual bears will accept close

approach of their keepers while rearing cubs, and the age at which it is safe to carry out activities such as temporary separation of the mother from the cubs for cleaning the den and checking the cubs, also varies *(Crandall, L.S. 1964)*
.

- It is recommended that the maternity den should be secluded, away from conspecifics and away from the public exhibit area *(Kolter and Usher-Smith 1998).*
- Appropriate secluded housing is particularly important for wild-caught females, primiparous females and very restless individuals *(Kolter and Usher-Smith 1998).*
- It is preferable for a separate building to be available as a maternity area/den, including three sections/dens/cages *(Kolter and Usher-Smith 1998).*

- The size difference between males and females can be utilised: a door of a size allowing the female but not the male to enter can be used to ensure only the female can access the cubbing den area. Within one of the indoor areas should be a cubbing box or kennel to serve as a maternity den. The cubbing box should be relatively small. Small openings high up are recommended to improve ventilation without producing draughts. Nesting material should be provided, such as straw, wood chips, bark or dry leaves. Avoid long straw due to the potential risk of strangulation of a cub. Ensure that the nesting material is clean and that it is low in dust. A video link with sound recording should be installed if possible; if not then a microphone should be installed so that the cub's vocalisations can be monitored. A baby monitor can be used for monitoring using sound *(Partridge 1992).*
- One of the neighbouring cages should be fitted out as a cub playground, with thick straw on the ground for safety when first climbing, ropes, tree trunks (firmly secured), barrels and plastic tubs held together to form climbing frames and resting places *(Kolter and Usher-Smith 1998).*
- Preferably there should also be an outdoor area for the female and cubs to use, separate from any other bears in the main enclosure, so that both the female and her cubs, and other bears, can have outdoor access. Any pool should have shallow sides or an escape ladder which cubs can use. The water level should be low when cubs are very young, or the pool may even be drained and the bottom filled with straw *(Partridge 1992).*

Management of the female

- The females should be separated from the male and confined in the maternity area for some time before the expected parturition date, so that she becomes used to the cages and the situation. Some individual bears will rear their cubs in situations where they are separated from the male only very shortly before parturition, or even after parturition has occurred. Disturbance by both other animals and unfamiliar people must be avoided, particularly in the early period after parturition, e.g. the first month *(Partridge 1992).*
- Only a familiar keeper or keepers should be allowed near the maternity area *(Kolter and Usher-Smith 1998)*

- Necessary management should be carried out quietly, with effort to reduce noise, and on a regular schedule, so that the activities are predictable *(Partridge 1992).*
- Do not clean the den out in the first weeks after parturition; cleaning activities may disturb the female sufficiently that she kills her cubs *(Partridge 1992).*

- A system was set up at Denver Zoological Gardens allowing the *Ursus maritimus* - Polar bear to be separated from her cubs periodically so that the den could be cleaned; this started no earlier than four weeks after the cubs were born - later than this in the first years (initially at 12 weeks) *(Kenny, D,E 2004).*
- At one facility, increased rearing success was achieved by allowing the female *Ursus maritimus* - Polar bear choices of dens, which let her move the cubs if she wants to, and by allowing her to choose her routine *(Meyerson 2007).*

Monitoring

- The bear should be monitored closely to enable prediction of the cubbing date and to ensure that any problems are identified quickly and intervention is carried out if necessary *(Kolter and Usher –Smith 1998).*
- Preferably, observation is carried out by video/microphone monitoring of the cubbing box. As an alterative, a keeper familiar to the bear may approach quietly and listen/observe through a peephole *(Kolter and Usher –Smith 1998).*
- If video is used, a series of squares of known size (e.g. 2 cm or 3 cm) painted on a wall may be used for improved accuracy in estimating the size of cubs *(Partridge 1992).*

The sound of cub vocalisations is the best indicator that birth has occurred.

- Lip smacking of the cub while drinking is a positive indicator.
- "Humming" of the cub while lying with a teat, its own paw, or its mother's hair in its mouth is also a positive indicator.
- Prolonged squeaking indicates a problem. Squeaks from the cub should elicit maternal care, therefore occasional brief squeaks are normal but prolonged squeaking is not *(Kolter and Usher –Smith 1998).*

Behaviours of the female indicating a problem include:

- Lack of response to squeaking of the cub(s)
- Leaving the cubbing box in the first few days after parturition *(Kolter and Usher –Smith 1998).*

Visual indications of a problem include:

- Cubs lying in a corner of the cubbing box, not being cared for;
- Injuries to the cubs, indicating maternal aggression *(Kolter and Usher –Smith 1998).*

NOTE: Handling of cubs should be avoided if at all possible. Weighing and measuring of cubs should be carried out ONLY if this is not likely to disturb the mother and have a deleterious effect on her relationship with her cubs *(Kolter and Usher –Smith 1998).*

Inflammation of the navel, which may occur due to excessive licking, or due to infection, should be treated only if absolutely necessary *(Kolter and Usher –Smith 1998).*

Tolerance of human presence will depend on the bear's character and on her pre-parturition relationship with her keeper *(Kolter and Usher –Smith 1998).*

Females and larger cubs

In general, females and cubs which have left the den need an enclosure similar to that for adult bears. Some modifications may be needed to make the enclosure safer and more negotiable for cubs *(Partridge 1992).*

Females and their cubs should be kept together for 1.5 to 2.5 years, as is normal in the wild *(Partridge 1992).*

It may be possible to reintroduce the female and cubs to the male, but this depends on the temperament of the female (whether she will defend her cubs) and the male (how aggressive he is) *(Partridge 1992).*

10.11 Breeding Diet

Pregnant females should be provided with a high energy and high protein diet this should include a high quality dog kibble, fish, chicken, red meat, eggs etc

- Water should always be available to the female bear while in the maternity area. This may be provided by an automatic drinking device (preferable to ensure water is always available without disturbance) or by a water bowl fixed to the bear's side of the door and filled from the outside using a hose, with care not to disturb the bear *(Crandall, L.S. 1964).*
- It has been suggested that food should be withheld from female bears once they are moved to cubbing dens when the cold weather arrives, to break the habit of the bear leaving the den at the usual feeding time *(Kolter and Usher-Smith 1998).*
- Bears may not eat for a few days before parturition and for a few weeks after parturition *(Kolter and Usher-Smith 1998).*
- It may be best not to offer food for the first three weeks after parturition, to minimise the risk of disturbing the female and breaking the bond with her cub(s). If food is provided, it should be placed in an adjacent area to which the female has access, not inside the cubbing den itself *(Partridge 1992).*

- Food could be provided via a chute, to minimise keeper approach near the den in the early stages after parturition *(Partridge 1992).*
- Initially provide small amounts of food, increasing quantities as the female's appetite increases *(Partridge 1992).*

10.12 Oestrus cycle and Gestation Period

OESTRUS/OVULATION: Oestrus lasts 10 to 30 days in mature females. Females coming into oestrus for the first time have a short oestrus, less than one week, which does not result in pregnancy *(Debra Bourne 1992).*

GESTATION/PREGNANCY: Gestation lasts 6.5 - 8.6 months. Initially, the fertilised ova develop only to the 200-cell blastocyst stage. Development then stops until late October to November, when implantation occurs and development continues, this active gestation period lasting six to eight weeks *(Debra Bourne 1992).*

10.13 Litter Size

A litter contains one to four cubs, but two or three is usual. Observed larger litters (five or six cubs) may be due to cub adoption. Mean litter size in North America varies from 1.70 - 2.66 *(Debra Bourne 1992).*

10.14 Age at Weaning

- Females nurse and protect their cubs, and remain in their winter dens until the cubs are capable of following.
- In the first weeks out of the den, the mother travels less far than usual and teaches the following cubs to climb and to search for food.
- Cub adoption and mixing of litters occurs occasionally
- In the first winter after birth the cubs den with their mother. The following year, if pregnant, she dens alone.
- Cubs remain with their mother for two to three years, occasionally into a fourth year. The mother chases her cubs away when she comes into oestrus.
- Instances of abandonment of a single cub (and of two cubs associated with disturbance) have been recorded.
- Males play no part in cub rearing *(Debra Bourne 1992).*

LACTATION / MILK PRODUCTION: Lactation may last 1.5 to 2.5 years or even longer *(Debra Bourne 1992).*

10.15 Age Of Removal From Parents and 10.16 Growth and Development

Behavioural development may be improved, and development of stereotypic behaviour might be decreased, if cubs are left with their mother for times

approximating the period which they would spend with her in the wild, generally a year or more *(Debra Bourne 1992).*

PARTURITION/BIRTH: Cubs are born while the female is hibernating, in January to March (December to January in India). *(Debra Bourne 1992).*

NEONATAL/DEVELOPMENT: Brown bear cubs are altricial, with only a fine hair covering at birth and closed eyes. The eyes open at about 20 - 35 days and tooth eruption starts at 35 - 40 days. They start walking at 45 - 55 days and by 75 - 90 days they follow their dam and are starting to eat solid food. Cubs remain with their mother at least to their second and often to their third or fourth spring, but may be able to survive alone from about seven months if orphaned. Growth rate is highly variable depending on food intake. Hand-reared cubs have variously reached between about 1.7 and 2.5 kg by one month, 4.3 - 6.4 kg by two months, 7.4 - 8.5 kg by three months, 20 kg by four months and as much as 50 kg at seven months. Wild cubs may reach 15 kg at three months. In the wild, young-of-the-year may range from 2.0 - 27 kg and yearlings from 9 - 37 kg *(Debra Bourne 1992).*

11 ARTIFICIAL REARING

- Zoo-born bear cubs should not be hand-reared as a matter of routine. Failure of females to rear cubs usually occurs due to disturbance; every effort should be made to avoid the female being disturbed.
- Orphaned/abandoned wild-born bear cubs should not be taken for hand-rearing if they are of an age where they are likely to survive alone.
- Hand-rearing should not be started unless the carer is prepared to give the time and effort required for rearing to release, or to ensure that appropriate care will be continued through to release.
- Consider whether hand-rearing is the best option for the individual compared with leaving it in the wild.
- Consider whether euthanasia is a more humane/kinder option for the individual than attempting hand-rearing. Debra Bourne 1992
- If wild-born cubs are hand-reared, every effort should be made to rear them with conspecifics, and to ensure that the cubs are maintained suitable for release, preferably not habituated to humans, dogs etc (*Debra Bourne 1992).*

Hand-rearing may be required due to:

- Death of the mother.
- Serious illness of the mother.
- Lack of or insufficient milk production by the mother, combined with a situation in which supplementary feeding is not possible.
- Rejection of the young by the mother.
- Illness, injury or congenital problems of the neonate.
- Interference in the rearing process by other members of the mother's social group.
- Requirement for specific pathogen free animals for reintroduction, from a herd with a serious infection problem.
- Inappropriate enclosure or environmental conditions for rearing young.
    - This situation should be avoided when possible by moving the female or social group to an appropriate environment. However, incidents such as extreme bad weather which may interfere with parent-rearing may not be predictable *(Debra Bourne 1992).*

11.1 Housing and 11.2 Temperature Requirements

The box needs to be lined with soft material to prevent injuries to the nose *(Kachan, T.G. 1994).*Cubs must be kept warm and dry *(Crandall, L.S. 1964).*

The following techniques have been used:

- Cubs were kept in an incubator set at 26.7 °C (80 °F) for the first seven weeks, reduced in the eighth week to 23.9 °C (75 °F); the cubs left the incubator at nine weeks *(Freiheit, C.F. & Crotty, M.J. 1969).*
- Cubs were kept in a box warmed with an electric heated pad to give a temperature of 29 - 30 °C (84 - 86° F) for the first three weeks, reducing after that to 27.5 °C (81 °F) and by six weeks they were maintained at room temperature. . By six weeks, in a playpen with a soft mattress and cardboard sides. By eight weeks, cubs preferred to be on a cool tile floor rather than the playpen mattress *(Quick, R. 1969).*
- Cubs have been kept in a wooden box, insulated and heated by a hot water bottle, with the box kept at 37-38 °C for the first 25-30 days. After this time, the hot water bottle was moved to one side of the box, giving the cubs choice about where to lie for thermal comfort (*Quick, R. 1969).*

- External warmth is required to 1.5 months of age. Young cubs need to have their muzzles wiped after feeding *(Kolter, L 2005).*

- Cubs are kept in a heated house without any humans living in it to three months of age, then in a wooden hut in an open-air, forested enclosure *(Kolter, L 2005).*

11.3 diet and feeding routine

- A high fat, low carbohydrate milk replacer (24% fat, 12% protein, almost zero carbohydrates, 38.0% solids) has been recommended. The food conversion rate is high on a high-fat milk replacer and low on a high-carbohydrate milk replacer *(Huber, D 1994)*

- Esbilac. In the first three weeks, powder mixed one part Esbilac to three parts water, with added multivitamins (one drop per day in week one, two drops in week two etc.). From the fourth week, mixed one part Esbilac to two parts water *(Freiheit, C.F 1963).*
- After 12 weeks the cubs were gradually switched from Esbilac to canned evaporated milk *(Freiheit, C.F 1963).*
- Esbilac at one part Esbilac to three parts water for the first two weeks, then one part to two parts water to six weeks, then one part to 1.5 parts water. Vitamins added (paediatric multivitamin) *(Freiheit, C.F 1963).*
- A cat milk replacer, KMR, has been used, at varying concentrations from 4:1 to 2:1.
- Multivitamins were added from day 14 and iron dextran was given on day 25. A mixture of cows milk with cream (fat 6%), 15 g, plus 1 g Mammysan milk powder (26% fat, 50% lactose, 15% protein, 6% milk-salt) and 1 g honey.) *(Freiheit, C.F 1969).*

- *Ursus arctos* - Brown bear cubs can be reared on whole cow's milk from a nursing bottle *(Crandall, L.S. 1964).*

- The mixture used by the Pazhetnovs: three litres fresh milk, one litre water, 200 mL semolina, two large spoons dried milk, two tablespoons sugar and a little salt *(Beecham, J. 2006)*
- As the cubs get older, add cooked barley (made one part barley to five parts water) *(Beecham, J. 2006).*
- Once feeding from a bowl has started, give the formula in the morning, and two additional feeds of the formula with seven eggs, two teaspoons multi-vitamins, seven tablespoons vegetable oil and cooked barley added *(Beecham, J. 2006)*
- A Kodiak bear (*Ursus arctos* - Brown bear) cub was fed 15 g whole milk enriched with butter fat to 6% fat, heated to 28 ° C (82 ° F) every three hours, with additions of small amounts of honey and "Mammyan", a prepared food. From 90 days vitamins were added in the form of four drops of cod liver oil every three days *(Crandall, L.S. 1964).*
- Cubs were reared on a mixture consisting of 500 mL milk, one egg yolk, 1 g glucose and 1 g salt. From 20 days 1 drop of a vitamin ADE mixture (vitamin A 100 mg, vitamin D 10,0000 IE, vitamin E 70 mg) was added *(Kachan, T.G. 1994).*

Utensils

- A standard rubber infant nipple with only a slightly enlarged hole.) *(Freiheit, C.F 1969)*
- Nipples with a cross-cut hole produced too fast a milk flow for the cubs *(Freiheit, C.F 1969).*
- An "Evenflo" feeding bottle and a premature baby nipple with the hole not enlarged was used *(Freiheit, C.F 1969).*
- Keeping the hole small was deliberate to make the cubs work for the milk and reduce the risk of formula being inhaled *(Freiheit, C.F 1969).*

- For a cub which suckled at fingers but not at the nipple, an infant pacifier (dummy), which was more finger-shaped was modified to make a nipple which was accepted better by this cub *(Freiheit, C.F 1969).*

- A bottle with a plastic nipple *(Kachan, T.G. 1994).*
- Bottle and nipple *(International Fund for Animal Welfare 2001).*

Feeding Frequency

The following schedules have been used:
1) Weeks 1-2 nine feeds per day: every 2.5 hours during the day (0600 - 2330) plus at 0300.; Weeks 3-8 eight feeds per day: 0600 - 2330 every 2.5 hours. Weeks 9-12 three feeds daily: 0800,1200, 1600 *(Freiheit, C.F 1969)*
2) Initially every two to three hours, including at night on demand (cubs crying), reducing after two weeks to every three to four hours (seven feeds per day), with night feeds given until six weeks of age *(Freiheit, C.F 1969)*

3) Feeding seven times daily, reduced after 30 days to six times daily *(Freiheit, C.F 1969)*
4) For first 23 days, eight times daily *(Freiheit, C.F 1969)*
5) For the first ten days, six times daily, then decreasing to five time daily to 20 days, four times daily to 90 days, and three times daily from 90 days *(Kachan, T.G. 1994)*
6) Fed five times daily *(International Fund for Animal Welfare 2001)*

Feeding Technique

- Keep the cub on its stomach, body tilted up at about a 45 degree angle. Brace the cub's head and shoulders with one hand; with the other hand hold the bottle (using the thumb and forefinger), and with the rest of the hand, brace the bear's chin *(Quick, R. 1969).*
- Do not lie a bear cub on its back to feed *(Quick, R. 1969).*

- Bear cubs must be fed lying on their front with the head slightly elevated holding the nipple of the bottle. A bear cub fed lying on its back may inhale milk and this may result in aspiration pneumonia *(M E Fowler 1995).* It may be necessary to hold the head and bottle firmly with older cubs to avoid the nipple becoming dislodged by the cub struggling *(Freiheit, C.F. 1969).*

Quantities

The following quantities have been fed:

- Cubs were fed as much as they wanted at each feed *(Quick, R. 1969).*
- Five hand-reared European brown bear cubs at about 75 days of age consumed 11.1% body mass (707 g formula) per day *(Huber, D. 1993).*
- For first 23 days, 15 g of milk mixture per feed (eight daily feeds); by 49 days 600 gm in 24 hours; by 90 days 725 g per 24 hours and by 92 days, 1.08 kg in 24 hours *(Ben Shaul, D.M. 1962).*
- Cubs were fed as much as they would take at each feed: in the first ten days,15-200 mL/day; days 10-20, 300-330 mL/day; days 20-30 380-400 mL/day; days 30-40 500-560 mL/day; days 40-50, 600-790 mL/day; days 50-60, 680-730 mL/day; days 60-70, 710-1270 mL/day; days 70-80, 850-1630 mL/day; days 80-90, 1,300-2,050 mL/day; days 90-100, 1,350-2,400 mL/day *(Kachan, T.G. 1994).*

11.4 Specific Requirements

Preventative antibiotic treatment should be considered for cubs which have not received colostrum (i.e. cubs hand-reared from just after birth) *(Quick, R. 1969).*

Cubs at one zoo were given two teaspoons of Lactobacillus acidophilus culture every 12 hours for two days and then were given ampicillin orally for five days *(Fransen, D.R. 1973).*

Toileting/Elimination

- Cubs need assistance to urinate and defecate, several times daily *(Freiheit, C.F. 1969).*
- The belly must be massaged to stimulate urination and defecation *(Kolter, L 2005).*
- Defecation stimulated by massaging the anal region immediately before each feed, until the cubs were able to walk *(Quick, R. 1969).*
- Stimulation of urination and defecation was carried out by massage of the belly by hand, and the anal area using a cotton wad; defecation without this stimulation was first noticed at 45 days of age *(Kachan, T.G. 1994).*
- Massage after every feed *(International Fund for Animal Welfare 2001).*
- Young cubs need to have their muzzles wiped after feeding *(Kolter, L 2005).*

Weighing

- It is generally recommended that animals should be weighed daily at least in the initial stages of hand-rearing, to monitor progress and check that food intake is sufficient *(Debra Bourne 1992).*

11.5 Data recording

The following data should be recorded on a daily basis:

- date and time when information was recorded
- weight of cub
- general activity and demeanor
- characteristics and frequency of defecation and urination
- amount and types of food offered
- food consumption at each feed
- Veterinary examination and results *(Debra Bourne 1992).*

11.6 Identification Methods

- .Microchips
- Tattooing
- Photo ID of physical differences such as size, colour, sex, age and individual features
- Identification of different personalities of individual cubs *(Debra Bourne 1992).*

11.7 Hygiene

- Cubs need to be kept dry and clean *(Crandall, L.S. 1964).*
- Cubs need assistance to urinate and defecate, several times daily *(Freiheit, C.F. 1969).*
- The belly must be massaged to stimulate urination and defecation *(Kolter, L 2005).*

- Defecation stimulated by massaging the anal region immediately before each feed, until the cubs were able to walk *(Quick, R. 1969).*
- Stimulation of urination and defecation was carried out by massage of the belly by hand, and the anal area using a cotton wad; defecation without this stimulation was first noticed at 45 days of age *(Kachan, T.G. 1994).*
- Massage after every feed *(International Fund for Animal Welfare 2001).*
- Young cubs need to have their muzzles wiped after feeding *(Kolter, L 2005).*

11. 8 Behavioural Considerations

- Hand-rearing risks the animal growing up to be behaviourally abnormal in its responses both to humans and to conspecifics.
- Hand-reared individuals may be incompatible with conspecifics.
- Hand-reared individuals may show poor breeding.
- Hand-reared females may not show normal maternal behaviour *(Debra Bourne 1992)*

11.9 Use of Foster Species

- Bears in the wild do sometimes adopt cubs. However, attempts to promote fostering in the wild have often been unsuccessful, with cubs sometimes being killed by the female. Adoption is most likely to occur when the cubs (the female's own and the cub to be fostered) are very young, before they would normally exit the den. After this time, the female appears more able to recognise the other cub as not her own *(Macdonald, D. 2001).*
- Fostering of older cubs in the wild is more likely to be successful if the female is immobilised and her sense of smell temporarily impaired (e.g. by placing Vicks "Vapo Rub" in her nostrils), or if the orphan is placed with the female's own cubs for at least two hours before she is allowed back to the cubs *(Alt, G.L 1984).*

- Rubbing Vicks "Vapo Rub" onto the orphan before presenting it to the female has been found to effectively inhibit aggression from the female *(Rogers, L.L. 1985).*

- Fostering in captivity may be limited by not having a suitable female with cubs to whom the cub(s) could be fostered *(Debra Bourne 1992).*
- At Amsterdam Zoo, where three female *Melursus ursinus* - Sloth bears bears all cubbed and two females each successfully reared one cub, after emergence from the dens, both cubs were observed sucking from a single female *(Martin, R.D. 1975).*

Interspecific foster rearing

- Black bear cubs in a zoo have been cross fostered successfully, at least twice, onto an *Ursus arctos* - Brown bear which was rearing cubs *(Reventlow, A. 1955).*
- Fostering of bear cubs onto a large domestic dog could be considered. A black bear cub, from about four weeks to about seven weeks of age, was fostered onto a 19 kg cross-bred domestic bitch has been described. The cub was then kept with one of its foster litter-mates (i.e. a domestic dog pup) for about a further 6.5 weeks before being placed with other orphaned bear cubs. There were no problems in its integration with the other cubs and no unusual behaviours were noted. Cross-fostering onto an appropriate bitch requires less intensive human care than does hand-rearing *(Haigh, J.C 1982).*

11.10 Weaning

The following have been used:

- Dry pre-cooked baby cereal was first added to the formula at the start of the 11th week. In the 12th week, pureed apples and bananas (one teaspoon per six ounces formula) were added, also ground dog chow, one tablespoon added to the milk. Food also was provided in shallow bowls from the 11th week *(Freiheit, C.F 1969).*
- First solid foods added to milk at 70 days (crushed biscuits and small pieces bread). At 105 days, gruel with egg yolk and honey, and Maizena four mixed with milk. By 120 days ground carrot, chopped lettuce, biscuits in milk, small pieces of herring, scraped meat, dates, banana *(Ben Shaul, D.M 1962).*
- Cubs given access to the outside start to eat grass at about four months. At this age some high-energy food should be given twice daily, but only a small amount so they are encouraged to forage for natural foods. Foraging behaviour should be well developed by five months and only a small additional evening feed is required *(Kolter, L. 2005).*
- A Kodiak bear (*Ursus arctos* - Brown bear) cub started drinking milk from a dish at 70 days and solid foods were added gradually (*Crandall, L.S. 1964).*
- In Croatia, five cubs were weaned gradually, starting after they were 107 days old *(Huber, D 1994).*

11.11 Rehabilitation and Release Procedures

Critics of hand-rearing for release suggest that hand-reared bears or those raised in captivity can not be released, because they have not been mother-trained to find food and dens and to avoid other bears, and are likely either to starve or to become problem bears eating human-related food sources; However, other authorities suggest that

hand-reared cubs, once released, quickly adapt to their natural habitat. *(Huber, D 1994)*.
Releasing hand-reared brown bears is more likely to result in the creation of problem bears than is the case with other bear species. Hand-reared bears should be released only if this can be carried out in a vast area without people *(Debra Bourne 1992).*

Note: Care must be taken with orphaned wild bear cubs, which are to be released back to the wild, not to imprint the cubs on humans or let them become habituated to humans or domestic animals such as dogs *(Kolter. L 2005).*

To minimise human interaction:
Dark, cotton gloves are worn when it is necessary to handle cubs, to avoid direct contact with humans. Personnel do not talk while working with the cubs. Faces are covered with dark masks while working with the cubs. These precautions are intended to minimise the possibility of cubs associating food with any strong, distinct external stimulus *(Kolter. L 2005).*

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