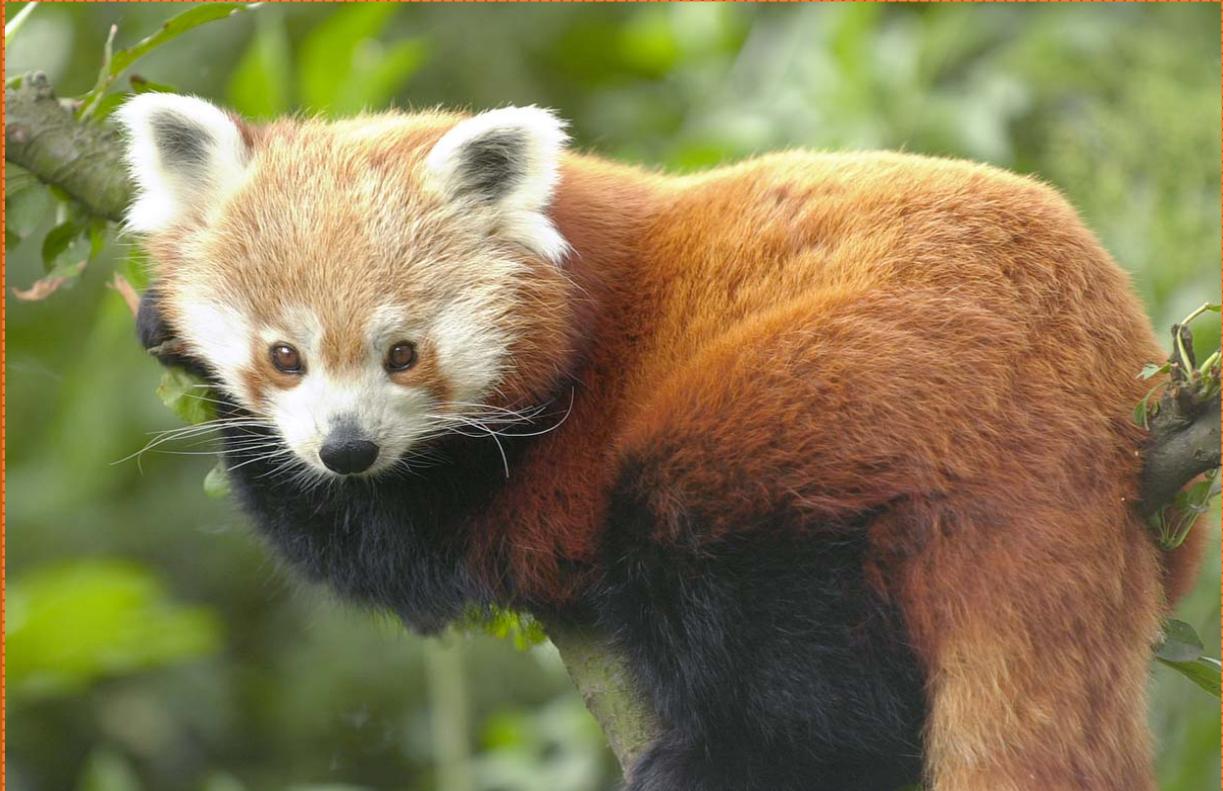


EAZA Best Practice Guidelines

Red Panda (*Ailurus fulgens*)



Picture: Red panda in Rotterdam Zoo, July 2013

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EAZA Preamble

Right from the very beginning it has been the concern of EAZA and the EEPs to encourage and promote the highest possible standards for husbandry of zoo and aquarium animals. For this reason, quite early on, EAZA developed the “Minimum Standards for the Accommodation and Care of Animals in Zoos and Aquaria”. These standards lay down general principles of animal keeping, to which the members of EAZA feel themselves committed. Above and beyond this, some countries have defined regulatory minimum standards for the keeping of individual species regarding the size and furnishings of enclosures etc., which, according to the opinion of authors, should definitely be fulfilled before allowing such animals to be kept within the area of the jurisdiction of those countries. These minimum standards are intended to determine the borderline of acceptable animal welfare. It is not permitted to fall short of these standards. How difficult it is to determine the standards, however, can be seen in the fact that minimum standards vary from country to country. Above and beyond this, specialists of the EEPs and TAGs have undertaken the considerable task of laying down guidelines for keeping individual animal species. Whilst some aspects of husbandry reported in the guidelines will define minimum standards, in general, these guidelines are not to be understood as minimum requirements; they represent best practice. As such the EAZA Best Practice Guidelines for keeping animals intend rather to describe the desirable design of enclosures and prerequisites for animal keeping that are, according to the present state of knowledge, considered as being optimal for each species. They intend above all to indicate how enclosures should be designed and what conditions should be fulfilled for the optimal care of individual species.



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Preface

The first official version of the husbandry and management guidelines for zoo red pandas was published in the fifth edition of the red panda studbook in 1988. The guidelines had been compiled over the previous years and were refined at the first red panda conference which was held in Rotterdam in 1987. Information and ideas from many people were compiled into these guidelines. And during the course of the panda conservation workshop held in Front Royal in 1991, the red panda husbandry and management guidelines was updated. Nevertheless, since these meetings there has been a lot of research into red panda diets, pathology, behaviour etc. AZA published the Red Panda Care Manual in 2011. Because none of the publications had a focus on European standards, it was necessary to come up with the EAZA Best Practice Guidelines for the Red Panda.

Acknowledgements

I would like to thank Loes Bodéwes put a lot of effort in compiling the EAZA Best Practice Guidelines for the Red Panda. Furthermore I want to thank Sarah Glass from Knoxville Zoo for sharing the AZA Red Panda Care Manual.

For the final editing process, the expertise of Angela Glatston (General), Joeke Nijboer (Nutrition), Endre Sos (Veterinary) has been invaluable. My sincere gratitude goes to these colleagues.



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Summary

This document reflects our current knowledge of the keeping of Red Panda (*Ailurus fulgens*) in captive environments. It provides Best Practice Information on successful captive management during the last 30 years.

Section 1., Biology and Field Data, reflects our current knowledge of the species in the natural environment using the most recent taxonomic information.

Section 2., Management in Zoos, covers housing, feeding, social environment, breeding and behavioural management. Managed programmes rely on the movement of animals between zoos and advice on capture, handling and transport is provided. A veterinary section provides information on current knowledge of medical care.

Because of recent developments within the Red Panda EEP this BPG will be updated within 2 years. Contraception and forming single sex pairs and/or groups to reduce population growth will be added. Updating the diet section with an example diet. And last but certainly not least the addition of conservation section.

I want to draw your attention to an excellent book about Red Pandas that covers their biology and conservation. The title of the book is RED PANDA, Biology and Conservation of the first panda. This book is edited Angela Glatston who is the current convener of the Red Panda Global Species Management Programme.

Finally this document is for all holders of Red Pandas. This to ensure the Red Pandas in our care will get the best possible care. It is essential that all keepers of these wonderful animals frequently refer to the Guidelines and contact TAG members with any concerns or queries.



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1. Biology and field data

1.1. Taxonomy

1.1.1. Order

All carnivorous animals are placed in the order of *Carnivora*. The name '*Carnivora*' refers to the word 'carnivore', which are all meat-eating organisms. The order *Carnivora* includes over 280 species of placental mammals, like wolves, cats, dogs, raccoons, bears, hyenas, walruses, weasels etc. Suborders of *Carnivora* are: *Feliformia* (cat-like *Carnivora*) and *Caniformia* (dog-like *Carnivora*).

1.1.2. Family

Carnivora are divided in sixteen families: *Feliformia*: *Felidae*, *Herpestidae*, *Viverridae*, *Hyaenidae*, *Nandiniidae*, *Eupleridae*. *Caniformia*: *Procyonidae*, *Ailuridae*, *Ursidae*, *Canidae*, *Mustelidae*, *Mephitidae*, *Phocidae*, *Obenidae*, *Odobenidae*, *Otariidae*. The red panda is the only species that belong to the family of *Ailuridae*.

1.1.3. Genus

The genus of the red panda is *Ailurus*.

1.1.4. Species

The only species within *Ailurus* is *fulgens*.

1.1.5. Subspecies

There are two subspecies of *fulgens*: *Ailurus fulgens* and *Ailurus refulgens* (*Ailurus Styani*). *Ailurus fulgens* is known as the red panda. ([GROVES, 2011](#); [FLYN ET. AL., 2000](#)). According to Groves should *Styani* an *fulgens* be treated as separate species.

1.1.6. Common names

Common names of red pandas are showed in table 1.

| Languages | Name(s) |
|-----------|---|
| Latin | <i>Ailurus fulgens</i> |
| English | Red panda, gold panda, bright panda, lesser panda, bamboo cat or fire cat |
| Dutch | Rode panda |
| German | Roter panda |
| French | Panda roux |
| Spanish | Panda rojo |

Table 1. Common names of the red panda in Latin, English, Dutch, German, French and Spanish

1.2. Morphology

Ailurus lives in the montane mixed deciduous-conifer forests of the Himalayas and the major mountain ranges of south-western China. It is solitary, rest for most of the day, and scansorial, coming to the ground to eat bamboo and retires to the trees to sleep and nest. It is well adapted morphologically and physiologically to a consistently cool and moist environment.

1.2.1. Body size

Adult *fulgens* have a head and body length of 45-60 cm and a tail of 30-35 cm length. The red panda tend to be smaller than Ryan's red panda (*Ailurus Styani*). Average weights for adult *fulgens* ranges between 4.5 and 5.5 kg, weights for *Styani's* ranges between 6.5 and 7.5 kg. Females are generally smaller and lighter than males.

1.2.2. General description

Besides the size, are the differences between the two species minor. *Ailurus Styani* has more robust teeth and the skull is a little bit bigger than *fulgens*. There are also some minor differences in pelage of *fulgens*. Juvenile red pandas have different body colours than adult pandas, as seen in figure 1. Figure 2 show differences in facial patterns of red pandas (SHRESTA ET AL, 2015). *Ailurus* have erect, triangular-shaped ears, covered with white hair on the ventral side and red or orange brown hair of the dorsal side and rest of the body. The paws and soles of the red panda have also hair. The striped tail of the panda is a distinctive feature (GLATSTON, 2010), which is used for balance.

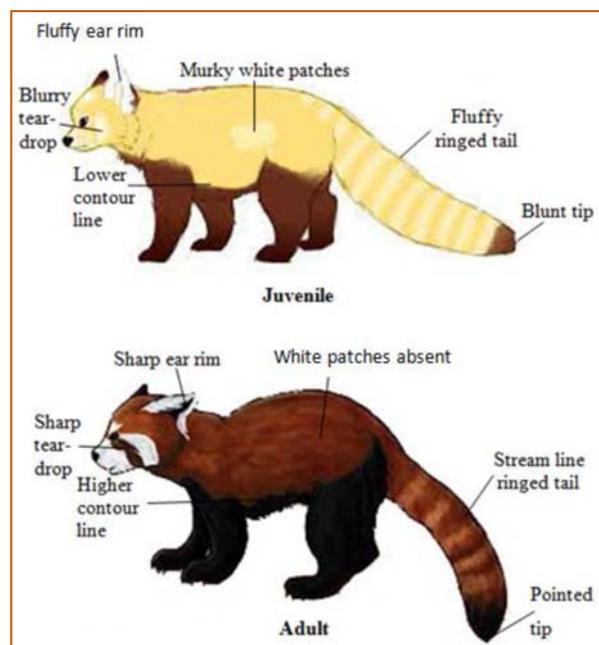


Figure 1. Difference in colours between juvenile and adult pandas (Shrestha et al, 2015)

| Name | Features | Adopted artistic conception |
|-------|---|--|
| Faint | Thin cheek mark with single layered crown. |  |
| Shiny | Cheek mark is broader and shiny. |  |
| Murky | Cheek mark is triangular and other marks clearly invisible. |  |
| Bald | White pelage coloration starting above the forehead, goes up to the muzzle, extends beyond the nose-bridge to the side of the face and tear-drops and cheek marks indistinct. |  |

Figure 2. Facial patterns of red pandas (Shrestha et al, 2015)

1.2.3. Basic anatomy

The dentition of *Ailurus* is similar to the general procyonid pattern, but exhibits significant molar hypertrophy and inclusion of supernumerary molar cusps and cusplets that enlarge occlusal surface area presumably to aid in the mastication of bamboo (ROBERTS & GITTLEMAN, 1984). The dental formula is: incisors: 3/3, canines 1/1, pre-molars: 3/3-4 and molars: 2/2. The red panda has 36 to 38 teeth.

The mandibles of the red panda are more robust compared to their body size. Features of the skull and body of the red panda are adapted to the living environment and diet. Robust mandibles are needed for chewing bamboo and can reflect the size of chewing muscles. Red pandas have less auditory sensitivity (GLATSTON, 2010).

1.3. Physiology

Morphological and physiological adaptations of *Ailurus* are specialized for a high altitude temperate environment and a bamboo diet. The red panda has dense fur (extending to the soles of the feet) and a low metabolic rate. It is also capable of lowering its metabolic rate in cooler conditions. It also has the capability to reduce its metabolic rate without lowering its body temperature apparently as a conservative energetic strategy.

While the red panda feeds primarily on bamboo, its diet is more seasonally variable than the Giant panda (*Ailuropoda melanoleuca*), another bamboo specialist, in that berries, fruits and even young leaves and bark are eaten (ROBERTS & GITTLEMAN, 1984).

The red panda has been classified as Vulnerable C1 by IUCN because its population in the wild is estimated at fewer than 10,000 mature individuals with a continuing decline of greater than 10% over the next 3 generations ([WANG ET. AL., 2008](#)). The status will be re-evaluated in 2015. Although red pandas are protected by national laws in their range countries, their numbers in the wild continue to decline mainly due to habitat loss and fragmentation, poaching and a possible inbreeding depression ([WEI ET AL. 1998](#)). In captivity there were 139 males, 169 females and 2 unknown with a total of 311 individual red pandas present in EAZA Zoos in 2012 ([WEERMAN, 2013](#)).

1.3.1. Digestive system

Red pandas belong to the order *Carnivora* and are the only species in the family Ailuridae. Red pandas have a simple stomach, with no cecum and a short gastrointestinal tract ([STEVENS & HUME, 1995](#)). These are adaptations for the easily digestible foods that usually form the diet of carnivores (i.e., meat). However in the wild, red pandas have specialized in a diet of bamboo leaves and shoots that could account for ~95% of the total food consumed. In autumn, their diet also contains fruits, acorns, and mushrooms ([WEI & ZHANG, 2011](#); [WEI ET. AL., 2000](#); [WEI ET. AL., 1999](#)).

In the wild, in order to thrive it is suggested the red panda selects high-quality portions of the bamboo like the tender leaves and shoots. However due to a rapid passage rate, they have to ingest large quantities (1.5 kg of leaves and 4 kg of shoots, as fed) to maximize nutrient intake and absorption ([WEI & ZHANG, 2011](#); [WEI ET. AL., 1999](#)). The simple structure of their digestive system limits the ability to process this high fibrous diet. To cope with this, red pandas have developed several morphological, physiological, and behavioural strategies: 1) skull and teeth adaptations for effective mastication, 2) ability to select the most nutritious parts of bamboo, 3) daily consumption of large amounts of food and rapid passage time of digesta to maximize the rate of energy intake, and 4) low metabolic rate that reduces energy requirements ([WEI ET. AL., 1999](#)).

1.3.2. Reproductive physiology of female pandas

The reproductive system is the same as the giant panda, but there are also similarities of the reproductive system of raccoons and skunks ([NORTHROP AND CZEKELA, 2011](#)). The reproduction system includes the same organs as human, including an uterus and ovaries. Glands that are associated with the reproductive system are absent or reduced. The placenta of the red panda have never been studied. The gestation time of red pandas is not exactly known, because a fertilized egg does not implant directly on the wall of the uterus, but remains in the uterus for varying lengths of time. This is known as a delayed implantation.

1.3.3. Reproductive physiology of male pandas

The testes forms rounded protuberances in the perineum. There is no scrotum present. The penis and baculum are relatively small, the baculum is only 23mm. Red pandas have a small prostate gland. The Cowper's gland is not present, as well as the glands of the ductus deferens and ampullae ([FISHER, 2011](#)).



1.4. Longevity

The lifespan of red pandas is longer for pandas in captivity than in wild. The average life span is 8-10 years in wild and 15-20 years in captivity, the oldest captive red panda was 21 years. Red pandas in captivity are treated by human, which means that there is always food available and diseases can be prevented or treated. Pandas older than 12 years are geriatric pandas. Pandas mostly die during winters, probably caused by stress when kept in indoor enclosures ([GLATSTON, 2010](#)).

1.5. Zoogeography and ecology

A.f. fulgens are found in the western part of the red panda's range, including India, Nepal and Myanmar. *A.f. Styani (refulgens)* are found in the eastern part of the range, primarily China.

1.5.1. Distribution

Red pandas have a large range that extends from western Nepal to northern Myanmar. The species also lives throughout mountainous areas of south-western China (Yunnan, Sichuan and Xizang provinces) at elevations between 4,900 and 13,000 feet. Figure 3. shows the distribution of the red panda in the map of Asia.



Figure 3. Distribution of *Ailurus fulgens*

1.5.2. Habitat

Red pandas live in temperate forests in the foothills of the Himalayas. The temperature in this region is generally cool, and there is little annual variation. The southern slopes of the mountains trap the water from seasonal monsoons, supporting forests of firs, deciduous hardwoods, and rhododendrons. A bamboo understory grows in these forests and provides the bulk of the red panda's diet. However, these swaths of bamboo are only found in narrow bands throughout the red panda's range. Thus, although red pandas are distributed across thousands of miles of territory, they are restricted to these small, fragile areas because of their dependence on the bamboo plants ([ROBERTS, 1992](#)).

1.5.3. Population and conservation status

At species level the red panda is currently listed as Vulnerable on the IUCN Red List of Threatened Species. Their actual numbers are far from clear although it has been suggested that a maximum of 10,000 individuals, both (sub)species combined, may still survive. This estimate is probably optimistic.

1.5.4. Threats

Despite protection, red pandas are still subjected to habitat loss and fragmentation, disturbance and illegal killing. These threats are not likely to disappear in the near future particularly as the local human populations continue to move deeper into the mountain areas. As a result the remaining individuals live in highly fragmented subpopulations, some of which are sufficiently small to be vulnerable to stochastic threats associated with small populations, such as genetic drift and inbreeding, random variations demographic parameters and natural and human caused catastrophes. The long term survival of red pandas in the wild may very much depend on human intervention.

1.5.5 Conservation actions

A well-managed global ex situ programme for the red panda can therefore contribute to a more viable in situ population in the following way:

Directly contribute to the conservation of the species by:

- Providing a genetically and demographically sustainable and behaviourally competent backup population for the wild population.
- Holding the potential to supply individuals for genetic or demographic supplementation or reintroduction programmes.

Indirectly contribute to conservation of the species by:

- Education and the raising of public awareness regarding the biology and conservation of the red panda
- Providing financial, technical, scientific and other support and expertise to the planning and implementation of in situ conservation and research work.

1.6. Diet and feeding behaviour

1.6.1. Food preference

The red panda is a vegetarian carnivore and is classified as carnivore, by its jaws, teeth and feet. Around 95% of the diet of the red panda consists of bamboo. Primarily young, tender, green bamboo leaves ([JOHNSON ET AL, 1988](#)), but sometimes also berries, blossoms, bird eggs, insects and fruit when weather is warm. Because bamboo has a low nutritional value, red pandas have evolved a low metabolic rate, which is comparable to sloths.



1.6.2. Feeding

Pandas have to spend to thirteen hours on foraging; searching and eating ([NOWAK, 1999](#)), mainly during dawn and dusk. Red pandas rest in trees during the day, but forage for food on the forest floor. Pandas have a small, bony projection on their wrists and sharp claws to grip bamboo. The panda chews the bamboo thoroughly, while the giant panda hardly chews at all.

1.7. Reproduction

1.7.1. Sexual maturity

Sexual maturity of the red panda is measured at the age when they can reproduce. Young become independent at the approximate age of 8 months. The mother will start a new breeding season. Red pandas are sexual mature at an average age of 18-20 months for both males and females. The first age of birth is around 24-26 months ([NORTHOP AND CZEKELA, 2011](#)).

1.7.2. Reproductive cycle of females

The inter-birth interval of red pandas is around 12 months. There are two reproductive cycles: the oestrus cycle and ovarian cycle. The oestrus cycle consists of physiological changes by reproductive hormones. The ovarian cycle consists of two phases, which are separated by ovulation. The first phase is the follicular phase; a phase for follicular development. Subsequently, the luteal phase starts: progesterone that signifies ovulation and sustains pregnancy ([NORTHOP AND CZEKELA, 2011](#)).

Females come into oestrus for around two weeks. Pandas are poly-oestrus or mono-oestrus ([STEINMAN ET AL, 2006](#)). Poly-oestrus cycles occur during a specific period of the year (for example: summer or winter) and mono-oestrus cycles means that ovulation takes place once a year. A single oestrus reduces the probability of successful pregnancy. Oestrus occurs during the breeding seasons from January till June, but mostly in late winter. Evidenced is that female pandas are poly-ovular, because 48% of all birthing result in two cubs ([HOWARD ET AL, 2006](#)). Urinary oestrogens during the peri-oestral interval show an increase in activity of oestrogen that can be detected 10 days before peak levels. Changes in hormones between pregnant and non-pregnant pandas are similar, which means that all behaviours that are driven by hormones are the same ([KERSEY, 1999](#)).

1.7.3. Reproductive hormones in males

Male pandas are solitary and almost never encounter other pandas outside the breeding season. During breeding season are noticed some changes in urinary glucocorticoids and androgens. Levels of androgen activity peaks prior to the breeding season ([STEINMAN ET AL, 2006](#)). Males have the choice to mate with different females, but it is unknown whether males mate with different females ([KERSEY, 1999](#)).



1.7.4. Gestation period and birth rate

The average time of gestation is 135 days, but varies from 112 to 158 days ([ROBERTS AND GITTLEMAN, 1984](#)). There are no signals of gestation during the first part of gestation period, but start in the second part of gestation. The female become higher in weight and bigger in size. Females are very vigilant during this period, restless during periods of rest and there is an increase of feed intake, water intake and urination.

1.7.5. Birth

Two weeks before birth starts the female to build a nest. Hay, grass, leaves and branches are used as nest material. The female is very active during this period. When birth starts, in late spring and summer, 1-4 cubs can be born, usually two young. The ratio of sexes is equal ([PROOIJEN, 1983](#)).

1.7.7. Development

Young grow up with their parents till the next breeding season. Both parents are ready to mate and reproduce again. The male will show some aggressive behaviour to the young when the next breeding season starts.

1.8. Behaviour

1.8.1. Activity

Pandas are less active during days and more active during dusk, dawn and night. The level of activity depends on temperature, feeding regimes and breeding season. Red pandas communicating by way of noises: snorts, huffs, barks, bleats, short whistles and squeaking. After waking, the panda clean their fur, back and belly and subsequently patrol their territory. The panda curls up like a cat when sleeping and generally sleep in evergreens or tops of limbs.

1.8.2. Locomotion

Movement on the ground is bear-like by slow, cross, extension movement and also faster bounding or trotting. Red pandas travel a few hundred meters per day. Tree climbing is extremely agile, because red pandas have flexible pelvic and pectoral girdles. Head always goes first when climbing, gripping trunk with hind claws. The tail is used for balance.

1.8.3. Predation

The primary predator of red pandas is the Black Leopard. Red pandas climb in trees when threatened. Red pandas have killed fawns of muntjac ([GLATSTON, 2015](#)).

1.8.4. Social behaviour

Red pandas are individual living animals, but commonly travel in pairs or small groups of family. Males show more territorial behaviour than females. Males have a larger ranges than females and spend more time on protecting and patrolling their territory, while females mostly stay within the middle of the territory. Both mark their territory with fluid that is released from pores on the base of their feet.

1.8.5. Sexual behaviour

Red pandas rarely interact with each other, except during breeding seasons. This season starts during winters and lasts for one to three days. The scent-markings increase during this season, by urinating or rubbing their anogenital area on trees. Aggressive behaviour occurs mainly in breeding seasons, by fighting over rest or nest places ([ZIDAR, 2008](#)). Females will invite males for sexual interactions.

After sexual interaction will pandas groom each other, but the male leaves the female after mating. The female carries nest materials and builds a nest several days before parturition.



2. Zoo management

2.1 Housing

Careful consideration should be given to exhibit design so that all areas meet the physical, social, behavioural, and psychological needs of the species. Animals should be displayed, whenever possible, in exhibits replicating their wild habitat and in numbers sufficient to meet their social and behavioural needs.

Zoos holding panda's for the first time should submit plans of their proposed enclosure to the EEP coordinator for approval before they receive the animals.

2.1.1 Ambient Environment

Temperature and Humidity: Temperatures at the upper range are of more concern with red pandas than thermal lows, therefore, 50 % of the enclosure should be in shade throughout the day, particularly when temperature is above 23.8°C ([ROBERTS, 1980](#)). Heat stress in red pandas is greatly exacerbated by high humidity. Air-conditioned indoor holding or nest boxes should be provided where temperatures get above 28°C for prolonged periods, especially with high humidity. Zoos subject to hot summer months should provide mist sprays or air-conditioned inside accommodation to keep the animals cool ([UNKNOWN, 2008](#)).

A minimum of three nest boxes (n+1) should be provided which should be situated at different locations within the enclosure. At least two of these nest boxes should be well insulated and placed in shaded locations in the enclosure so as to maintain an interior temperature not exceeding 20°C. Cool nest boxes should be available in countries where summer temperature is regularly above 23°C for prolonged periods, e.g. where average summer temperature is 23°C and above ([GLATSTON, 2015](#)).

Light: Red pandas should be housed in outdoor exhibits with access to inside quarters if climactic conditions (e.g., extreme heat) warrant it. Animals should never be locked in holding quarters for extended periods of time (1 month or more, unless a mother with cubs) therefore artificial lighting is not required. If for some reason, such as in quarantine, animals are kept inside, they need to be subject to natural daylight and day length.

Water and Air Quality: Red pandas are a terrestrial species that do not require water systems. However, fresh water should be available to all animals at all times of day. Care should be taken so that sufficient water is available and freezing is avoided. When there is no fresh potable water available in the exhibit, sturdy bowls that are not easily overturned are usually suitable for providing water. Animals with restricted water intake will also decrease food intake, so the availability of fresh water is very important ([ROBERTS & GLATSTON, 1994](#)). Air exchange rate needs are not generally applicable since red pandas are usually housed outdoors. When facilities think indoor enclosures are necessary please contact the EEP coordinator to discuss this subject.



Sound: At this time, it is unknown for red pandas what the tolerances are for sound and vibration, however, as with any wildlife, those disturbances should be kept to a minimum. Noise should be minimized before and after parturition. If air conditioning is used, the unit should be on at least one month prior to parturition to allow for acclimation.

2.1.2. Habitat Design

In captivity red pandas are nocturnal and crepuscular and exhibit a polyphasic activity pattern throughout the night. Their activity patterns change throughout the year in response to temperature, feeding regimes, and the presence of young ([ROBERTS & GLATSTON, 1994](#)). Their gross behavioural repertoire includes scent marking, a tendency to maintain personal distance except during breeding season, the tendency to climb and hide from disturbing/frightening elements such as loud noises, natural foraging feeding activities, breeding associated activities, young rearing behaviours, and sleep. To accommodate these behaviours and others, enclosures should follow these guidelines ([ROBERTS & GLATSTON, 1994](#)).

Environment: Red pandas should be housed in outdoor enclosures (indoor enclosures should also be provided where extreme weather conditions indicate that these are required). Where indoor quarters are provided the animals must have access to the outdoor facility at all times (24 hours/day)

As animals will graze grasses and forbs; it is recommended that at least 50% of the enclosure be planted with (edible) grasses. Red pandas prefer to rest on elevated perches above the level of the viewing public, so attention should be given to furnish the animals with this possibility by providing a variety of climbing structures and resting perches at various locations and heights in the enclosure. Living trees are preferable as these provide shade and climbing opportunities. The environment should include rocks, trees, pools, logs, clumps of vegetation etc. These will provide both adequate shade and facilitate the animals' need to withdraw from the direct gaze of the general public at times ([UNKNOWN, 2008](#); [ROBERTS & GLATSTON, 1994](#)).

Enclosures require a floor area of at least 80 m², preferably more, and should have climbing structures. The size enclosure required is related to the situation of that enclosure within the zoo. It is recommended that the minimum enclosure size only to be used in very quiet situations of where the public is separated from the actual edge of the enclosure by a fence or a plant border ([UNKNOWN, 2008](#)).

Public access should be restricted to one, or at most two, sides of the enclosure so that animals can retreat from public disturbance. The size of the enclosure and its location within the zoo should be taken into account when planning public access: a large enclosure in a quiet location can have access around a greater proportion of the perimeter than a small enclosure in a busier area. Following parturition red panda females become increasingly intolerant of public disturbance and provision should be made to reduce public disturbance after birth ([UNKNOWN, 2008](#); [ROBERTS & GLATSTON, 1994](#)).



Enclosures should not be located near aggressive animals, which can disturb the red pandas: a distance of at least 50 m between a red panda exhibit and that of a large carnivore is recommended. Also, red pandas should not be situated close to busy traffic routes or noisy gathering places. However, enclosure size is an important parameter: animals housed in large enclosures can probably tolerate more disturbance from traffic or the public than those in small ones ([UNKNOWN, 2008](#); [ROBERTS & GLATSTON, 1994](#)).

Pandas generally prefer to rest and sleep alone except during breeding season. Exhibits should be designed with this behavioural norm in mind. Pairs of pandas should not be housed closer than 10 m from one another. Visual barriers should be placed between adjacent pairs ([UNKNOWN, 2008](#); [ROBERTS & GLATSTON, 1994](#)).

Scent marking is important for this species. Scent-marking anal glands are present in most carnivores, and red pandas possess a pair that empty into the distal aspect of the rectum. Also on the plantar surface of the feet there are a series of small pores from which small amounts of clear, colourless, and odourless fluid appears of uncertain function ([FISHER, 2011](#)). Because of the tendency to mark their environment, furniture/substrate in red panda enclosures should be allowed to build up scent posts. However, these areas should be monitored and cleaned on a rotating basis.

For a more natural feeding scenario mechanisms to fasten bamboo to trees, or other upright structures should be incorporated into the exhibit. One inch or less diameter PVC pipes are recommended.

Nest Boxes: A minimum of 3 nest boxes should be provided to allow hiding and sleeping choices for the animals within the enclosure. These should be constructed of insulating material and placed at different shaded locations in the enclosure. Some part of the enclosure is to be in shade throughout the day to provide animals relief from the radiant heat of the sun ([ROBERTS & GLATSTON, 1994](#)).

Nest boxes ranging from 61 cm wide x 91 cm long x 51 cm high, up to 92x127x76 cm have been used in zoos.

2.1.3. Barriers and Containment

Barriers may be constructed of mesh, walled, moated and fenced, glass screened or any combination thereof that does not endanger the health and safety of the animals. Red pandas are not only very good climbers but they can also swim very well, enclosure barriers should be constructed with this in mind. Barriers should be at least 1,5 m in height, and the surface should be very smooth or should be topped with a smooth overhang. Water moats should only be used in combination with other barriers. In the winter, moats should be drained to avoid freezing unless the surrounding barriers meets the criteria outlined above. It is important that branches of climbing trees are not allowed to overhang the boundary fence ([UNKNOWN, 2008](#)). Beware: red pandas are escape artists.



It has not been determined if hotwire is an effective barrier. Evidenced so far is that panda ignore hot wire. However, hotwire could be used in some cases to keep wildlife from entering the exhibit.

2.2. Capture and Transport

Animal transportation must be conducted in a manner that is lawful, safe, well planned, coordinated, and minimizes the risk to animal(s), employees and general public. Safe animal transport requires the use of appropriate means of transport and equipment that is in good working order.

The equipment must provide for the adequate containment, safety, physical, behaviour and psychological needs of the animal(s). Transport protocols should be well defined and clear to all animal care staff.

Red pandas should only be transported in spring or fall, ideally in temperatures between 5–16°C.

Capture: Prior to capture it is helpful if the trees can be made inaccessible to the animals. This can be achieved by tacking a flexible sheet of plastic, 50 cm wide around the trunk of the climbing trees. Hand restraint is not recommended. Red pandas can be safely and easily captured using a net.

After capture red pandas should always be weighed. When animals are transferred to a new exhibit/zoo, its identification chip should be checked. Pandas are often mis-sexed, especially as infants. It is strongly recommended, whenever a red panda is transferred to your zoo from outside, or even when it is transferred between exhibits in your own zoo, that its sex is checked.

Shipping: Red pandas should always be shipped individually. Red pandas should be transported in an IATA recommended crate (50 cm long x 40 cm wide x 45 cm high). One of the short sides of the crate should be made of cage wire for ventilation. Sky kennels or similar airline approved plastic pet carriers work well. Modifications should be made to prevent airport personnel from accidentally opening crates. Any doors of the sky kennel should be secured with zip-ties on all four corners. Mesh ventilation panels and doors should be loosely covered with an open weave fabric such as burlap to provide privacy without overly restricting airflow.

Each crate should contain a layer of wood wool or similar bedding material. In the event of a longer journey the animal's normal diet can be sent along during transport to provide familiar foods. If being transferred to another institution, sufficient food to transition to an alternative diet should be provided as well. Food and water containers should be securely fastened to the door of the crate with access from the outside to add or refill. Red pandas do not need to be sedated during transport.



2.3 Feeding

A formal nutrition program is recommended to meet the nutritional and behavioural needs of all red pandas. Diets should be developed using the recommendations of nutritionists, veterinarians as well as EAZA Taxon Advisory Groups (TAGs), and European Endangered species Program (EEP). Diet formulation criteria should address the animal's nutritional needs, feeding ecology, as well as individual and natural histories to ensure that species-specific feeding patterns and behaviours are stimulated.

2.3.1. Requirements

Energy: Animals require energy for basal metabolic functions, in a resting, unstressed, post-absorptive state, in a thermo-neutral environment (no shivering or special activity to maintain body temperature). Basal energy expenditure is related to body surface; Kleiber (1975) concluded fasting homeotherms produce 1,000 kcal of heat per square meter body surface. Kleiber (1975) used previously published research to establish the equation $70BW^{0.75}$ to express kilocalories needed per day for basal metabolic functions.

Red pandas vary their intake of shoots and leaves relative to seasonal changes both in the wild and in zoos. It was noted by McNab (1988) that the red panda have a low rate of metabolism, which is only 39% of the value predicted by the Kleiber equation at ambient temperature of 25–30°C.

Seasonal Influence: Red pandas have a higher energy requirement in the winter months and probably also in late gestation, during lactation and especially during growth. During these times the animals should always be fed ad libitum or enough so as to have at least 3% of the total food offered is left uneaten ([NIJBOER & DIERENFELD, 2011](#)).

Body Condition: Wild red panda (*Ailurus fulgens*) weights range between 3–5 kg ([NOWAK, 1999](#); [MACDONALD, 1999](#)). Adult *A. fulgens* (in zoos) with a body weight of between 5–6 kg have been found to consume between 145–200g of nutritionally complete biscuits (as fed) each day. This represents intake of animals in a maintenance situation, (e.g., when the animals were under little stress from the weather, not pregnant or lactating, and in the absence of any other food item) ([NIJBOER & DIERENFELD, 2011](#)). Due to their dense hair coat and body shape, it is difficult to determine a standard body condition score for red pandas. Periodic photos taken in the same position, over time, may be helpful to pair with weights, as an assessment of body condition.

Nutrients: In Table 4 the target nutrient levels for the red pandas are presented. These requirements are calculated for one adult animal of average weight per day. Be aware to look at the animal itself and its BCS, nutritional requirements always vary per individual.

| Nutrients | Recommended minimum level (dry matter basis) |
|--------------------|--|
| Crude protein (CP) | 18.0% |
| Fat (EE) | 5.0% |
| Fibre (ADF) | 10.0% |
| Calcium (Ca) | 0.75% |
| Phosphorous (P) | 0.6% |
| Sodium (Na) | 0.15% |
| Potassium (K) | 0.65% |
| Magnesium (Mg) | 0.1% |
| Iron (Fe) | 100.0 ppm |
| Copper (Cu) | 8.0 ppm |
| Manganese (Mn) | 40.0 ppm |
| Selenium (Se) | 0.18 ppm |
| Zinc (Zn) | 50.0 ppm |
| Thiamine | 2.5 ppm |
| Riboflavin | 5.0 ppm |
| Vitamin B6 | 2.0 ppm |
| Vitamin B12 | 30.0 ppb |
| Niacin | 30.0 ppm |
| Folate | 600.0 ppb |
| Biotin | 100.0 ppb |
| Choline | 1250.0 ppm |
| Pantothenate | 15.0 ppm |
| Vitamin A | 8000 IU/kg |
| Vitamin E | 220 IU/kg |
| Vitamin D | 800 IU/kg |
| Linoleic Acid | 1% |

Table 2. Target nutrient levels for red pandas (Unknown, 2008)

2.3.2. Diet

Dietary ingredients should be fresh and of good quality. Fresh water should always be available. Every effort should be taken to avoid spoilage of the food during warm weather and freezing during cold. Offering bamboo with a dry biscuit should help eliminate these kinds of problems. To further reduce this problem it is suggested that the animals are fed at least twice per day; at these times fresh food should be provided and the old food removed ([NIJBOER & DIERENFELD, 2011](#)). This will help minimize the impact of desiccation, by keeping fresh, hydrated product available through the day. When animals are housed together it may be important to offer food in more than one bowl and in several locations. This will ensure that all animals will have access to the same food items and will help prevent one animal from potentially dominating the food situation and excluding others from the more nutritious components of the diet ([ROBERTS & GLATSTON, 1994](#)).

In order to monitor food uptake and prevent diseases it is recommended that food be presented in such a way that it is inaccessible to vermin ([UNKNOWN, 2008](#)).

Bamboo: If possible 200g of fresh bamboo leaves should be offered daily to each animal. Preferable presented as branches. The preferred sorts are *Pseudosomas* spp., *Phyllostachys aureosulcata*, *P. Japonica*, *P. bissetii*, *P. nuda* etc.

It is desirable to obtain representative samples of the bamboo offered throughout the year and to have them chemically analysed. Such an analysis is best conducted in a forage laboratory like those of the local university of agricultural agencies. Protein (CP), fat (EE), acid detergent fibre (ADF), calcium (Ca) and phosphorus (P) are the main nutrients needed. If bamboo samples are similar in composition to the biscuit portion of the diet (no less than 18% protein, 0.5% Ca and 0.4% P in a 1:1 to 2:1 Ca:P ratio) then more bamboo may be offered than the recommended 200g of bamboo leaves, up to a maximum of 400g.

If bamboo is unavailable or seasonally available then fibre must be incorporated into the concentrate portion of the diet (the biscuit). If an appropriate biscuit is not provided than an additional fibre source such as ground beet pulp must be provided in some acceptable form (possibly unsweetened gruel) or through an adequate source of grass and plants in the enclosure ([NIJBOER & DIERENFELD, 2011](#)).

Biscuit/gruel: Based on current feeding ecology information, red pandas should be offered apart from a large quantity of bamboo, a nutritionally balanced diet of good quality nutritionally complete biscuits. The nutrient profile of this biscuit should consist of: protein 23%, fat 4.5%, acid detergent fibre 13%, Calcium 1.0%, Phosphorus 0.6%) ([ERIKSSON, 2012](#); [PRADHAN, 2001](#); [WEI ET. AL., 1999](#); [WEI ET. AL., 2000](#)). Frequent weighing and adjustment of the biscuit portion of the diet is recommended based on weight, condition, intake, and behavioural observations.

Red pandas that are “off” their food (this can occur in varying circumstances) can be tempted to eat by soaking their biscuit in water or apple juice, making a sweetened gruel or by smearing their biscuits with a sweet product. It is important that the sweetener/gruel is withdrawn from the diet as soon as possible to avoid dental problems ([NIJBOER & DIERENFELD, 2011](#)).

Young pandas around the time of weaning are susceptible to death through starvation. Such deaths have been reported in young pandas between 5 -7 Months. It is important to check young pandas regularly at this time. Young animals which are not accepting the normal diet adequately should be provided with a sweetened gruel and extra bamboo at this time. They can be weaned onto the normal diet gradually.

Fruit: These are nutritionally not important to the diet of the red panda. In fact, they can be harmful especially if offered in large quantities, as they will dilute the nutrients in the biscuit thus lowering the nutrient content of the diet ([FULTON, 1987](#); [NIJBOER & DIERENFELD, 2011](#)). In addition, fruits provide readily fermentable carbohydrate and little fibre, which is not appropriate for the gastrointestinal health of the red panda.



Fruit can be useful in small amounts as a training reward or when providing medications to the animals as undesirable substances can be presented in a palatable form ([NIJBOER & DIERENFELD, 2011](#)). Many red pandas readily accept apples and bananas, but all produce should be fed very sparingly as it can cause the animals to become overweight.

Provision of Food and Water: Fresh water needs to be available to all animals at all times of day. Care should be taken so that sufficient water is available and freezing is avoided. Where there is no fresh potable water available in the exhibit, sturdy bowls that are not easily inverted are usually suitable for providing water. Animals with restricted water intake will also decrease food intake so the availability of fresh water is very important.

2.3.3. Diet evaluations

Increased or decreased requirements for illness, thermoregulation, or activity can be met by offering diets ad lib and monitoring body weight and condition over time. In general, diets should be offered so that a small amount of food is remaining at the end of the feeding period; however this should be managed on an individual basis to avoid obesity.

Analysis of weight fluctuations can be a valuable tool for managing individuals and populations. Weight changes can reflect nutritional problems (e.g., obesity and under-conditioning), illness (e.g., cancer, organ failure, etc.), changes in reproductive condition (e.g., pregnancy or weight loss during lactation), and hormonally or environmentally induced changes in metabolism (e.g., prior to dormancy and the onset of the breeding season). Correlating weight changes with key life history parameters will enable animals to be managed much more effectively and efficiently.



2.4. Social Environment

Dates of the formation of a pair and/or separation of animals and dates of mating are to be recorded and made available on request to the EEP Coordinator. Changes in pairing are to be discussed with the EEP Coordinator.

2.4.1. Group Structure and Size

Careful consideration should be given to ensure that animal group structures and sizes meet the social, physical, and psychological well-being of those animals and facilitate species-appropriate behaviours.

Breeding pairs should remain together 24 hours per day throughout the year. The male should remain in the enclosure with the female after birth unless there are obvious signs that he is interfering with or inhibiting normal maternal care.

Young may remain with the parents at least through the next breeding season and up to one month prior to the next anticipated birth. Juveniles should not be separated from their parents earlier than about 7 months of age (February in Europe) to ensure proper socialization and weaning ([UNKNOWN, 2008](#)). The young should be remained together after separation until they are placed in breeding pairs, juveniles of more than one litter can be housed together. Singletons should be housed with other young to ensure socialization, every effort should be made to locate other similar aged young for this purpose. When young of more than one litter are housed together they should be individually marked.

Adult males (>1 year old) are not to be housed together in the presence of a female. Even when no female is present, all male groups can be difficult and are best attempted in large enclosures and should be monitored closely. Male siblings who have been together since birth can be usually maintained successfully as groups in the absence of females.

Temporary (when no other pairing options are available) trios of one male and two females may be assembled for breeding purposes providing that one female is separated from the group in April. It is emphasised that pandas should only be held in trios where no other option is possible and that this is a temporary measure ([UNKNOWN, 2008](#)).

2.4.2. Influence of Others

Red pandas are typically maintained in single species exhibits. In 2010, the zoos that were holding red pandas at that time were asked if they were or had held pandas with other species. The following table 3 shows what species have been exhibited with red pandas and any considerations or problems that occurred.

| Common Name | Scientific Name | Considerations / problems |
|-------------------|----------------------------|---|
| Chinese Muntjac | <i>Muntiacus reevesi</i> | <ul style="list-style-type: none"> • Both species share the exhibit during the day; the pandas are closed into their shelter and separated from the muntjac overnight. • Need a nice slow intro- then non-breeders seem to do fine. • A muntjac ended up breaking its leg trying to get out of the exhibit and panicking with people around. • During breeding season for the pandas, pandas sometimes became aggressive. Pandas were aggressive towards muntjac fawns and can kill muntjacs. |
| Japanese Koi | <i>Cyprinus carpio</i> | <ul style="list-style-type: none"> • No problems |
| White-naped Crane | <i>Grus vipio</i> | <ul style="list-style-type: none"> • They all get along very well. Pandas stay up in the tree 90% of the time. |
| Chinese Goral | <i>Naemorhedus griseus</i> | <ul style="list-style-type: none"> • Species ignore each other. |

Table 3. Species successfully exhibited with red pandas.

Human Interaction: To a large extent, red pandas are not dangerous, however, they are more than capable of protecting themselves. Red pandas do have strong, sharp claws and a very strong bite. They are capable of causing injury when trying to climb a person like a tree. There have been a few cases of red pandas that have exhibited aggression towards keepers, most commonly with hand raised individuals. In case of aggression ability to shift the animal to another area for cleaning is recommended. Red pandas have been successfully trained to enter holding areas or crates, to station on scales and even to hold for injections, palpation, and vaginal swabs.

2.2.3. Introductions

Red panda introductions rarely result in aggression, but should be done gradually nonetheless. It is better to introduce a male to a female once she is established in the enclosure. Gradual introduction (e.g., olfactory, followed by visual, followed by physical contact) in neutral territory is preferred. Providing distractions (e.g., bamboo or treats spread through the introduction area) can help ease introductions. Care should be taken not to provide areas where one animal can corner another.

Pair formation should occur no later than the end of November, 6 weeks prior to the onset of the breeding season, which occurs in the late winter months in captive populations of the northern (January – March).

2.5. Breeding

It is important to have a comprehensive understanding of the reproductive physiology and behaviours of the animals in your care. Hand rearing in general is not practised in European zoos, however if the EEP coordinator finds it necessary, information about hand rearing of red pandas is presented in appendix III.

2.5.1. Reproductive Physiology

Per studbook data, both male and female red pandas will reach sexual maturity in approximately 1 year and 7 months (in the second breeding season after birth). In Europe Red pandas breed in the late winter months, between January–March. Red pandas give birth in late May – early August after a gestation of from 114 to 145 days ([NORTHROP & CZEKALA, 2011](#)).

2.5.2. Pregnancy and Parturition

It is extremely important to understand the physiological and behavioural changes that occur throughout an animal's pregnancy. The average gestation of red panda cubs is from 114 to 145 days ([NORTHROP & CZEKALA, 2011](#)). Ultrasounds have been successful in determining pregnancy, but are NOT recommended as they require anesthetizing the pregnant female. Some research is occurring on running faecal assay hormones to determine pregnancy and more research in this area is required.

There are very few signs of impending parturition, decreased activity about 1 month before birth has been observed. Increased appetite is common, and diet increases are recommended. A change in gait will be noticed, such as a distinctive waddle, within a week of cubbing. The female may build nests in the nest boxes with any available material, but this is not always the case. Nests can be elaborate with multiple materials, or simple with just a few leaves. Nest materials should not be removed, if faecal material is present, the faeces should be removed. Within one or two days of birth, grumpiness, restlessness and decreased appetite may be noted. Females will occasionally give birth outside of the nest boxes. In these cases, the females will usually move them into the chosen nest box on their own, but if they don't, monitor the situation and decide whether intervention is necessary.

Normally, red panda mothers spend nearly all their time in the nest box during the first weeks after parturition; cubs should be evaluated if mothers are spending excessive amounts of time out of the nest box. Red panda mothers will move cubs between nest boxes, but moving cubs excessively or constantly carrying cubs around enclosures can indicate that the female is not comfortable with nest boxes or the environment and can result in injury to cubs or cub abandonment. Additionally, mothers will sometimes cause injury to cubs due to excessive grooming.

When the occasion occurs that cubs are not getting enough milk from their mother supplemental feeding can be a better alternative than hand rearing.



2.5.3. Birthing Facilities

As parturition approaches, animal care staff should ensure that the mother is comfortable in the area where the birth will take place.

The provision of at least three, insulated nest boxes located in shaded or air-conditioned areas is recommended. Nest boxes from 60.1 cm wide x 91.4 cm long x 50.8 cm high to 91.4 cm wide x 127 cm long x 76 cm high have been used in zoos. Wood wool, straw or other appropriate bedding should be provided for all nest boxes.

The female should be left in her familiar enclosure with the male. Following parturition red panda mothers become increasingly intolerant of public disturbance and provisions may have to be made. Since containment may be altered for the cub's safety, other measures may need to be taken.

2.6. Veterinary Care

Adequate, qualified medical care must be provided by the exhibiting institution. Care is to be provided by qualified veterinarians either on a full time or a consulting basis. The institution's veterinarian is encouraged to contact other holding zoos to discuss medical practices.

The exhibitor should notify the owner and studbook keeper of significant medical problems. Optional medical procedures should be discussed with the owner's veterinary consultants; emergency procedures should be discussed after the fact.

Blood and other tissue samples should be made available (at the zoo veterinarian's discretion) on request of the EEP Coordinator, for genetic analysis or for the monitoring of physiological parameter ([UNKNOWN, 2008](#)).

2.5.1. Routine Health Inspections

Careful observation by caretakers or medical staff of physical appearance and health should be performed on a daily basis. Suggested weights for red pandas of different size are presented in appendix I. Animals which appear to lose weight or do not look in optimal condition are in need of diet enhancement or medical attention. When weighing the animal it is recommended to train the animal to get up on the scale on command, so that the procedure is as little invasive as possible.

Red pandas are very susceptible to canine distemper, which is always fatal. Prevention of exposure to canine distemper and vaccination against the disease is critical. Red panda should never be vaccinated with live or modified live virus vaccine, only killed virus vaccines—Purvax® from Merial pharmaceuticals are being used in North American zoos.

Ideally, an initial series of vaccinations should start at 8 weeks and be repeated every 3 weeks until 16 weeks; red pandas should be vaccinated twice a year for protection ([ROBERTS & GLATSTON, 1994](#)). However, practical considerations are also of importance, it is best to vaccinate young red pandas when

it is least likely to disturb maternal behaviour. In some cases this may mean that vaccination is delayed until at least 16 weeks.

Rabies vaccination with a killed vaccine is used in endemic rabies areas. Red pandas develop titers comparable to protective titers in domestic carnivores following vaccination with a 1 ml dose intramuscularly (IM) ([ROBERTS & GLATSTON, 1994](#)). Similarly killed vaccine products should be administered when vaccinations against feline enteritis are considered necessary by the attending veterinarian.

Parasite checks should be conducted on a twice-yearly basis. A faecal exam includes:

- A direct smear for the detection of protozoa (e.g., amoeba, ciliates) or motile larvae;
- Flotation methods for nematodes, cestodes, and coccidia;
- Sedimentation techniques for identification of various lungworm larva.

The lungworms that occur in red pandas are *Crenosoma*, *Troglostrongylus*, and *Metastrongyloides*. Most parasites are easily identified and eliminated with proper anti-parasitic therapy. The patient is treated for parasites and proven free of parasites on two successive exams.

Red pandas are susceptible to heartworm disease (*Dirofilaria immitis*) and should be treated with appropriate preventative measures in the areas where the heartworm occurs.

Red pandas are susceptible to flea infestation, especially in warm weather. There have been several instances recorded of red pandas dying from flea infestation. Even in cases of severe flea infestation red pandas should NOT be treated with a flea bath as this can result in death. It is therefore advisable that the keepers caring for red pandas are not in contact with common flea carrying species such as cats. Where this is unavoidable measures should be taken to avoid contamination of the red panda nest boxes. It is advisable to change red panda bedding regularly. When birth is imminent it is advisable to treat the floors of the nest-boxes with some preparatory anti-flea preparation to avoid this problem. Topical treatment for domestic cats/kittens generally is considered safe and effective for adults ([UNKNOWN, 2008](#)).

2.5.2. Capture and Immobilization

Red pandas can be safely and easily captured using a net. Prior to capture it is helpful if the trees are made inaccessible to the animals. This can be achieved by tacking a flexible sheet of plastic, 50 cm wide, around the trunks of the climbing trees. After capture the animal can be transported to the hospital/clinic in a plastic sky kennel. Red pandas are also easily trained to enter a squeeze/transfer cage. Some short minor manipulative procedures on red pandas (e.g., vaccinations or injectable medications) can be accomplished using physical restraint by a net, heavy gloves, or a squeeze cage ([ROBERTS & GLATSTON, 1994](#)).



Anaesthesia: Any prolonged procedure or painful manipulation is performed under anaesthesia. Pre-anaesthetic preparations facilitate the procedure and increase patient safety. Food and water are withheld for 12 hours to minimize vomiting which can cause fatal inhalation pneumonia. Confining the patient to a small dark area during induction of anaesthesia minimizes excitement and stress and lowers the amount of anaesthetic drug required ([ROBERTS & GLATSTON, 1994](#)). Qualified personnel must be employed to carry out all sedation procedures.

Dissociative anaesthetics in combination with sedatives or tranquilizers are the choice of injectable anaesthetic agents for red pandas since Ketamine (11–14 mg/kg) alone usually results in a patient with extreme muscle rigidity and minor CNS stimulations. Ketamine (5 mg/kg) is therefore combined with medetomidine (50 µg/kg).

Telazol is the anaesthetic of choice for red pandas at a dose of 4.5–6 mg/kg, which produces a rapid and safe anaesthesia with acceptable muscle relaxation. For prolonged procedures such as major surgery, supplemental injections of Telazol are given or the patient is given an inhalation anaesthetic such as isoflurane or sevoflurane ([ROBERTS & GLATSTON, 1994](#)). An induction chamber can also be used with gas anaesthesia.

When animals are immobilised for any reason, the following measurements should be taken: total length (tip of nose to tip of tail), tail length (base to tip of tail), chest girth, waist girth, hind foot length. Should a lactating female have to be sedated a milk sample should be collected for analysis in order to aid the development of a new milk substitute ([UNKNOWN, 2008](#)).

2.5.3. Diseases, disorders and/or injuries

EAZA zoos should have an extensive veterinary program that manages animal diseases, disorders, or injuries and has the ability to isolate these animals in a hospital setting for treatment if necessary. Red panda keepers should be trained for meeting the animal's dietary, husbandry, and enrichment needs, as well as in restraint techniques, and recognizing behavioural indicators animals may display if their health becomes compromised. Protocols should be established for reporting these observations to the veterinary department. Red panda hospital facilities should have x-ray equipment or access to x-ray services, contain appropriate equipment and supplies on hand for treatment of diseases, disorders or injuries, and have staff available that are trained to address health issues, manage short and long term medical treatments and control for zoonotic disease transmission ([UNKNOWN, 2008](#)).

Dental Disease is common in red pandas and is a source of bacterial entry, which may progress to tissue infection and/or septicemia. Although dental disease may not be listed as a cause of death in pathology records it can be an important underlying causative factor for poor nutrition and/or bacterial septicemia. Animals fed soft gruel diets high in carbohydrates are very prone to tartar accumulation, gingival problems which lead to generalized dental disease with loss of teeth; this can be prevented by feeding the recommended biscuit and bamboo diet. Routine dental care is indicated in all older pandas as we see dental problems such as tartar, gingivitis, chronic tooth wear, abscessed teeth, and periodontitis in most

middle aged pandas which result in loss of masticatory surfaces with resulting chronic weight loss and deterioration of physical condition. Regular removal of tartar with tooth polishing minimizes periodontitis and resultant gingival disease with its tooth loss ([ROBERTS & GLATSTON, 1994](#)).

Hair Loss is not uncommon in managed red pandas. There is a seasonal moult which hair loss can be quite pronounced, especially in the flanks and the tails. This usually occurs in the spring, but there can be individual cases where it occurs in the fall. In young pandas with focal areas of hair loss on the face, head, under the neck and feet the diagnosis of a dermatophytosis (*Microsporum gypseum*) should be considered. To treat, an Itraconazole/Fluconazole oral suspension along with a topical anti-fungal product has worked well. If there are puncture wounds from maternal carrying, antibiotic treatment should also be considered. Hair loss in older animals may indicate other skin parasites and should be scraped and/or biopsied. We have diagnosed hypothyroidism as a cause of a non-pruritic dermatitis with alopecia and obesity by thyroid biopsy and response to thyroid supplementation ([ROBERTS & GLATSTON, 1994](#)).

2.5.4. Individual Identification

ID/Recognition is considered important to the effective management of this species, therefore it is recommended that all animals should be permanently identified via transponder chip with corresponding ID number between the shoulder blades ([ROBERTS & GLATSTON, 1994](#)).

2.5.5. Post Mortem Provisions

All animals dying are to be autopsied by qualified medical staff and a full determination of the cause of death made. The post-mortem should be conducted in accordance with a standardised protocol. A copy of the recommended protocol is provided in Appendix II of these guidelines.

Detailed post mortems should be forwarded to the EEP Coordinator and the GSMP coordinator. Tissues are to be submitted to the owner institution of for special projects upon request. Disposition of the skin, skeleton and all other tissues is to be determined by the facility unless the pathologist of the exhibiting zoo determines that all remains must be destroyed. Facilities should endeavour to locate a willing recipient for each carcass should they not want to keep the carcass themselves ([UNKNOWN, 2008](#)).

Neonatal post mortems: Special attention is to be paid to neonatal deaths. The following list includes additional information that should be emphasised and obtained from neonatal animals (including aborted foetuses, stillbirths and neonates up to 30 days of age). Examine all specimens submitted including partially consumed carcasses. Use below in conjunction with the panda post mortem protocol in appendix II.

1. Obtain weight, sex and estimate degree of maturity/ immaturity.
2. Crown-rump and other measurements.
3. Examine skin and umbilicus (fix section of stump and surrounding skin in formalin); pelage – texture, colour and amount (if any) of fur.



4. Examine for external malformations (check for cleft palate, hare lip and other facial, skull, trunk and limb abnormalities)
5. Assess state of hydration (subcutaneous and serosal surfaces dry or moist) and nutritional status (record subcutaneous and body cavity fat stores as: none, moderate or abundant).
6. Examine for internal malformations (e.g. diaphragmatic hernia, cardiac abnormalities etc.)
7. Determine if animal had drawn breath using “sink test” by placing a segment of lung in 10% buffered formalin: if lung floats animal probably breathed; if the lung sinks the animal had probably not breathed (if lung proves not to be pneumonic).
8. Verify sex by examining gonads
9. Determine nursing activity by looking for and estimating amount of milk curd (white cottage cheese like substance) present in the stomach and the presence of “milk stool” (yellow-white semi-solid material in the colon) with absence of meconium (greenish-brown pasty material throughout the gastro-intestinal tract).

Proceed with the standard red panda post mortem protocol as seen in appendix II. Be sure to fix placenta or any foetal membranes if available ([UNKNOWN, 2008](#)).

2.7. Behaviour Management

2.7.1. Animal Training

Classical and operant conditioning techniques have been used to train animals for over a century. Classical conditioning is a form of associative learning demonstrated by Ivan Pavlov. It involves the presentation of a neutral stimulus that will be conditioned (CS) along with an unconditioned stimulus that evokes an innate, often reflexive, response (US). If the CS and the US are repeatedly paired, eventually the two stimuli become associated and the animal will begin to produce a conditioned behavioural response to the CS.

Red pandas are easily trained to shift, target, crate up, tolerate close visual inspection, medicate, and perform many other routine procedures. Red pandas can easily be trained to enter a nest box or shipping crate for food ([ROBERTS & GLATSTON, 1994](#)).

2.7.2. Environmental Enrichment

Environmental enrichment refers to the practice of providing a variety of stimuli to the animal’s environment, or changing the environment itself to increase physical activity, stimulate cognition, and promote natural behaviours. Stimuli, including natural and artificial objects, scents, and sounds are presented in a safe way for the red pandas to interact with. Some suggestions include providing food in a variety of ways, using the presence or scent/sounds of other animals of the same or different species, and incorporating an animal training (husbandry or behavioural research) regime in the daily schedule.



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Appendices

Appendix I Suggested Weight for Red Panda

Suggested weights for red pandas of different size are:

| Head & body length (cm) | Weight (Kg) |
|-------------------------|-------------|
| 45 | 4.3 |
| 50 | 4.8 |
| 55 | 5.3 |
| 60 | 5.7 |
| 65 | 6.2 |
| 70 | 6.7 |

Pregnant females should weigh approximately 25% more than indicated above.

Appendix II Red Panda Post Mortem Protocol

INSTITUTION/OWNER

ADDRESS COUNTRY

SUBSPECIES ID#..... ISIS#..... STUDBOOK

BIRTH DATE/AGE SEX WEIGHT (KG) (ACTUAL/ESTIMATE)

DEATH DATE DEATH LOCATION DATE OF PM

WILD CAUGHT/ CAPTIVE BORN (delete as appropriate)

HISTORY (Include clinical signs, circumstances of death, lab.work, diet & housing)

GROSS EXAMINATION

(If no abnormalities are note mark as normal, N, or not examined, NE)

GENERAL EXAMINATION (Physical and nutritional condition, pelage, subcutaneous fat stores, body orifices, superficial lymph nodes)

MUSCULOSKELETAL SYSTEM (Bones, marrow, joints, muscle)

BODY CAVITIES (Fat stores, pleura, thymus, lymph nodes)

RESPIRATORY SYSTEM (Nasal passages, pharynx, larynx, trachea, bronchi, lungs, lymph nodes)

CARDIOVASCULAR SYSTEM (Heart, pericardial sac, great vessels, myocardium, valves, chambers)

DIGESTIVE SYSTEM (Mouth, teeth, tongue, oesophagus, liver & gall bladder, pancreas, stomach, small & large intestine, anus)



SPLEEN

URINARY SYSTEM (Kidneys, ureters, bladder, urethra)

REPRODUCTIVE SYSTEM (Testes/ovary, uterus & cervix, penis/vagina, accessory sex organs, mammary gland, placenta)

ENDOCRINE SYSTEM (Thyroids, parathyroids, adrenals, pituitary)

CNS/SENSORY ORGANS (Brain, meninges, spinal cord, eyes, ears)

ADDITIONAL COMMENTS AND OBSERVATIONS:

Prosector:..... Date:.....

SUMMARISE PRELIMINARY DIAGNOSES:

LABORATORY STUDIES (Results of cytology, fluid analysis, urinalysis, serum chemistries, bacteriology, mycology, virology, parasitology, X-ray photography)



TISSUE CHECK LIST

Where possible freeze 3-5 cm blocks of tissue from major organs (e.g. lung, liver, kidney, spleen) in small plastic bags, preferably in liquid nitrogen to be kept ultra-frozen at -70°C; freezing at conventional temperatures is acceptable if there is no access to an ultra-freezer.

Preserve as many of the following tissues as possible in 10% buffered formalin at a ratio of 1 part tissue to 10 parts solution. Tissues should be no thicker than 0.5 - 1.0 cm.

NOTE: There is generally no need to fix and label each tissue separately. Take two sets of fixed tissue, one for the Primary Pathologist and the other for the Regional Pathologist. Send tissues required for diagnosis to the Primary Pathologist and request a duplicate set of slides for the Regional Pathologist who should be contacted for further instructions. Also freeze post-mortem serum (from the heart), urine and any abnormal fluid accumulations. Consult regional breeding programme coordinator for a Special Projects Protocol for any special instructions about specimens requested by a Designated Researcher.

- Brain
- Nerve (Sciatic)
- Spinal Cord
- Eye
- Tongue
- Oesophagus
- Trachea
- Thyroid
- Parathyroid
- Pituitary
- Heart
- Muscle
- Diaphragm
- Liver
- Gall bladder
- Spleen
- Pancreas
- Stomach
- Small intestine
- Large intestine
- Caecum
- Skin
- Aorta
- Bone with marrow
- Testis/ovary
- Uterus
- Mammary gland
- Ureter
- Urinary bladder
- Urethra
- Kidney
- Adrenal
- Thymus
- Prostate
- Lymph node
- Salivary gland



PRIMARY PATHOLOGIST:

Name

Lab.

Address

(Please attach final pathology report and send a copy with this protocol to the EEP coordinator)

Appendix III Hand Rearing

1. Due to a powerful sucking response that could result in aspiration of liquid, animals should be fed initially by stomach tube (size 5-10 French, depending on animal size). A measured volume is delivered by syringe. The procedure is simple and easily taught to handlers by veterinary staff. Attempts at bottle feeding should be delayed until animals are well stabilized to milk formula (one week longer, depending on animal age and condition). Initial bottle feeding attempts should utilize a sterile solution of 5 % dextrose and 0.9% NaCl in case of aspiration. For young pandas the small teats designed for premature human infants may be appropriate. Bottle feeding can be adopted when controlled sucking is obtained. The size of the hole in the teat is important for regulation of milk flow rate and should be monitored periodically to avoid excessive milk flow.
2. The milk formula used is a solution of powdered Esbilac (Borden, Inc.) in boiled water to which a lactase enzyme preparation (Lactaid; Lactaid., 600 Fire Rd, P.O. Box 111, Pleasantville, N.J. 08232) is added at rate of 1 drop per 100g formula. (Lactaid is available as a product used by persons with lactose intolerance). The formula should be predigested with the enzyme for 24 hours in a refrigerator or for 90 minutes at 90-95°F (eg. in a water bath). Due to possible bacterial contamination we use the 24 hour formula for one day only (discard at 48 hours after initial preparation). 90 minute formula is kept for only 12 hours prior to being discarded. Formula is kept refrigerated after the predigestion period and only the amount required for each feed is warmed prior to feeding.
3. For the first few feeds the formula should be very dilute (7% Esbilac by weight, i.e. 7g Esbilac, 93g boiled water, 1 drop Lactaid) to allow acclimation to formula constituents. Formula concentration is gradually increased in stepwise fashion (10%, 12%, 15%, 18%, 20% Esbilac) according to animal performance and age. Thus the formula concentration might reach 15% strength in one week and 20% in three weeks. Formula is kept at this strength until weaning. In some instances paediatric vitamins (ABDEC, Parke-Davis, Morris Plains, N.J. 07950) or iron supplements have been given to hand reared red pandas but these not be necessary in most cases as Esbilac contains generous levels of these nutrients.
4. Animals are initially fed at 3 hour intervals (8x per day). As the animals stabilize and get stronger the interval can be increased to 4 hours (6x per day). The amount fed per day is based on body weight; therefore it is essential to weigh the animals each day. A typical regimen for the first week would be 25-30% of body weight distributed over 8 feeds (3.1-3.8% of body weight per feed). The amount to feed is recalculated at 3-4 days intervals based on body weight changes. As the animal ages the percentage of body weight fed per day is gradually reduced, eg. at about one month old the panda is fed 20-25% of its body weight per day, at 2 months old 16-18% per day and at 3 months old about 15% per day. These amounts are modelled after milk intakes of mother-reared carnivores; small (undersized) animals should be fed at the upper end of these percentage ranges.



5. Weaning is commenced at approximately 3 months by addition of panda gruel (see below) to formula (eg. 1 tsp. per bottle). Then animals must be taught to feed from a bowl, which can prove difficult. In one case the teat had to be placed in the bowl of formula to initiate feeding. The amount of gruel added is gradually increased such that animals are fully weaned by 5 to 6 months. Red pandas resist rapid dietary change. Bamboo and salad (apple, carrot, green bean) are offered separately from about 70-90 days to allow manipulation and investigation, they may not be eaten at first. Water should be made available as solids are introduced.

6. The gruel to which animals are weaned is prepared daily, kept refrigerated and the excess discarded after 24 hours. A batch of about 760g is composed of the following: 114g Gerber's mixed cereal, 276g evaporated milk, 57g applesauce, 1 tablespoon vitamin-mineral supplement (Pervinal, Pet Products & Co., Brentwood, N.Y. 11717), 1/2 tablespoon honey, 2 egg yolks and 284 g boiled water.

7. Hand reared red pandas gain weight at a rate equal to or above that of mother-reared young. Weights of hand reared animals are provided below. Early weights of animals pulled due to small size are excluded (i.e. animals much smaller than those below are underweight).

- birth ca. 100 g
- 10 weeks 0.9 - 1.4 kg
- 2 weeks 160 - 210 g
- 4 weeks 260 - 360 g
- 6 weeks 460 - 650 g
- 8 weeks 650 - 960 g
- 3 months 1.3 - 1.9 kg
- 4 months 1.8 - 2.6 kg
- 5 months 2.4 - 3.7 kg
- 6 months 3.2 - 4.8 kg

8. Additional considerations:

- Animals should be reared as a group to prevent abnormal socialization as they mature. Since young animals tend to suck on each other, they may need to be housed separately for an initial period.
- Stimulate young animals to induce elimination. Older animals may develop soreness in the anal region from frequent scent marking (anal rubbing) of objects in the enclosure.
- The normal range for rectal temperature appears to be 95.4- 98°F. Rectal temperatures above 99-100°F may indicate a medical problem. Rectal temperature should be monitored once or twice a day in young animals.
- Young pandas are initially kept in an incubator or warm box at 85-90°F. As they mature, they are prone to heat the stress. Fans can help in hot weather.
- Provide climbing apparatus for older animals but beware: red pandas are escape artists.
- Nails will require periodic trimming, even so it may be necessary to wrap older animals in a towel for feeding to avoid scratches. Handlers, will need heavy trousers when animals start to climb on them.

9. In order to aid the development of a new milk substitute any zoo which has to sedate a lactating panda is asked to obtain a milk sample for analysis.