

Husbandry Manual for



White- Handed Gibbon

Hylobates lar

(Mammalia – Hylobatidae)

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Disclaimer

This husbandry manual has been constructed to meet the requirements for completion of Certificate Three in Captive Animals, Course number 1068 at TAFE NSW- Western Sydney Institute, Richmond College.

This manual is the result of a students project work so care should be taken in the interpretation of information, therein no responsibility is taken for the loss or damage that may result from the use of these guidelines.

The manual is offered to the ASZK Husbandry Manual Register for the benefit of animal welfare and care.

Husbandry guidelines are utility documents and are “works in progress”, thus the author welcomes recommendations and improvements.

Occupational Health and Safety Warnings

WARNING: This animal is classed as hazardous (medium risk) as they are likely to seriously injure a person by inflicting serious bites, scratches or by grabbing a person.

Physical Risks- The White-Handed Gibbon has very long sharp canines and has the ability to cause serious bite wounds to keepers. They also have extra long strong arms and can grab and scratch keepers in quick movements as they are agile.

To minimize it is recommended to lock up the gibbons when cleaning the enclosure or have two keeping staff on incase of injury. Carrying a 2 way radio is required at all times.

Chemical Risks- Exposure to Animal House, Bleach or Airlift disinfectants.

To minimize it is recommended to wear PPE – gloves or face masks when preparing or using the chemicals. Always read correct instructions and use correct dilution. Make sure labels are visible on containers also and that the MSDS is followed.

Biological Risks- Potential for zoonotic diseases. Primates can carry Hepatitis A and/or B.

To minimize risks – Keepers are required to be vaccinated with Hepatitis A/B shots as well as Tetanus shots. Always wash hands, clean any wounds immediately and wear PPE where appropriate.

Radiation Risks – Exposure to ultraviolet radiation from the sun.

To minimize risks – Keepers are required to wear sunscreen, hats and long sleeves where appropriate.

Ergonomical Risks- The layout of the enclosures and whether there are awkward parts of the enclosure that are difficult for keepers to access.

To minimize risks – Consider modifying enclosure, signs showing where difficulties are, making the enclosure “keeper friendly” by having things accessible.

Psychological Risks – euthanasia of one of the gibbons in your care or administering medication for sick or injured gibbons.

To minimize risks- Training of employees, experienced staff for euthanasia and administering medication.

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1 Introduction

The White-Handed Gibbon belongs in the *Hylobates* genera of gibbons which is the most common and widespread. There are thought to be as of today 16 species of gibbon. “White-Handed Gibbons are small, slender, graceful apes in relation to their great ape cousins” (Durrell Wildlife Conservation Trust, July 2006). White-Handed Gibbons have a white ring around their black face and white hands and feet.

They can be found in Sumatra, Malay Peninsula, Thailand and Myanmar. They are highly arboreal and move by “brachiation” where they swing their body along using alternative handholds which has only been developed by the lesser apes (Durrell Wildlife Conservation Trust, July 2006).

The White-Handed Gibbons walk or run bipedally and they do so with the arms raised over the head, and when resting, gibbons put all their weight on two tough pads of skin on their bottoms, known as ischial callosities. Gibbons are diurnal – active during the day and asleep at night. They do not build nests, but sleep on branches in the forest canopy (Durrell Wildlife Conservation Trust, July 2006).

Most of this information below will be drawn from the most recent copy of Australasian Species Management Program (ASMP) Regional Census and Plan 2009.

1.1 ASMP Category

- PRIMATE TAXON ADVISORY GROUP
- Population Management Plan , Level 3 – Phase Out Species

1.2 IUCN Category

- Endangered (EN)
- CITES listed Appendix 1

1.3 Wild Population Management

- “The wild population of White-Handed Gibbons is listed as Endangered as it is believed to have undergone a decline of more than 50% in the last three generations (45 years) due to rampant forest loss and loss of mature individuals due to hunting” (Brockelman & Geissman, IUCN Red List, 2008).
- This species is protected under CITES Appendix 1 – Listed in 1975. Appendix I lists species that are the most endangered among CITES-listed animals. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial (www.cites.org).
- White-Handed Gibbons are the most prevalent species in captivity of all gibbon species. They are a phase out species in the Australasian region and only seven remain. Other countries continue breeding programmes to ensure they remain to be seen in captivity.
- There is an urgent need for improved protection of these areas, ideally involving local communities that should benefit from as well as participate in management. Illegal use of forest products, as well as poaching, is common in most protected areas. Inadequate management and protection, rather than forest destruction, are the main long-term threats and conservation efforts must seek to identify the hunters and incorporate them into new management priorities (Brockelman & Geissman, IUCN Red List, 2008).

1.4 Species Coordinator

- There is no species coordinator in the Australasian region as they are a phase out species. They are to be deleted from region through natural attrition and the spaces will be made available to White-cheeked Gibbon.

1.5 Studbook Keeper

- EAZA Studbook Keeper: David Gill, SOUTH LAKES, davidsgill@wildanimalpark.co.uk
- AZA Studbook Keeper: Adrienne Whiteley, SYRACUSE, adriennwhiteley@ongov.net

2 Taxonomy

2.1 Nomenclature

- **Class : Mammalia**
- **Order: Primates**
- **Family: Hylobatidae**
- **Genus: Hylobates**
- **Species: *Hylobates lar***

2.2 Subspecies

- Malaysian Lar Gibbon, *Hylobates lar lar*
- Carpenter's Lar Gibbon, *Hylobates lar carpenteri*
- Central Lar Gibbon, *Hylobates lar entelloides*
- Sumatran Lar Gibbon, *Hylobates lar vestitus*
- Yunnan Lar Gibbon, *Hylobates lar yunnanensis* (possibly extinct)

(Geissman, 1995)

2.3 Recent Synonyms

Hylobates albimana (Vigors & Horsfield, 1828)

Hylobates longimana (Schreber, 1774)

Hylobates variegates (É. Geoffroy, 1812)

Hylobates varius (Latreille, 1801)

(Brockelman & Geissman, IUCN Red List, 2008)

2.4 Other Common Names

-Malaysian lar

-Lar Gibbon

-White-handed Gibbon

-Common Gibbon

3 Natural History

The White-handed Gibbon belongs to the group called Lesser Apes or Gibbons. There are 16 recognised species according to Geissman (2010). All the Gibbons are found in South-East Asia. According to (www.junglewalk.com) they do share some features of the Great Apes such as a large brain, a flat face with shortened jaws, a more or less upright posture, broad chest and no tail. Ischial callosities are also present which are leathery patches on the buttocks.

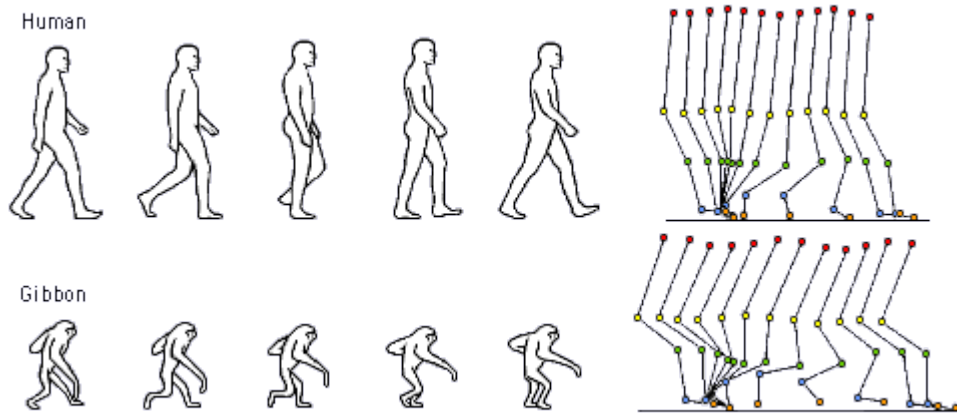


Image 1: Comparative locomotion of humans and gibbons.

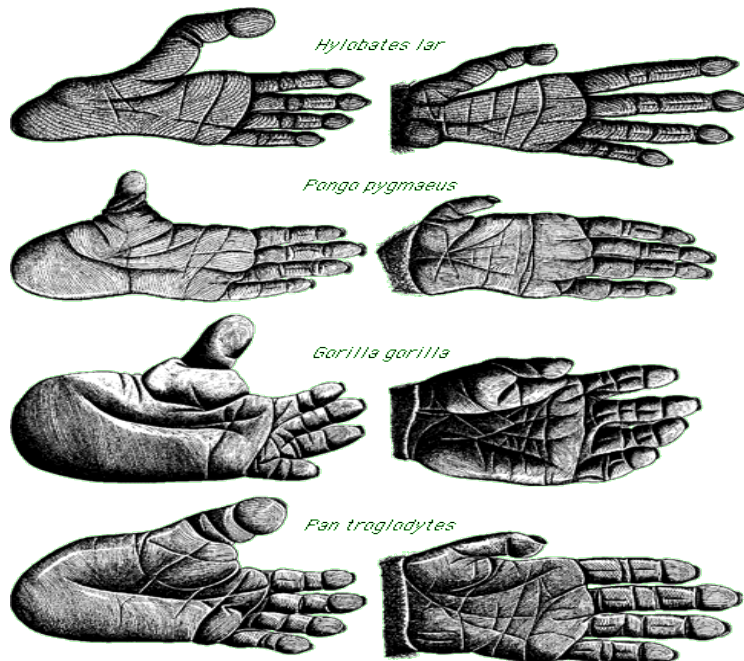


Image 2: Comparisons of foot and hand of White-Handed Gibbon compared to the Great Apes. (Pictures from <http://gibbons.de>)

The species, like other gibbons is diurnal and arboreal. They are very small and lightweight. They have very long arms and a slender body. The White-handed Gibbons hands are very similar as they have four long fingers and a smaller opposable thumb. They can grasp and carry things with either their hands or feet. They swing through the trees by brachiating (See Image 3 below). “When on a large branch or the ground, these gibbons walk or hop bipedally with the arms raised over the head” (Roonwal & Mohnot, 1977, cited in Rowe 1996, p.211). They use four fingers when swinging but don’t use the thumb for this.



Image 3: Showing the various stages used in brachiation by gibbons.

(Picture from <http://gibbons.de>)

The White-handed Gibbon has a throat sac located beneath the chin to help enhance their calls. A male song is simple with quaver- hoots , where a female song is longer which rises to climax at approximately 18 seconds. They are social and more active during the day. They mate for life and stay monogamous. Any young born to the family will stay until they reach sexual maturity.

The males are more territorial and will call and display. This seems to reinforce pair bonds. They will “duet” with different sings but females will start the calls. The White-handed Gibbons are very agile and even acrobatic. They look like tightrope walkers when they walk along small branches or ropes with their arms outstretched to keep their balance. They cannot swim and will actively avoid water. They can leap across long gaps of up to 9 metres in a single jump! The gibbon is the only anthropoid ape to walk on its hind limbs only, usually raising its arms for balance.

These are the most active of all gibbons. They move faster, more quietly, and farther each day than any other forest apes or monkeys. Brachiation comprises 90% of locomotion activity. Adaptations include precision of movement, incredible eye-hand coordination and dexterity. They sleep sitting on their ischial callosities, hands resting upon flexed knees and head buried between knees and chest.

Each family defends its territory by song and threat display. Gibbons are very territorial. A pair maintains and defends a territory through a series of calls and vocalizations. They also use an elaborate system of calls to keep track of family members within the territory.

Gibbons do social grooming, when one individual grooms another, to reinforce the bonds between individuals. They are very vocal, making loud "whoop" sounds. Their loud resonant songs can be heard up to a kilometre away. Songs by far excel those of all other species because of a sound-amplifying throat sac. Each morning upon waking the noisy display takes half an hour or more and is usually started by the adult female. The male and female have different calls. In friendly greetings, corners of mouth are drawn back, revealing teeth, and tongue is sometimes protruding. In anger, mouth is opened and closed repeatedly, smacking lips and snapping teeth together. Snarling is interpreted as an intention of biting. The gibbons seem to be born knowing the songs because they are always the same, and not learned.

3.1 Morphometrics

3.1.1 Mass and Basic Body Measurements

Head and Body Length for ♀ – 41.91 – 57.91 centimetres

Head and Body Length for ♂ - 43 – 58 centimetres

Weight of ♀ - 4-6.8 kilograms

Weight of ♂ - 4.98 -7.62 kilograms

(Rowe 1996, p. 211)

3.1.2 Sexual Dimorphism

- There is no difference in coat colour with regards to sex.
- Males and Females are similar in size and canine length.
- The female starts the vocalizations or “great call”, and the male begins as she finishes. In this way they are sexually dimorphic by their songs (Rowe 1996, p. 212).

3.1.3 Distinguishing Features

“White-handed Gibbons have a white face ring and white hands and feet. The coat colour can vary from cream to black and from dark brown to red” (Rowe 1996, p. 211).

Although not visible but an interesting fact is that White-handed Gibbons have 44 chromosomes and are varied in colour, compared to Siamangs which have 50 chromosomes and are all black although both belong to the Genus- *Hylobates* (Rowe 1996, p. 211).

3.2 Distribution and Habitat

- Primary and secondary, tropical dry deciduous and moist evergreen rain forest, lowland to montane forest up to 2400 metres but usually at 250-500 metres elevation (Roonwal & Mohnot, 1977, cited in Rowe 1996, p.211).

- South East Asia - Found mainly on Malay Peninsula but also Thailand, China, Laos, Burma and Sumatra. (Rowe 1996, p. 211).

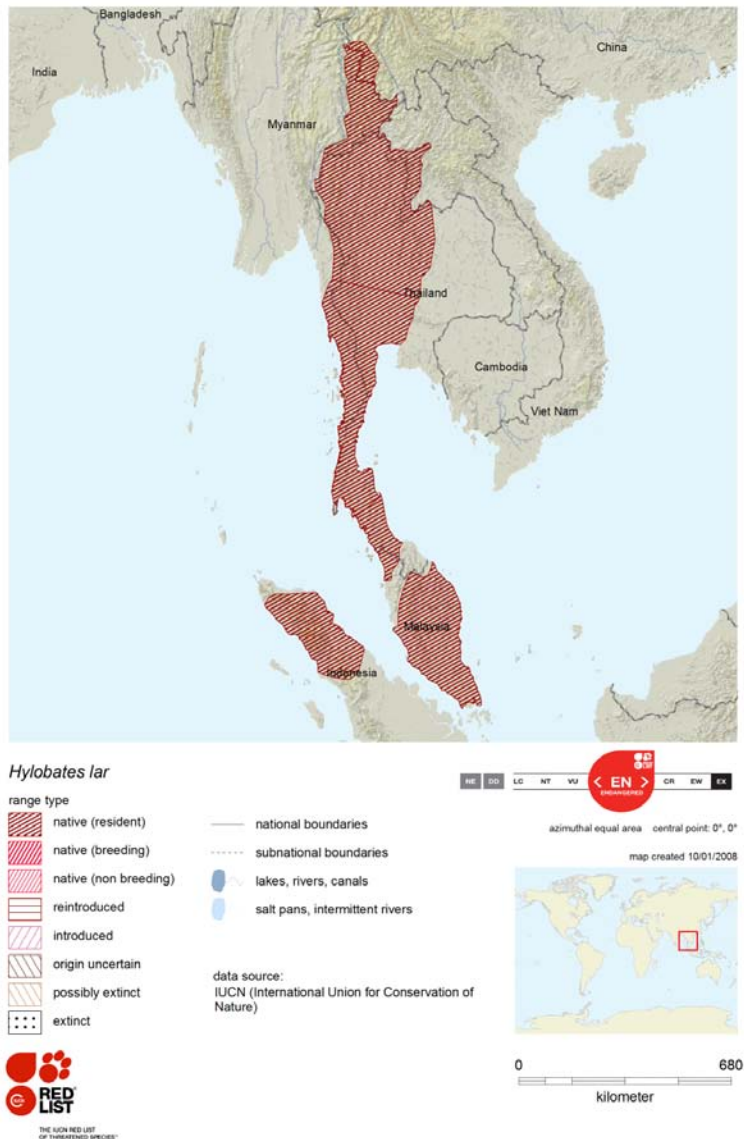


Image 4: Distribution map of White-Handed Gibbons in the wild.

(Brockelman & Geissman, IUCN Red List, 2008)

- They are partially sympatric with Siamangs (*Hylobates syndactylus*), Pileated Gibbons (*Hylobates pileatus*) and dark-handed gibbons (*Hylobates agilis*) (Rowe 1996, p. 211).
- Found in northern Sumatra (Indonesia) throughout peninsula Malaysia, north through southern and eastern Myanmar, most of Thailand and marginally into southern China. It is unclear whether the population in Thailand is native, but they have been introduced or reintroduced (Brockelman & Geissman, IUCN Red List, 2008).
- The species occurs in a small area of northwestern Lao (west of Mekong River).
- There are no exact population estimates but numbers are thought to be decreasing due to habitat loss and being hunted.
- It has been found that the average group size generally increases with the latitude they live at (Brockelman & Geissman, IUCN Red List, 2008).
- The home range is from 12-53.5 hectares (van Schaik & Dunbar, 1990, cited in Rowe 1996, p. 211) with a day range of 1490-1600 metres (Raemaekers, 1979, cited in Rowe 1996, p.211).

3.3 Conservation Status

- IUCN Red List- As of 2008 listed as Endangered (EN). This species is listed as Endangered as it is believed to have undergone a decline of more than 50% in the last three generations (45 years) due to rampant forest loss and loss of mature individuals due to hunting (Brockelman & Geissman, IUCN Red List, 2008).
- CITES- Appendix I – Listed in 1975. Appendix I lists species that are the most endangered among CITES-listed animals. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial (www.cites.org).
- Threatened due to hunting primarily. The hunters will kill them to get at the particular trees and other forest products. They will also hunt them for meat or the live pet trade.
- They are also threatened to a lesser extent by forest logging and by new roads being made and making their territories even smaller.
- They are currently being phased out in Australasian zoos. A phase-out species. To be deleted from region through natural attrition, spaces will be made available to White-cheeked Gibbon (2009 ARAZPA Holding Notes).
- They are still found in zoos around the world from Europe, Africa, North America through to Asia and Australia.
- There are some field sites and projects to release them to the wild. These include the Wildlife Friends of Thailand and Kalaweit in Sumatra and Borneo. Volunteers are welcome to help assist with looking after the gibbons.
- About 300,000 are believed to be in the wild (Pappas & McLennan, 2002).

3.4 Longevity

3.4.1 In the Wild

- According to Pappas & McLennan (2002) the lifespan in the wild is on average 25 years.

3.4.2 In Captivity

- According to Pappas & McLennan, (2002) the lifespan in captivity is on average 30-40 years old.

3.4.3 Techniques used to Determine Age in Adults

- They are sexually mature at 108 months or 9 years for females.
- They are sexually mature at 78 months or 6.5 years for males.

(Harvey et al, 1987, cited in Rowe 1996, p. 211)

- There is virtually no sexual dimorphism in either the canine teeth or body size (Geissman, 2010).
- Fur colouration is no guide to the age.
- Age could be determined by wear on dentition but there were no available publications to be found at this time.

4 Housing Requirements

4.1 Exhibit Design

- Firstly the exhibit must meet the requirements set for “Policy on Exhibiting Primates in NSW”, NSW Agriculture, 2000 which is detailed in this section of the manual.
- The enclosure should allow for natural behaviours such as brachiation.
- Cocks, (2000, p.8) recommends enclosure size: 30m x 7m x 8m high.
- The enclosure should contain visual barriers, which allow visual escape from both cage mates and the public (Cocks 2000, p.8).
- The exhibit should be designed with a minimum flight distance of 5m, i.e. the distance from the public the average gibbon feels comfortable (Cocks 2000, p. 8).
- Shade must be provided at all times as well as fresh drinking water.
- Recommended island enclosure size is 30m x 7m (Cocks 2000, p. 10).
- “Ideally arboreal pathways should be provided for the gibbons at three vertical levels using trees, ropes and platforms (Cocks 2000, p.9).
- The substrate should be natural e.g. grass/dirt except in the night dens where concrete is used to aid in cleaning it properly and efficiently.
- The enclosure should provide visual barriers which allow the animal to get away from both cage mates and the public.
- In the zoo environment it is recommended that the exhibits be at least 75m apart and preferably no visual contact between pairs if individual gibbons are particularly territorial (Mootnick 1997, p. 272).

Image 5: White-Handed Gibbon Exhibit at Taipei Zoo.

Exhibit is an island enclosure with ropes and natural branches to allow brachiation, high movement and space to move around freely.



http://lh4.ggpht.com/_kg8uWJoBdTc/RczCxoKpjlI/AAAAAAAAATI/O9BeTmlavro/000027.JPG

4.2 Holding Area Design

- A crush system should be available for animal restraint and capture.
- A safety area such as a walkway should be provided for the keepers.
- Sliding doors into exhibit should have a locking mechanism to secure the White-Handed Gibbons in the night area whilst the keeper is in the enclosure.
- The floor should have a slope to allow for drainage after cleaning.
- The drain system is recommended to be outside of the night quarters.
- Noise from the public or other noises should be kept to a minimum especially noise from above, for example helicopters as this can stress the animals out profusely.
- There should be one night den area per White-Handed Gibbon. Recommended size for each night quarter: 1.6m wide x 2m deep x 2.4m high (Cocks 2000, p. 9).
- The interconnecting slides in the holding cage and night quarter areas should allow a complete circular movement through the complex to avoid individuals being trapped by more dominant animals (Cocks 2000, p. 9).
- White-Handed Gibbons are arboreal and the platforms need to be above the keepers head height.
- Roof ideally should allow for arboreal locomotion, i.e. mesh roof (Cocks 2000, p. 9).
- If night time temperatures fall below twelve degrees Celsius heating is required in the night quarter (Cocks 2000, p. 9). Bedding should be provided such as straw or hessian sacks.
- The holding area should be made of steel mesh to prevent dangerous contact between White-Handed Gibbons and keepers. The minimum mesh wire diameter is 3.15mm and dimension of 50x50 mm (NSW Agriculture 2000, p. 29).
- The holding area should be rodent free by using traps or baits if necessary.
- Each exhibit must allow access to an area such as a nest box, raceway or night den, suitable for the physical isolation of individuals so that animals can be restricted for close examination and veterinary treatment (NSW Agriculture 2000, p. 9).

4.3 Spatial Requirements

The following information is stated in the Policy on Exhibiting Primates in New South Wales (NSW Agriculture, 2000):

- Enclosures may be open, semi-enclosed or totally enclosed or consist of islands surrounded by water.
- Enclosures must be well constructed and maintained in good repair. Particular attention must be given to eliminating sharp edges and broken wires.
- Sufficient shelter must be provided to allow protection from wind, rain and extremes in temperature. Access to both shade and sunlight must be provided.
- Primates must be exhibited in a setting which will educate the public about the primate's natural habitat and provide for its behavioural and physical well-being.
- Sufficient space must be provided, both horizontally and vertically to enable the animals to take exercise, to protect animals from undue dominance or conflict and to provide for their social, breeding and behavioural needs.
- Enclosure size must be a minimum of 6 metres in width and 9 metres in length.
- The height of the enclosure should be at least 3.5 metres.
- For the housing of 2-3 individuals the length of the enclosure should be 15 x the maximum body length and the width be 10 x the maximum body length. For every additional animal add 50 x (max body length) squared to the floor area.
- Gibbon exhibits should ideally be longer than wide to maximize ability to brachiate in a given area (Cocks 2000, p. 8).
- All doors should open into the exhibit for safety reasons.
- The enclosure should not exceed the maximum carrying capacity.
- Primate enclosures must be constructed so that the enclosed animals can rest at least two body lengths above the eye level of any member of the viewing public. Monkey pits are therefore not acceptable housing for any primate species.
- Island enclosures must have a minimum moat width of 5 metres and the moat must be a depth of 9 metres minimum.
- The sides of the island should be constructed in such a way as to allow the gibbons to easily climb out of the water if they fall close to the island's edge. Recommended island size: 30m x 7m (Cocks 2000, p. 10).

- The enclosure should contain visual barriers, which allow visual escape from both cage mates and the public (Cocks 2000, p. 8).

4.4 Position of Enclosures

- The majority of the enclosure must be out of visual range of any neighbouring exhibits housing potential predator species or other groups of the same primate species if the species is territorial. Where visual contact is available, and signs of distress are observed, action must be taken to alleviate this distress (NSW Agriculture 2000, p.8).
- It is recommended that the exhibits be at least 75m apart and preferably no visual contact between pairs if individual gibbons are particularly territorial (Mootnick,1996, as cited in Cock 2000, p. 11).
- Gibbon pairs are highly territorial. Aggression between gibbons in adjacent enclosures have been known to cause the failure of pair formation and the mis-mothering or even killing of infants by gibbon parents (Cock 2000, p. 11).

4.5 Weather Protection

- Sufficient shelter must be provided to allow protection from wind, rain and extremes in temperature. Access to both shade and sunlight must be provided (NSW Agriculture 2000, p. 7).
- If possible, three quarters of the exhibit should be in shade in summer and one quarter in winter.
- Access to the night quarters must be available when it is cold, wet or night hours.
- Island enclosures are approved for the White-Handed Gibbons as long as it meets the parameters set by NSW Agriculture's Policy on Exhibiting Primates in NSW.
- Breeding White-Handed Gibbons with young infants require access to night dens at all times for protection from the elements.

4.6 Heating Requirements

- Enclosures must provide animals with access to shelter from climatic extreme (NSW Agriculture 2000, p. 11).
- Shelters should provide an air temperature between 18 and 30 degrees Celsius. Heated concrete shelving may be used in shelters to provide appropriate heating (NSW Agriculture 2000, p. 11).
- If daytime temperatures fall below twelve degrees Celsius heating is also required in the holding cage (Cocks 2000, p. 9).
- Where primates are housed indoors, there shall be sufficient air changes per hour to provide ample fresh air and prevent the build up of odours and noxious gases. Humidity must be kept at levels appropriate to the species and so that the health of the animals is maintained (NSW Agriculture 2000, p. 11).
- Insulated bedding materials should be provided in the colder months but access to bedding should occur all year round. Straw, shredded paper, nest boxes or hessian sacks can be used.

4.7 Substrate

- The enclosure must be well drained to prevent flooding or a water build up.
- A mixture of artificial and natural, or all natural substrate must be provided, to allow for normal behaviours, such as foraging and scent marking (NSW Agriculture 2000, p. 9).
- The substrate must be effectively managed to avoid disease. The substrate may need regular changing so that it does not become a harbour for parasites. (NSW Agriculture 2000, p. 9).
- For Island Exhibits, a combination of dirt, grass and vegetative substrate is allowed (personal observation).

4.8 Nest Boxes and/or Bedding Material

- Nest boxes should be provided for breeding White-Handed Gibbons.
- The nest box should be in the night quarters and away from the public eye in a quiet area. The boxes should be above the height of the keepers as they are an arboreal species.
- Straw, hessian sacks, shredded paper are preferred bedding materials. These should be checked regularly and changed if any faeces or food leftovers occur to ensure it is fresh and free of potential diseases or parasites.
- There should be a nest box for each gibbon to ensure space is provided if they require time away from the other gibbons.

4.9 Enclosure Furnishings

- The climbing structures must be a mixture of flexible and rigid materials. These can include rope, bamboo, tree limbs, fire hoses, hammocks and vegetation.
- Ideal inter-structure distance (e.g. between bars and ropes) is 2m (Cocks 2000, p. 9).
- The climbing structures should be a minimum of 2.4 metres off the ground (NSW Agriculture 2000, p. 26).
- Sitting/sleeping perches should be 2 metres off the ground and have a sufficient number so that each gibbon can be by itself if required (NSW Agriculture 2000, p. 32).
- Four horizontal pathways in the upper half of the exhibit are required with a mixture of flexible and rigid materials (NSW Agriculture 2000, p. 32).
- Four vertical pathways are required in the upper half of the exhibit with a mixture of materials again (NSW Agriculture 2000, p. 32).
- There should be a minimum of one elevated feeding platform per adult White-Handed Gibbon (NSW Agriculture 2000, p. 32).
- Rope diameter between 25mm and 40mm is recommended (Cocks, 2000).
- The majority of the climbing structures must be 5m from the public.
- Ideally arboreal pathways should be provided for the gibbons at three vertical levels using trees, ropes and platforms (Cocks 2000, p. 9). This allows for natural movement.
- The ropes must be well maintained and be changed or sealed if fraying occurs. They must be heavy enough to remain taut when the gibbons use them.
- Behavioural enrichment that stimulates all of the five senses should be provided to ensure a happy healthy White-Handed Gibbon group.
- Natural enrichment items such as logs, browse and scents should be provided on a rotated schedule.

- Unnatural enrichment items can be used such as hammocks, bungees, swings, hessian sacks, tyres and balls. These can be on a rotated schedule also to provide extra stimulation for their behavioural and psychological needs.
- Care must be taken to ensure the enrichment item will not hurt the Gibbon e.g. toxic or be used as an escape item.
- All enrichment and furnishings should be changed frequently to provide the gibbons with stimulation and variety of enrichment.

5 General Husbandry

ANNUAL CYCLE OF MAINTENANCE ACTIVITIES

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
Breeding Season												
Enclosure Repairs												
Enclosure Renovations												
Full Cleaning of Enclosure*												
Routine Health Checks (monthly)												
Vet Checks												

- A full enclosure clean means removing and changing all furniture and giving it a full clean, not just the daily clean and hose.

5.1 Hygiene and Cleaning

- Animal House by Glason is recommended as a disinfectant diluted 1 part solution to 10 parts water – (See Appendix 1).
- Watering dishes are to be scrubbed clean daily with a scour and refilled with fresh water.
- Nest boxes and bedding checked daily and changed when required. I recommend changing them seasonally.
- If White-Handed Gibbon gives birth in the nest box it should be cleaned as soon as possible thereafter.
- Night den, platforms and shelves to be disinfected regularly to prevent excess faecal matter, food and urine to build up.
- Soil and grassed areas to be cleaned daily of any food scraps, faeces and excess leaves.
- Dustpan, brush, rake and any equipment used in cleaning to be cleaned thoroughly every day and bleached once a week.
- The gibbons are required access during and after cleaning to dry areas (NSW Agriculture 2000, p. 16).
- Where cleaning will disrupt scent marking behaviour in particular species, the enclosure must then be cleaned on a rotational basis in certain areas (NSW Agriculture 2000, p. 16).
- Other cleaning products used are Neutra-san and Airlift Jellybean.

Daily Cycle of Activities for White-Handed Gibbons- Hylobates lar

	MON	TUES	WED	THUR	FRI	SAT	SUN
Removal of Organic Waste							
Night Dens Disinfected							
Health Checks							
Enrichment							
Browse							
Maintenance if required							

5.2 Record Keeping

- For each White-handed Gibbon an individual record must be kept.
- Records must be maintained and kept up to date at all times.
- Each White-handed Gibbon shall be individually and permanently identified by an appropriate method of identification.

The following data should be recorded according to the Policy on Exhibiting Primates in NSW, Part 6 – RECORDS (NSW Agriculture 2000, p. 21)

The records shall provide the following information:

- i) identification number, common name, scientific name, any personal name and any distinctive markings;
 - ii) origin (details of parents and their origin and of any previous locations);
 - iii) dates of acquisition and disposal, with details of circumstances and addresses;
 - iv) date of birth;
 - v) veterinary records, including results of physical examinations, details and dates of any treatments, results of routine health examinations;
 - vi) breeding (including mating, reproductive and behavioural cycles, parenting ability) and details of any offspring;
 - vii) date of death and cause including results of post mortem reports;
 - viii) normal diet;
 - ix) any other specific details pertaining to the individual such as changes in behaviour or diet.
-
- All documents, records and other information pertaining to each animal including those from previous locations must be kept safely and maintained for the life of the primate plus five years.

5.3 Methods of Identification

- A microchip is the best form of individual identification and this should be done when the animal is anaesthetized at the first available opportunity.
- Each individual White-handed Gibbon also has its own ARKS number that is for the purpose of records and knowing who is who for ISIS (International Species Information System).
- Females are generally smaller than the males (personal observation).
- Ear tags could be used but are not recommended as White-handed Gibbons could pull them off quite easily.
- To determine individuals distinctive markings or facial features can be used. For example one of our White-handed Gibbons at Mogo Zoo called Jessica has a full ring of white around her face and a whiter backside. On the other hand Josephine her companion has only a half moon of white around her face and has a darker backside (personal observations).

5.4 Routine Data Collection

- Data collected could be used as part of a long term study.
- Reproductive behaviour or records of sexual swellings in females.
- Time and age at death/euthanasia.
- Any births or offspring changes, for example sexual maturity.
- Blood samples – Yearly is suggested (personal observation).
- Faecal samples – Twice yearly is suggested (personal observation).

6 Feeding Requirements

6.1 Diet in the Wild

- Fruit – comprises 50% of diet (Rowe 1996, p. 211)
- Leaves – 29% of diet (Rowe 1996, p. 211)
- Insects
- Flowers
- New stems, shoots and buds

The White-Handed Gibbons in particular are fussy eaters and prefer fruit over anything else, especially fruits high in sugar such as figs. Gibbons are omnivores which eat both plants and animals. “Gibbons drink water, often by dipping a hand into the water or rubbing a hand on wet leaves, and then slurping up the water from their fur. They drink by licking their own fur after it has been wet” (junglewalk.com, 2009).



Image 6: White-Handed Gibbon eating bananas.

http://blogs.orlandosentinel.com/features_popculture_blog/images/2007/04/13/monkeybananamoundhr.jpg (2009)

6.2 Captive Diet

Exhibitors must provide diversity in the taste, colour, size and nutritional value of food items fed to primates. Food offered must meet the nutritional requirements of the species as determined by the natural diet in the wild. Commercial monkey diets must be supplemented with fresh items such as fruits, raw vegetables and browse on a daily basis (NSW Agriculture 2000, p.17).

The preparation and feeding must be planned to satisfy the nutritional requirements of all group members including lactating females and growing animals e.g. infants.

“Primates must be fed in small portions at least twice a day, with additional activity feeds offered on a daily basis” (NSW Agriculture 2000, p. 17). The food given to the gibbons must be presented in a way to prolong feeding and foraging.

“Arboreal primates must be fed at least 1.5 metres off the ground to accommodate natural behaviour and to reduce faecal contamination of the food. Exception: some activity feeds may be provided at ground level” (NSW Agriculture 2000, p. 17). Fresh clean water must be made available at all times. “Food and drink must be provided to animals in a manner that takes account of the species biology and ensures that every animal kept in an enclosure has adequate access” (ARAZPA, 2009).

Although gibbons easily adapt to a captive diet of fruit and vegetables balanced with animal protein (Chivers and Raemaekers 1986, as cited in Cocks 2000, p. 13), a zoo diet should not merely provide the basal nutrients but should also reflect a natural diet and possibly enhance a natural manner of feeding (Cocks 2000, p. 13). This could be achieved by feeding up high and providing food that imitates their wild diet.

In general, captive gibbons are offered a lower daily amount of food (approx. 300 to 800g) than estimated food intakes in the wild (approx. 800g) (Chivers & Raemaekers 1986, as cited in Cocks 2000, p 13). This is because they tend to brachiate a lot less as they have a smaller space in captivity.

The following is based on the diet given at Mogo Zoo for 0.2 (two female) White-Handed Gibbons.

- Vegetables- raw and cooked
- Fruit- dried and ripe
- Browse (willow, banana leaves, mulberry and wattle)
- Cereals and grains
- Egg and Chicken – boiled
- Leaf Eater Primate Pellets by Specialty Feeds (See Appendix 2)

AM Diet for 0.2 at Mogo Zoo

- ½ pear per animal
- ½ apple per animal
- ½ banana per animal
- 100 grams of grapes per animal

Can include one extra of the following

- Paw Paw (25 grams per animal)
- Kiwi Fruit (25 grams per animal)
- Rockmelon (25 grams per animal)
- Orange (1/4 cut in half per animal- once a week)
- Fruit in Season eg Mango, Persimmon or Dragon fruit.

PM Scatter Feed Diet for 0:2 at Mogo Zoo

- 1 prune each
- Primate pellets
- Sultanas
- Mung beans or sprouts
- Kibble
- Nuts
- Snow Peas
- Extras can include dates, figs or cereals e.g. oats

Usually equals a cup per animal.

PM Diet for 0.2 at Mogo Zoo

- ¼ Iceberg Lettuce per animal
- ¼ Zucchini per animal
- 2 slices of capsicum per animal
- ½ carrot per animal
- ½ cucumber per animal

Can include one extra of the following - Sliced Mushrooms, Chopped Pumpkin (1/2 slice per animal) or Corn Rounds (2 per animal).

Extra Food for 0.2 at Mogo Zoo

This varies daily and seasonally. It can include

- cooked vegetables e.g. pumpkin or sweet potato
- Frozen ice blocks
- Novelty feeds eg Popcorn or Durian Fruit
- Fruit e.g. grapes/rock melon
- Protein items (Egg, Mealworms, Cheese, Pasta or Boiled Chicken)

Gibbons have sensitive digestive systems and have an inability to cope with fruits with a high acid content such as tomatoes, grapes, pineapples, or citrus fruits. Large quantities of these fruits may result in severe physiological reactions (e.g. swollen eyes, diarrhoea, etc.) (Mootnick, Haimoff and Nyunt-Lwin 1987, as cited in Cocks 2000, p. 13).

Alternate Diet used at Taipei Zoo

Daily diet for each white handed gibbon in a separate enclosure, the weight of food, % and total amount.

Food	Feed (g/d)	%	Feed (g/d)	%
Monkey rice	75.00	10.02	75.00	9.39
Cake	33.33	4.45	33.33	4.17
Bread	50.00	6.68	50.00	6.26
Banana	65.00	8.69	65.00	8.14
Papaya	100.00	13.36	100.00	12.53
Apple	100.00	13.36	100.00	12.53
Guava	80.00	10.69	80.00	10.02
Sweet potato	100.00	13.36	100.00	12.53
Orange	33.33	4.45	33.33	4.17
Tomato	17.00	10.02	17.00	2.13
Carrot	16.67	2.23	16.67	2.09
String bean	20.00	2.67	20.00	2.51
Mulberry leave			50.00	6.26
Total	748.33	100.00	798.33	100.00

(Yang & Yang, 2004)

TIME OFFERED/ FOOD ITEM (g)	<i>agilis</i>	<i>moloch</i>	<i>pileatus</i>	<i>leucogenys</i>	<i>syndactylus</i>
0700 hours					
Monkey chow	45·00	30·00	52·50	52·50	60·00
Red apples	131·25	131·25	175·00	175·00	262·50
Yellow apples	100·00	100·00	100·00	150·00	100·00
1030 hours					
Green beans	20·00	10·00	10·00	20·00	40·00
Spinach	60·00	40·00	20·00	60·00	60·00
Carrots	20·00	30·00	40·00	20·00	40·00
Broccoli	10·00	10·00	10·00	10·00	10·00
Yam	80·00	80·00	80·00	80·00	100·00
Kiwi	20·00	20·00	20·00	20·00	20·00
Kale	15·00	15·00	15·00	30·00	30·00
Celery	30·00	30·00	60·00	30·00	45·00
Greens	90·00	45·00	30·00	60·00	130·00
1430 hours					
Red apples	87·50	87·50	87·50	131·25	131·25
Yellow apples	50·00	50·00	50·00	50·00	50·00
Bananas	280·00	350·00	420·00	420·00	350·00
Greens	30·00	15·00	30·00	45·00	45·00

Table 2. Mean amount of food offered daily to each adult *Hylobates* at the International Center for Gibbon Studies.

(Mootnick 1997, p. 273)



Image 7: Jess The White-Handed Gibbon at Mogo Zoo eating a peach.
(Sophie Miller, 2009)

6.3 Supplements

According to the Policy on Exhibiting Primates in NSW, 2000 there are no supplements required in the diet of any *Hylobates* species.

There are various supplements out there for captive gibbons including Primate Vitamin Mix.

Vitamins are very important for all primates. This vitamin mixture will help you to keep primates in perfect condition. You can sprinkle these vitamins over their food.

Ingredients :

- Ascorbic Acid (Vitamin C)
- Inositol
- Taurine
- Vitamin E Acetate
- Niacinamide (Vitamin B3)
- Calcium Pantothenate
- Vitamin A
- Riboflavin (Vitamin B2)
- Folic Acid
- Pyridoxine HCl (Vitamin B6)
- Thiamine HCl (Vitamin B1)
- Vitamin D3
- Menadione (Vitamin K)
- Vitamin B12
- Biotin
- Dextrin

Primate Vitamin Mix - 1 oz - **\$6.85** (primatestore.com, 2009).

Primate Mineral Mixture - 1 oz

This mineral mixture is designed for primates. If you want to supplement a primate with minerals then this is the mixture for you!

Ingredients:

- Calcium
- Chlorine
- Chromium
- Copper
- Flourine
- Iodine
- Iron
- Magnesium
- Manganese
- Phosphorus
- Potassium
- Selenium
- Sodium
- Sulfur
- Zinc

Primate Mineral Mixture - 1 oz - **\$2.95** (primatestore.com, 2009).

6.4 Presentation of Food

At Mogo Zoo food is presented in the following schedule:

- Primate Pellets presented at 07:00 to check on the animal's health.
- AM feed of fruit placed on platforms, enrichment furniture and on ground between 8:00-9:00 hours.
- PM feed of scatter mix placed on platforms, enrichment furniture and on ground between 12:00 and 13:00 hours.
- Night feed of vegetables placed in night dens to encourage them to go to bed between 16:00 and 17:00 hours.

A study by Leivers (1998 cited in Cocks 2000, p.14)

It is well documented that the captive environment can impose severe restrictions on the ability of animals to display the full repertoire of species typical behaviour. Not only this, but a lack of adequate stimulation may affect the behaviour, psychological welfare and health of animals; commonly referred to as boredom related problems. This can manifest itself either through increased lethargy or the development of abnormal behaviours to compensate for the lack of stimulation e.g. rocking, stereotyped movements, coprophagy, regurgitation/reingestion and self-stimulation to name a few.

Enrichments activities include:

- Smears on platforms and poles around enclosure including jam, peanut butter and honey
- Fruit frozen into ice blocks
- Novelty fruits (Custard Apple, Durian Fruit, Dragon fruit, Persimmon, Tamarinds, and Pomegranate)
- Slow release feeder tubes
- Feeder Mops
- Feeder Buckets
- Hessian Sacks filled with food or herbs
- Feeder balls
- Log smears
- Enrichment balls

Aussiedog.com.au can provide a range of enrichment devices used in zoos. They include a fun feeding tube, feeder bags, seed tube with ball reservoir and mini food ball on a bungee.



Image 8: Fun Tube www.aussiedog.com.au



Image 9: Feeder Bag www.aussiedog.com.au



Image 10: Seed tube with ball reservoir www.aussiedog.com.au



Image 11: Mini food ball on bungee www.aussiedog.com.au

7 Handling and Transport

7.1 Timing of Capture and Handling

- The time of capture can depend on the time of transport for example specific flight times. It is best to capture the animals with as minimal time as possible in the transport box.
- The ideal time for capture is early morning before the zoo opens to the public or after the zoo has closed to ensure minimum people are around and to lessen the stress on the animal.
- A capture in the morning is best to allow enough time for the capture and transport of the animal. It also means the animal has not been fed since the day before to possibly negate the affects of the drugs used to capture the animal. (Personal observation) Holding off food and water is required to prevent possible regurgitation. A night capture can also be ideal as the animals are not as active.

7.2 Catching Bags

- Capture bags are not used for White-Handed Gibbons.
- “Catching gibbons with a hoop-net is possible, but due to risk of injury to the keeper, is not recommended with adults” (Cocks 2000, p. 13).

7.3 Capture and Restraint Techniques

- Gibbons are highly agile with sharp canines. Staff must be cautious when capturing and restraining. They are also capable of catching darts and removing them.
- Ideal capture method would be for the animal to enter a crush and be locked inside with a transport box adjoining. The animal would then walk into the box with no need for immobilization.
- All captures should be performed quickly to prevent stress on the animal and over heating which can lead to death in gibbons.
- Other methods include the hoop-net construction mentioned in 7.2.
- A sedative administered via juice in a bottle. The gibbon would need to be conditioned to do this.

- Chemical restraint by manual injection by grabbing the gibbons arm through the enclosure. They must also be conditioned to do this. This is only recommended to happen in small areas and by experienced keepers or vets.
- Darting any gibbon species is not recommended as they have very long extremities and the chance of hitting a bone is very high.
- “Gibbons can be caught in a secondary enclosure using a flexi-net which is flat on one side and round where it is attached to the handle. Once the animal is caught in the net, the tranquilizer is injected in the outer thigh” (Mootnick 1997, p. 275).

7.4 Weighing and Examination

- Anesthesia is required as they are classed as hazardous and can cause serious bites or scratches. This is even more important with adult White-Handed Gibbons.
- Weighing must be done under anesthesia at all times unless the animal has been conditioned or hand-raised.
- Infant or juvenile gibbons can be restrained manually but this is not recommended.

7.5 Release

- Release site should have a path for the animal to take free of obstacles that the gibbon may encounter and injure themselves on.
- The release should ideally occur on ground level even though they are arboreal incase the effects of the anesthesia or sedative drugs have not worn off and they fall and injure themselves.
- The release site should be in a wide open area so the animal does not feel stressed or trapped.
- If the gibbons are living on an island enclosure then the release should not occur anywhere near the water’s edge incase they are not yet familiar with water and the potential dangers of falling into it.
- A morning release is ideal to ensure observation can occur during the day by staff members and volunteers. It also allows time to potentially remove the animal should any issues arise where a vet is required or should removal from a group occur.

7.6 Transport Requirements

Transport must follow IATA (International Air Transport Association) regulations. The following is from the regulations (Chan, 1998, as cited in NSW Agriculture, 2000)

- Primates must be carried in closed containers. The containers must be well constructed. Dimensions, where stated, are length, width and height.
- The container must be well constructed and be able to withstand other freight damaging it or causing the structure to buckle or bend. It must be rigid enough to prevent the animal escaping through gaps at the seams or joints. Certain species require re-enforced containers due to size and weight.
- It must be constructed of non-toxic materials. Chemically impregnated wood may be poisonous which must not be used.
- The container must be suitable to keep the animal inside at all times and protect the animal from unauthorized access. The door must be constructed so that accidental opening cannot occur, either from the inside or the outside.
- The container must not cause the animal to damage itself. All inside edges must be smooth or rounded. There must be no sharp projections, such as nails, upon which the animal can injure itself. Joints of a wooden container must be made so that they cannot be damaged by the animal gnawing or clawing the container from the inside.
- The container must be clean and leak-proof. If the container is to be reused, it must be cleaned thoroughly and then either disinfected or sterilized prior to reuse.
- The shipper must provide absorbent bedding. Straw is unacceptable as many countries prohibit its importation.
- It must be easy for staff to handle and provide the handlers protection from being clawed or bitten by the animal. Spacer devices must be incorporated into the design as they will provide handles for moving the container as well as preventing the ventilation openings becoming blocked by other freight. Handles may be attached in addition to the spacer bars.
- If forklift spacers are required they must be at least 5 cm (2 in) thick. Allowance for the extra height must be made when calculating the dimensions of the container.
- The container must be adequately ventilated on at least three sides, with the majority of the ventilation being provided on the upper part of the container. The ventilation openings must be small enough so that any part of the animal cannot protrude from the container and they must be covered with a light material such as muslin.
- Because all primates are CITES listed species, it is imperative that all the appropriate CITES documentation be completed before acceptance of the shipment and such documents must accompany the shipment as well as the usual shippers and health certification.

7.6.1 Box Design

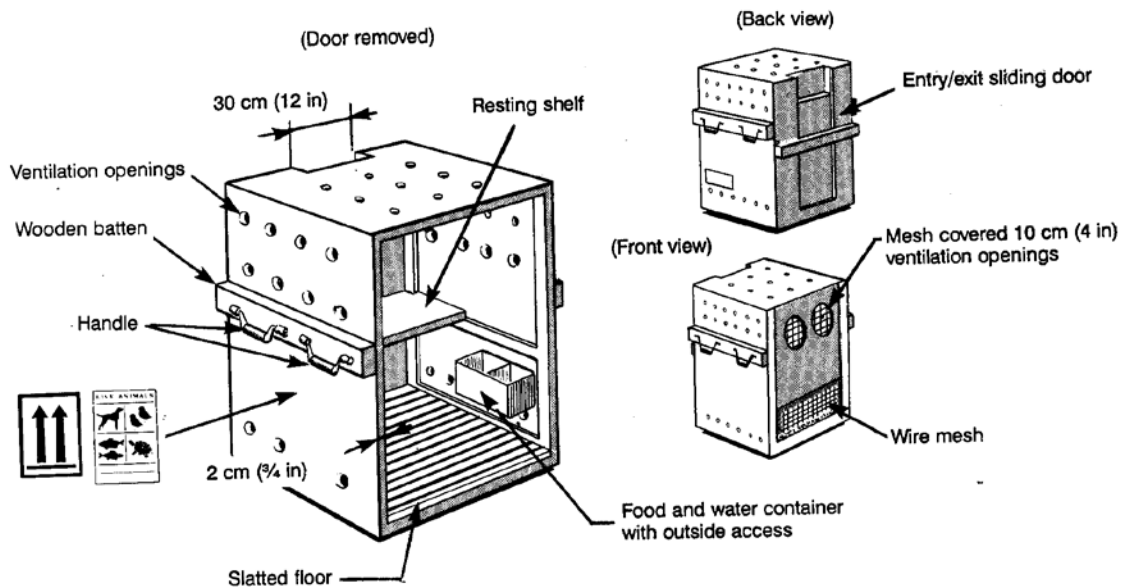


Image 12: Box design for transporting gibbon.
(NSW Agriculture 2000, p. 48)

- IATA container guidelines for gibbons recommend the space per animal be no less than 0.5 cubic metres in multiple containers.

The following is the guidelines and requirements for a Gibbon according to the Policy on Exhibiting Primates in NSW (NSW Agriculture 2000, p. 45-50).

- **Frame:** Solid wood or metal, bolted or screwed.
- **Sides:** Wood or metal. The front must consist of 2.5 cm (1 in) weld mesh or chain link which must be attached to the frame with a steel strip (staples must not be used). Behind the mesh 2 cm (4/5 in) bore steel tubes must be sunk into the top and bottom of the frame to a depth of approximately 2.5 cm (1 in) at a distance of 7.5 cm (3 in) apart, center to center. The distance between the bars and the mesh must be such that the animal cannot poke its fingers outside the transport box. A 2/3 solid panel with 1/3 wire mesh at its lower portion and two 10 cm (4 in) observation openings in the upper part must be placed in front of the weld mesh/chain link. The other three sides must be solid with ventilation openings.
- **Handling Spacer Bars/Handles:** Must be provided as shown in the illustration on three sides of the container.
- **Floor:** The base of the container must be solid and leak-proof and covered with an absorbent material, such as wood shavings, to a depth of at least 10-15 cm (4-6 in).

- **Roof:** Solid but with meshed ventilation openings.
- **Door:** Access into the container must be by a vertical sliding door at the back which extends along the whole height of the container. It must be fastened with tamper proof fastenings or screwed shut after loading. A centre batten must be provided across the whole width of the container, including the door, which is put in position after the door is closed.
- **Ventilation:** Meshed ventilation openings, approximately 2.5 cm (1 in) in diameter must be provided along the base, in the upper 1/3 of the sides and rear and on the top of the container. Whenever openings are covered by mesh care must be taken that there are no sharp edges present. All edges must be covered with a smooth material that is tamper-proof. A muslin, or similar material, curtain must cover all ventilation opening including the front.
-

7.6.2 Furnishings

- Absorbent bedding must be provided suitable for the Gibbon species.
- Furnishings should be minimal to prevent any harm occurring during transport.
- Straw is unacceptable as many countries prohibit its importation but shredded paper is allowed.

7.6.3 Water and Food

- Food and water containers must be provided fixed inside the transport box or attached with a way the Gibbon can access it during the move. If fixed they must be at a height above the ground where the Gibbon cannot sit on it.
- There must be outside access to the bowls to refill and empty without the Gibbon escaping.
- The water container must be emptied after use and never over filled as the Gibbons can splash themselves and become wet and possibly get sick.
- Food given should be minimal unless they are kept in emergency circumstances over a 24 hour period in their transport box. Food can include soft fruit and vegetables sparingly, biscuits or bread with jam and honey.

7.6.4 Animals per Box

- One animal per container unless the animals are used to living together and this would lessen the stress levels. The space per animal in a multiple containers is no less than 0.5 cubic metres (NSW Agriculture 2000, p. 49).

7.6.5 Timing of Transportation

- Transport on a plane can occur at any time a flight is available to the required destination. The evening is recommended as the Gibbons are less active.
- Transport on the road is also preferred at night when the temperature is cooler as primates can overheat during the day in boxes especially in times of extreme heat conditions.

7.6.6 Release from Box

- The Gibbon should be settled and not showing any signs of stress before being released into a new enclosure.
- The release should occur when the Gibbon has fully recovered from the sedative or anesthesia drug it was given.
- The release site should be clear of obstacles that can cause harm to the Gibbon when they are released from the transport box.

8 Health Requirements

8.1 Daily Health Checks

- Observe the animal first thing in the morning whilst feeding and cleaning the enclosure. Check eyes are clear and wide open, general appearance, free movement and feeding well.
- Observe each individual for signs of abnormal behaviour. These can include lethargy, lack of or limitation of movement, unusual aggression or placidity, loss of appetite, vomiting and sitting away from the group.
- Physical signs of illness must be observed also which include loose faeces, swelling, lesions or abrasions and unusual posturing amongst others.
- Consistency of faecal matter to be checked for any abnormalities such as blood, loose faeces, colour or mucous.
- Make sure records are kept of any abnormal observations- suggest carrying notepad to record observations to then be transferred to daily reports and the records system.
- Consult the veterinarian when needed.
- Daily health checks must be performed by keepers who the White-Handed Gibbons are familiar with. It must be a keeper who spends sufficient time observing and caring for the White-Handed Gibbons and can pick up signs of unusual behaviour and abnormalities.

8.2 Detailed Physical Examination

- Observe general body condition for example sleek coat & weight.
- Observe eyes for brightness, clearness, responsiveness.
- Observe ears for fluid.
- Observe condition of teeth- how many, colour, ease of eating.
- Check body condition if animal is conditioned to allow touching and massaging all over.
- Under sedation check heart and lungs for regularity also.
- Record any physical observations.

8.2.1 Chemical Restraint

- The gibbon is encouraged to the mesh to be groomed by a staff member and injected in the outer thigh, biceps or lumbar region (Mootnick 1997, p. 275). The injection must occur in a soft tissue area. The needle should not be visible to the animal until ready.
- A dart gun or blow pipe may be used as other methods (Mootnick 1997, p. 275) but it is advised against due to the Gibbons having delicate skeletal makeup and possible darting inaccuracy could lead to problems.
- The dose of a tranquilizer will depends on the age and condition the White-Handed Gibbon is in. It will also depend on weather conditions. The dose rate should be calculated by a qualified veterinarian.
- Drugs used for restraint (See Appendix 3) – As a general rule Mootnick (1997, p. 275) suggests a dose rate 90ml of Ketamine hydrochloride and 0.5mg of Acetylpromazine per 10kg of body weight. When necessary 0.5mg of Diazepam Intensol per 10kg body weight has been used to reduce tremors and rigidity from the Ketamine hydrochloride. If hypersalivation occurs 0.15ml of Atropine sulphate may be given.
- Isoflurane gas can be administered for deep sleep as required when consulting with a veterinarian.
- A pet carrier or cage of appropriate size can be used for temporary transport of the animal when under chemical immobilization.
- Katamine is used for anesthesia and dose rates are calculated in conjunction with a veterinarian. Riley (2008, p. 26) used a dose rate of 0.5ml/8.2kg *Hylobates lar* in 2007 and was successful.
- Domatel is recommended for a deep sleep and dose is calculated in conjunction with a veterinarian. Riley (2008, p. 26) used a dose rate of 0.4ml/8.2kg in 2007 for *Hylobates muelleri* and was successful but unsuccessful for *Hylobates lar*.

8.2.2 Physical Restraint

- Mootnick (1997, p. 275) suggests wearing overalls, disposable respirator, face shield, disposable gloves and two-ply elbow length leather gloves for manual restraint.
- Manual restraint is not recommended as White-Handed Gibbons are classified as a potentially hazardous animal.
- Mechanical restraint in the form of nets and blankets can be used with sedation to occur once captured.
- White-Handed Gibbons have long limbs which are delicate so care should be taken if manually restraining so as not to cause injuries.
- White-Handed Gibbons can climb very high even under sedation and restraint and therefore care should be taken to keep the animal on the ground.
- A pet carrier or wooden transport box can be used as a temporary method of transport when under physical restraint.

8.3 Routine Treatments

- Faecal checks should occur twice a year as a minimum requirement to check for internal parasites (Cocks 2000, p. 16).
- Intestinal worm treatment can be given every 3 months or when an infestation occurs.
- Keepers maintaining daily health checks and observations should pick up on changes to ensure treatments occur to keep parasites, infections and diseases at bay.

8.4 Known Health Problems

Parasitic Disease (from Cocks 2000, p. 16)

- Non-human primates are potential hosts for a large number of parasites.
- Many of the parasites found in non-human primates can potentially be transmitted to humans including *Giardia intestinalis*, *Entamoeba histolytica* and *Balantidium coli*. Readers are advised to appropriate human and veterinary medicine texts for more information on zoonotic parasites of non-human parasites eg (Schultz 1986, Ott-Joslin 1993, as cited in Cocks 2000, p. 17).
- Parasite Species that may be observed on Examination of Faeces (Bodley 2000, as cited in Cocks 2000, p. 17). Some of the parasites that may be found on examination of faeces from *H. moloch* are listed below:
 - o Protozoa: *Balantidium coli*, *Entamoeba histolytica*, *Giardia intestinalis*
 - o Nematodes: Rhabditoids, i.e. *Stongyloides stercoralis*; Trichurids, i.e. *Anatrichosoma cynomolgi*; Oxyurids, i.e. *Enterobius* spp.
 - o Cestodes, i.e. *Hymenolepis nana*

Zoonotic Diseases (from Cocks 2000, p. 17)

- Keepers involved in the care of non-human primates should be aware of the potential for exchange of pathogens between the animal in their care and humans
- There are a large number of potentially zoonotic pathogens carried by non-human primates including bacteria (eg. *Salmonella* spp., *Shigella* spp., *Mycobacterium* spp.), viruses (e.g. measles (rubella) virus, Hepatitis B virus, Herpes Simplex) nematodes (e.g. oxyurids) and protozoa (e.g. *Giardia intestinalis*, *Balantidium coli*, *Entamoeba histolytica*).
- Transmission can occur via physical contact (bites, scratches), contact with animal tissue (blood, faeces, secretions), via airborne particles that are aerosolized, via ingestion, via insect vectors and via indirect transfer of fomites (eg. cleaning equipment used for servicing enclosures, keeper uniforms).

- Keepers are advised to follow precautionary measures when working with non-human primates. Adherence to precautionary measures will reduce the risk of zoonotic transmission.

Tuberculosis (from Cocks 2000, p. 18)

- The bacterial organisms *Mycobacterium tuberculosis* and *Mycobacterium bovis* can cause tuberculosis or TB in non-human primates.
- Non-human primates may acquire tuberculosis via contact with infected humans or by contact with other infected primates.
- Transmission is usually aerosol, but can occur through ingestion, and direct and indirect contact. Clinical signs vary, are non-specific (depending on location of lesions and disease severity) and can include any of the following: chronic cough, anorexia, weight loss, lethargy, diarrhoea and cutaneous abscesses.
- Prevention of the disease is via quarantine and testing protocols to reduce the probability of collection primates being exposed to the pathogenic *Mycobacteria*.
- Strict importation testing protocols should be followed, and regular surveillance of captive groups for the disease using intradermal skin testing and blood testing is recommended.

Hepatitis B Virus (from Cocks 2000, p. 19)

- Humans are the natural host for Hepatitis B (HBV) and serve as the primary reservoir for infection in non-human primates (Bielitzki, 1999 in Cocks 2000, p. 19).
- HBV has been discovered in 47% of 30 gibbons sampled however *Hylobates lar* was not part of the 30 studied (Lanford et al, 2000, as cited in Cocks 2000, p. 19). Keepers should be vaccinated as a precautionary measure when working with any gibbon species.
- Bite wounds and needle stick injuries are possible routes of transmission between non-human primates and humans.
- Infection in non-human primates may be asymptomatic, or may result in signs of hepatitis including anorexia, lethargy, jaundice and elevated liver enzymes detected on blood testing.

8.5 Quarantine Requirements

The following are requirements from the Policy on Exhibiting Primates in New South Wales (NSW Agriculture 2000, p. 15).

- Minimum 33 day quarantine period required, with two faecal tests that must be negative for parasites and bacteria and three negative tests for tuberculosis to be completed (Mootnick 1997, p. 274).
- Newly received primates must remain quarantined from resident primates until their health status has been established, in accordance with acceptable veterinary practice and any importation requirements. Any disease in a newly acquired primate must be successfully treated before it is placed with other residents.
- Primates which have been acquired in compatible groups must be kept in those groups during quarantine. Introductions to a new group must be undertaken slowly and with care.
- The quarantine area and its drainage system must be totally separate from regular holding areas. Staffing and feeding regimes must ensure that there is no contamination of the quarantine area from outside and vice versa. The physical and psychological needs of the animals whilst in quarantine must be provided for.
- Newly received primates must be vaccinated in accordance with the vaccination program of the resident animals.
- While primates are in quarantine, examination and, where indicated, treatment for internal and external parasites and any other tests or treatments prescribed by the veterinarian must be undertaken.
- A footbath containing an effective disinfectant must be used prior to entering all primate quarantine enclosures or areas containing quarantine enclosures and its use strictly adhered to by all personnel. A personal recommendation from experience is Virkon by DuPont.

9 Behaviour

9.1 Activity

- “In the wild, White-handed Gibbons spend about 35% of their day actively foraging for food, 24% in non-foraging activities (travel, play, sentry, aggression, mating, grooming or vocalizing) and 41% being inactive” (Pappas & Luckner-Loveless, 2002).
- A frequency in social activity occurs at times of increased ripe fruit abundance in the wild (Gron, 2009).
- The three predominant types of within-group social interaction include grooming, play (slapping, biting, wrestling etc) and social contact with grooming as the most common (Gron, 2009).
- There are some indications that allogrooming serves more a hygienic than social function in lar gibbons and tends to be reciprocal between individuals (Ellefson 1974; Reichard & Sommer 1994, as cited in Gron, 2009).
- - These are the most active of all gibbons. They move faster, more quietly, and farther each day than any other forest apes or monkeys. Brachiation comprises 90% of locomotor activity. They can easily leap a gap of 30 feet between one tree and another, (but because they can not swim, they avoid crossing open water) (Oakland Zoo, 2009).
- Other day activities could include travelling to search for food and play.

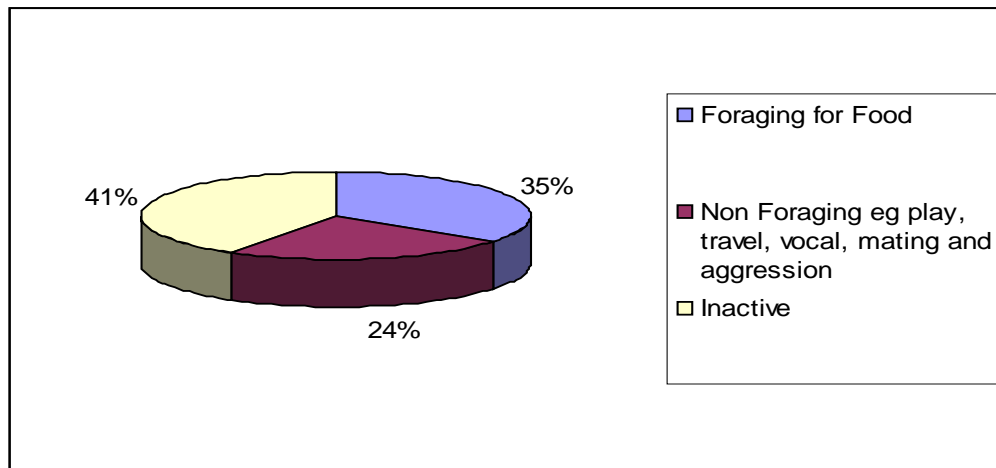


Image 13: Daily Activity Chart for White-Handed Gibbons.
(Pappas & Luckner-Loveless, 2002).

9.2 Social Behaviour

- Monogamous pairing is most common but polyandry can occur.
- Produce offspring every 3 years on average.
- Group is usually made up of father, mother and offspring. Usually no more than two to four offspring at a time.
- Sub-adult White-Handed Gibbons will be ejected out of the family unit at approximately 6-8 years of age when reaching sexual maturity.
- Grooming is the most common past time within the family group.
- Lar gibbons have seven basic vocalization note types. These include the "wa", "hoo", "leaning wa", "oo", "sharp wow", "wao" and "other" type of vocalization (Raemaekers et al. 1984; Clarke et al. 2006, as cited in Gron, 2009).
- - The White-Handed Gibbons have different calls for different situations. These include normal duets (structured vocalizations given by the mated pair usually during the mid-morning or afternoon), "ooaa" duets (similar to normal duets but rarer), calls emitted when disturbed (e.g. when predators are seen, in times of alarm, during territorial disputes or conflict), adult male solos (often given early in the day, near dawn or before), subadult male solos, adult female solos (given by mated females when isolated), and contact calls (Raemaekers et al. 1984; Raemaekers & Raemaekers 1985, as cited in Gron, 2009).
- Most vocalizations occur in the mornings and I have found this to occur after feeding. It will usually last from 10-15 minutes. (Personal experience).
- Duet calls probably serve to reinforce the bond between the mated pair, but also to exclude other gibbon individuals.
- Grimaces (exaggerated smiles) indicate subordination while open-mouth threats indicate an agonistic threat. Branch-jerks occur when a dominant animal shakes a branch and elicits submission from another individual (Ellefson 1974, as cited in Gron, 2009).
- There is no personal leadership of a White-Handed Gibbon group, although adult females lead group progressions most often.
- Disputes generally occur near the boundaries of the home range when two groups are in visual contact with one another and typically last around an hour (Bartlett 2003, as cited in Gron, 2009).
- The variability of the nature of interactions between neighboring groups may partly be the result of variable social and kin relationships between members of neighboring groups (Bartlett 2003, as cited in Gron, 2009).
- Inter-group interactions can be quite violent, and there is evidence that wounds incurred in territorial aggression have resulted in the death of combatants (Palombit 1993, as cited in Gron, 2009).

9.3 Reproductive Behaviour

- “While lar gibbons usually live in monogamous pairs, their reproductive system is complex and can be polyandrous, sometimes including flexible sexual relationships which often occur outside of the usual pair bond” (Gron, 2009).
- Mating occurs in every month of the year, but most conceptions occur during the dry season (March) with a peak in births during the late rainy season, in October (Barelli et al. 2008b; Savini et al. 2008, as cited in Gron, 2009).
- Female White-Handed Gibbons will display swelling, protrusion and colour change to the sex skin which starts several days before ovulation and ends after ovulation which is usually 7-11 days.
- There are no courtship displays as such but duetting can reinforce the pair’s bonds.

9.4 Bathing

- White-Handed Gibbons do not bathe. Water is provided for drinking which they will use leaves to suck the water off or their hands to scoop the water into their mouth.
- White-Handed Gibbons can be kept on islands as they cannot swim and are afraid of the water. They can go down and drink water from the edge or lean over and use the water as a toilet.

9.5 Behavioural Problems

The following information is stated in the Policy on Exhibiting Primates in New South Wales (NSW Agriculture 2000, p. 7):

- Abnormal behaviour patterns include: excessive grooming; hair pulling; repetitive pacing, running, jumping or rocking; social withdrawal; and self mutilation.
- White-Handed Gibbons are a Lesser Ape and therefore very intelligent and will become bored easily and destructive if no enrichment or stimulation is provided.
- White-Handed Gibbons can destroy enclosure furnishings and vegetation if bored.

9.6 Signs of Stress

- Lethargy.
- Diarrhoea or loose stools.
- Loss of appetite.
- Spending time away from family group.
- Swelling or unusual posturing.
- Lack of or limitation to movement.
- Unusual aggression or placidity.

9.7 Behavioural Enrichment

- A social species that must be housed with at least one other individual.
- - Primates must not be exhibited singly, with the exception of adult Orangutans. Primates must be held with other members of their own species in one of the types of group listed for that species in Schedule 3. In exceptional circumstances, where a particular primate is shown not to accept companionship, approval may be given by the Director-General for the housing of a single primate (NSW Agriculture 2000, p.7).
- White-Handed Gibbons must be housed with other species of Gibbon in the *Hylobates* group e.g. Muellers or Pileated.
- White-Handed Gibbons are best with 1.1 adults and 2-4 juveniles to ensure normal social interactions and behaviours.



Image 14: Jess and Jo the White-Handed Gibbons at Mogo Zoo
(Sophie Miller, 2009).

- Exhibit should display natural or natural looking furnishings e.g. ropes, poles and platforms.
- Should include furnishings at different heights and levels with some rigid and some flexible furnishings.
- Enclosure must allow for natural act of brachiation
- Tyres, hammocks, swings and toys can be used also to encourage social interaction and stimulation. An example from Aussiedog.com.au is a Gibbon Swing.



Image 15: Gibbon Swing from Aussiedog.com.au

- Sound recording of other gibbons can be played to stimulate a reaction e.g. territorial calling. Having other gibbons housed within earshot can also have a reaction if they hear them calling.

Feeding Examples

- A variety of fruit, vegetables, browse, proteins, nuts, seeds are offered to captive White-Handed Gibbons.
- Food should be scattered around the enclosure to ensure natural behaviours are exhibited and to encourage foraging.
- Browse should be given including willow, bamboo, wattle, eucalyptus, mulberry, fig, ginger and banana leaves amongst others. (See Appendix 4 for suitable browse for primates).

- Insects can be given including mealworms, crickets, silkworms either scattered or in boxes and hidden to provide a challenge.
- Special foods can be given as a treat every now and then including Persimmon, Pomegranate, Jack Fruit, Tamarillo, Custard Apple, Dragon fruit and Durian (Riley 2008, p. 32).
- Aromatherapy can be given including mint, basil, parsley, coriander, lavender, tea tree oil, spices, herbs and any novel smells. These can be given as is or placed in enrichment items e.g. boxes, hessian sacks or just rubbed around the exhibit.
- Containers either plastic or cardboard can be used to hide foods e.g. sultanas with small openings to encourage the gibbons to get a reward.
- Smears can be placed around the enclosure or on items e.g. toilet rolls and logs with holes. The smears can be honey, jam, peanut butter, mashed banana or pumpkin and filled with mealworms or sultanas.
- Frozen treats can be given in summer either hung up with string or placed around enclosure or in small seashell type pool to encourage them to scoop them out and keep cool. The treats are usually made up of chopped up fruit, water and fruit juices.
- Enclosure should allow for natural movement and either have enough room for every individual according to the state policy on exhibiting primates and either be enclosed if not an island enclosure or open air enclosure surrounded by a moat.
- Keepers can interact with White-Handed Gibbons but ideally it should be through mesh unless they are used to keepers being in the enclosure with them.
- Interaction through mesh can allow for grooming and training to occur should animals need to be anesthetized for medical reasons or to be sent away to another zoo.
- White-Handed Gibbons are a threat to humans and considered hazardous as they can bite and scratch and are a territorial species.
- Training should be done from a young age ideally “clicker” training where the animal is rewarded with a food treat after responding to clicker after doing something the keeper has asked of them.

Enrichment Examples Used at Honolulu Zoo www.honolulu zoo.org



IMAGE 16: FEEDER BALL



IMAGE 17: BROWSE HANGER



IMAGE 18: FEEDER BUCKET



IMAGE 19: FROZEN FRUIT BLOCK



IMAGE 20: WATER



IMAGE 21: STUFFED BANANA STALK



IMAGE 22: FEEDER MOP

9.8 Introductions and Removals

- When introducing unrelated pairs it should be done on neutral ground so no gibbon feels threatened.
- “Gibbons that are intimidated easily, especially those that have been housed alone for a number of years, should not be housed with aggressive conspecifics” (Mootnick & Nadler, 1997 in press, as cited in Cocks 2000, p. 15).
- The following information is stated in the Policy on Exhibiting Primates in New South Wales (NSW Agriculture 2000, p. 24) - Introduction or re-introduction of animals into a group must be undertaken with caution. Introduction must occur in a stepwise manner, increasing contact from sound and smell to sight and finally to physical.
- A separate area must be available to allow for introductions to take place which allows for ready separation of individuals and constant monitoring. Once given physical contact, the group must be very closely observed for 48 hours with daily monitoring for at least two months.
- A submissive hand-reared gibbon should be familiar with its surroundings before a conspecific enters the enclosure, and a slow introduction is preferred (Breznock *et al* 1979, Mootnick & Nadler, 1997 in press, as cited in Cocks 2000, p. 15).
- Indications that the introductions are going well are grooming, duetting, sharing food and copulation.
- If no aggression is shown, then interaction time can be increased each day. Separate feeding areas should still be given and the gibbons can choose if they wish to food share.
- If one or both of the gibbons is very aggressive, Mootnick, (1996, as cited in Cocks 2000, p.15) recommends having three connecting enclosures, so that the gibbons have visual contact with each other before they are housed into the adjoining enclosure.
- It is not recommended to house adult same-sex pairs together as this may result in aggressive encounters (Cocks 2000, p. 15).
- Adult offspring should be removed from the natal group before they are peripheralized (Mootnick 1996, as cited in Cocks 2000, p. 15).
- Peripheralization or an individual being outcast can occur anywhere between the ages of five to eight years of age at the age of sexual maturity (Cocks 2000, p. 15).

9.9 Intraspecific Compatibility

- It is not recommended to house adult same-sex pairs together as this may result in aggressive encounters (Cocks 2000, p.15).
- Indications that the introductions are going well are grooming, duetting, sharing food and copulation.
- White-Handed Gibbons usually mate for life or until a partner passes away. If placed together from a young age there should not be many problems as long as their behaviours have been monitored at the zoo they were previously at.

9.10 Interspecific Compatibility

- In the wild they are partially sympatric with Siamang (*Hylobates syndactylus*), pileated gibbons (*Hylobates pileatus*) and dark-handed gibbons (*Hylobates agilis*). The White-Handed Gibbon will compete with pig-tailed macaques (*Macaca nemestrina*) for food. The gibbons have been observed to harass the macaques by loud hooting, chasing, and biting in order to protect a small tree with large fruit (Rowe 1996, p. 211-212).
- White-Handed Gibbon has also been placed successfully with same sex (female) Muellers Gibbon (*Hylobates muelleri*) at Mogo Zoo (personal observation). There have also been cases of White-Handed Gibbon and Siamang living together.
- In recent times Siamang gibbons have been successfully housed with Orangutans at Adelaide and Melbourne Zoo (personal observation).

9.11 Suitability to Captivity

- The exhibit should allow for natural movement and brachiation and it should provide space to get away from other members of the group.
- White-Handed Gibbons have been housed successfully at zoos all over the world for many years. They have been shown to be kept successfully as pairs, family groups, same sexed pairs, and even unrelated pairs e.g. with Mueller's Gibbon.
- They are a lot easier to house than great apes. They require less room and do not have the same level of strength.
- If White-Handed Gibbons are housed in pairs or groups and provided with a variety of foods in their diet, enrichment and stimulation, then they should not become bored or destructive.
- Sub-adults should be removed around 5- 8 years of age to ensure no aggression or self mutilation occurs due to stress.

10 Breeding

10.1 Mating System

- Monogamous pairing meaning usually one mate for their lifespan.
- “Groups with one female and multiple males can be polyandrous” (Gron, 2009).
- New pairings can be made if one partner dies although not always successfully.

10.2 Ease of Breeding

- If the female and male White-Handed Gibbons get along then mating should occur naturally with no intervention from keepers.
- Mating can occur all year round and allowing interaction between the sexes and copulation should lead to breeding success.

10.3 Reproductive Condition

10.3.1 Females

- Females must be in good physical condition and health to carry young.
- Females must be able to physically carry the young to full term and nurse the young eg be of appropriate age for breeding.
- Vitamin D source e.g. sunlight is required for primates and to ensure the full term birth of the young.
- Providing a stimulating natural environment and grouping the gibbons appropriately should help the females prepare for and care for the young.

10.3.2 Males

- The reproductive male will normally be the dominant male if living in a group system.
- Males must be in good physical condition to ensure healthy genes are given to the young and to give it the best chance in life.
- Studbook keepers in zoos would ensure pair bonding will only occur between non related gibbons to ensure new genes are passed on and creating new bloodlines.

10.4 Techniques Used to Control Breeding

- Female and males can be housed in single sexed groups to ensure no breeding.
- Females can have a hysterectomy to prevent pregnancy.
- Breeding can be controlled by males getting a vasectomy.
- Females can also have a contraceptive method e.g. oral contraceptive.
- Separating the males and females can be done and housed individually but would not be recommended as they are monogamous and pair bond. This could lead to a stressful situation for individuals.

10.5 Occurrence of Hybrids

- “There have been some occurrences of hybrid gibbons where zoos could not identify different species and some White-Handed Gibbons were mated with Javan or Hoolock Gibbons” (Geissman 1995, p. 468).
- “Hybridization has occurred also where a female Siamang and a male gibbon were mated and had young” (Wolkin & Myers 1980, p. 203).
- Hybridization has also occurred in the wild where ranges may overlap.

10.6 Timing of Breeding

- “In captivity breeding can occur all year round and the oestrus cycle length is 27 days” (Harvey, Marin & Clutton-Brock, 1987, pg 181-196).
- “Lar gibbon females exhibit swelling, protrusion and color change of the sex-skin beginning several days before ovulation and ending after ovulation, usually lasting around 7-11 days .Pregnant females also show sexual swelling, but at random times during pregnancy (Dahl & Nadler 1992; Barelli et al. 2007, as cited in Gron, 2009).
- “The interbirth interval is usually 3 years with a minimum length of 41 months” (Brockelman et al. 1998; Reichard & Barelli 2008, as cited in Gron, 2009).
- “Most conceptions occur during the dry season (March) with a peak in births during the late rainy seasons in October” (Barelli et al. 2008b; Savini et al. 2008, as cited in Gron, 2009).

FIGURE OF BREEDING TIMES FOR *Hylobates lar*.
(Barelli et al. 2008b; Savini et al. 2008, as cited in Gron, 2009).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Breeding Season												
Peak Mating Period												
Peak Parturition												

10.7 Age at First Breeding and Last Breeding

- From studies I have seen of both wild and captive animals, gibbons are thought to reach sexual maturity at about 6 to 8 years of age (Geissman 1991, p. 11).
- There is no definite last breeding age. In general it seems to occur to Gibbons in their late twenties to early thirties (personal observations).

10.8 Ability to Breed Every Year

- “The gestation period for a White-Handed Gibbon is 7 months approximately or 205 days” (Harvey, Marin & Clutton-Brock, 1987, pg 181-196).
- A female may breed again in the same year if the young is aborted early on in the pregnancy.
- White-Handed Gibbons can not breed every year when birth and young is successful. They will usually have another young after 3 years.

10.9 Ability to Breed More Than Once Per Year

- The White-Handed Gibbon is unable to breed more than once per year.

10.10 Nesting, Hollowing or Other Requirements

- In captivity, White -Handed Gibbons do not have nesting practices.
- A nesting box can be provided with straw or hessian sacks however they are not usually used at time of birth.
- Birth will usually occur in the night den if access is available.

10.11 Breeding Diet

- A general increase in food is usually given to expectant mothers.
- An increase in protein e.g. egg may be given also.
- Extra supplements to assist pregnant gibbon can be given also e.g. OSSOL.
- Increased appetite can lead to aggression at feed time. Hand feeding the pregnant female to ensure she gets what she requires is recommended.

10.12 Oestrus Cycle and Gestation Period

- - “In captivity breeding can occur all year round and the oestrus cycle length is 27 days” (Harvey, Marin & Clutton-Brock, 1987, pg 181-196).
- “The gestation period for a White-Handed Gibbon is 7 months approximately or 205 days” (Harvey, Marin & Clutton-Brock, 1987, pg 181-196).

10.13 Litter Size

- “One infant, however twin Siamangs have occurred but twin gibbon births are a rare occurrence” (Dal Pra & Geissman 1994, p. 325).

10.14 Age at Weaning

- Weaning occurs by the age of 2 although young will stay part of the family group for a few more years.
- Mother can breed again once the infant is weaned.
- “Food sampling will begin at a younger age, usually around 4-6 months of age” (Ellefson 1974; Roberts 1983, cited in Gron, 2009).
- The young will still suckle whilst mother allows them to.

10.15 Age of Removal from Parents

- Offspring will remain with the family until peripheralization occurs.
- “Adult offspring should be removed from the natal group before they are peripheralized. Peripheralization can occur from about five to eight years of age” (Mootnick, 1997, cited in Cocks 2000, p. 15).

10.16 Growth and Development

- “At birth White-Handed Gibbons weigh an average of 383.4 grams, are nearly naked with a dark skin colour” (Gron, 2009).
- They are able to vocalize soon after birth.
- Infants are carried by clinging to their mother’s ventrum (the stomach).
- Infant will first ingest solids at approximately four months of age.
- “At around four months it may move a short distance from its mother if allowed” (Ellefson 1974, as cited in Gron, 2009).
- While uncommon, a measure of parental care of an infant was seen in captivity including predominantly play behaviors (Clemens et al. 2008, cited in Gron, 2009).
- “Brachiation has been seen to occur by a captive infant at 9 months of age” (Roberts 1983, as cited in Gron, 2009).
- Weaning will occur around two years of age.



Image 23: Infant White-Handed Gibbon.
Source: Primatology.net (2009)



Image 24: Mother and infant White-Handed Gibbon.
Source: gibboncenter.org (2009)

11 Artificial Rearing of Mammals

- Hand raising should be avoided if possible.
- “Hand-rearing must only be undertaken in exceptional circumstances, in consultation with animal management staff, the Species Coordinator and a veterinarian with primate experience” (Ihaka, 2008).
- “Male gibbons, which were hand raised, appear to be more adversely affected sexually than female gibbons. Although females may be sexually inadequate they can usually be induced to present sexually by dominant male partners” (Mootnick & Nadler, 1997, as cited in Cocks 2000, p. 15).
- Gibbon Handraising at Perth Zoo: Analysis of Methods and Suggested Guidelines (Campbell, 2008) will be used throughout this section in large parts.
- Hand raising of baby Siamang at Auckland Zoo will also be referenced. There is no published paper but revision notes are supplied from Senior Keeper Christine Tintinger.

11.1 Housing

- For newborn gibbons a humidicrib can be used until they are stabilized (Campbell, 2008) (See Appendix 5).
- Newborn or young gibbons can be kept in human incubators where the temperature was maintained between 31 – 35 degrees Celsius and 65% humidity for the first 6 weeks of age (Kirkwood & Stathatos 1992, p. 137).
- Gibbons can be kept in a cot when it does not require the humidicrib anymore or something similar to a cot (Campbell, 2008).
- Placing some small ropes and branches can help encourage natural locomotion and help allow the infant to develop the required skills for brachiation (Campbell, 2008).
- Allowing the infant to spend time outside can be beneficial and help them learn the sights, sounds and smells of the environment. (Campbell, 2008). The infants must have visual and olfactory contact with other members of the family and try and be introduced into the family group as soon as possible.
- Iwani the hand raised male Siamang at Auckland Zoo was housed in a portable mesh birdcage at 4 months of age with an overhead heat lamp. He was placed in front of the Siamang enclosure. (Tintinger, 2010).

11.2 Temperature Requirements

- Depending on the age of the infant, it is unlikely that it can maintain its own body temperature so appropriate housing must be provided, such as a humidicrib (Campbell, 2008).
- “The temperature should be set to 30°C (85°F) (Strasser, 2002, as cited in Campbell, 2008). The infant should always be provided with a heat source. This can include heat lamps and heat pads. Care must be taken to avoid over heating. Only cotton blankets should be used and the infant should have the opportunity to move away from or closer to the heat source” (Strasser, 2002, as cited in Campbell, 2008).

11.3 Diet and Feeding Routine

The following information is stated in *Gibbon Handraising at Perth Zoo* (Campbell, 2008) and was successful for three infant gibbons:

- Glass or plastic bottles can be used although specialist animal feeding bottles are a more appropriate size for gibbons.
- The recommended teats are Enfamil neonatal Nipple by Mead Johnson or Similac Special Care teats by Abbott Laboratories (See Appendix 5).
- Human milk formulas have proved successful for young gibbons and the most suitable. In Australia, S26 Gold has been a successful formula that hasn't required any additional supplements (See Appendix 6). Karicare can be used also (Tintinger, 2010).
- Recommended milk formulas include SMA and Carotid for Siamang infants (Ihaka, 2008).
- When calculating milk volumes a target of 20% of the infant's body weight in total milk volume should be used. Milk should be offered at 50% strength to begin with and gradually increased to full strength over a period of a few days. Cool pre boiled water should be used to make formula. Guargol a thickening agent has been added to milk during periods of unexplained diarrhoea (See Appendix 6). Discard any unused formula after 24 hours.
- The volume of each feed can be gradually increased and the frequency of feeds reduced.
- Solid foods should be offered to infant gibbons at approximately 60 days and increased gradually.

Table 1 shows a comparison between weights, milk and solid intake and number of feeds per day for the three infants raised at Perth Zoo (Campbell, 2008).

Age (days)	Expected Body Weight (grams)			Total milk intake			Number of feeds per day			Total Solid intake		
	Jermei	Meili	Lily	Jermei	Meili	Lily	Jermei	Meili	Lily	Jermei	Meili	Lily
0-5	-	560	552	-	160	143	-	10	11	-		
10	-	638	593	-	224	120	-	10	11	-		
20	-	742	688	-	189	144	-	8	11	-		
30	-	824	748	-	230	160	-	8	11	-		
40	642	908	796	159	232	178	8	8	8	-		
50	656	970	832	154	264	205	7	8	8	-		
60	640	1034	874	118	264	200	7	7	7	10	10	
70	644	1024	916	150	205	210	7	7	9	10	10	
80	742	1030	950	174	201	220	7	7	9	10	50	
90	830	1096	954	194	224	220	7	7	9	10-20	50-80	
120	1052	1199	1118	208	226	230	6	6	7	20-30	80-100	
150	1174	1362	1258	139	194	178	4m 2s	6	5	30-80	120	
180	1282	1500	1410	120	200	135	3m 2s	6	4	80 +b	120	
210	1400	1590	1588	120	185	108	3m 2s	5	3	130 +b	150	
240	1520	1688	1660	170	126	120	3m 2s	3	3	150 +b	150	+ b
270	1500	1800	1872	165	99	120	3m 2s	3	3	160 +b	150	
300	1700		2036	150	77	120	3m 2s	2	3	160 +b	150	
330	1750		2207	180		120	3m 2s		3	160 +b		
360	1850		2364	170		120	3m 2s		3	160 +b		
400	2000			180			3m 2s			160 +b		
450	2100			180			3m 2s			160 +b		
500	2300											

m= milk formula

s = solids (fruit and vegetables)

b= milk balls make from formula and Farax or Heinz baby cereal

11.4 Specific Requirements

- White-Handed Gibbons do not have any specific requirements that differ from other Gibbon species. The Siamang being the largest gibbon species would require an increased amount of milk due to its larger size.
- “Calling behaviours in gibbons appear to be instinctive and these behaviours will often develop in the hand raised infant prior to any exposure to or experience with adults” (Campbell, 2008). Opportunities for song development should be given, for example access to a recording of White-Handed Gibbons calling and also to their parents if preferable to hear and see them singing.

11.5 Data Recording

- “Body weight should also be recorded daily and other measurements taken throughout the infant’s development” (Campbell, 2008).
- Neonates are thought to weigh approximately 400 grams at birth. Births weights can range from 264g (premature) to 437 grams with a mean of 370 grams (Sasaki 1962; Rumbaugh 1966; Keeling & McClure 1972; Schultz 1973 as cited in Kirkwood & Stathatos 1992, p. 134).
- “A developmental record should also be kept detailing significant stages in the infant’s physical and behavioural development” (Campbell, 2008).
- “During the initial care phase the temperature, pulse and rate of respiration should be checked every three hours around the clock. After 2 weeks this can be reduced to twice daily and then after a month, once daily should suffice” (Strasser, 2002, cited in Campbell, 2008).
- Scales will be required to weigh the infant at regular intervals.
- A rectal thermometer will also be required to take the body temperature. A lubricant should be applied and the thermometer should be disinfected before and after each use (Campbell, 2008).
 - Daily neonate sheets should be maintained which record formula used, date, day of hand raising, time of feeds, milk strength, volume offered, volume taken, body temperature, TVI (total volume intake), Body weight, % BWT in formula and general observations of the infant. Consistency and frequency of the faeces should also be recorded and all carers should agree on appropriate terms to maintain consistency and avoid ambiguity (Campbell 2008).

11.6 Identification Methods

- White-Handed Gibbons usually give birth to one infant so identification should not be a problem.
- To tell one individual from another you can look at the facial markings or any physical markings or features that look different. For example at Mogo Zoo Jessica the White-Handed Gibbon has a full ring of white around her face and a whiter back where Josephine has half moon markings around her face and is a darker colour (personal observation).
- Using a microchip scanner is a last method under sedation to tell which gibbon is which.

11.7 Hygiene

- Juvenile gibbons will have a reduced immunity compared to the adult gibbons which makes it easier for them to get general diseases.
- Hygiene is very important especially if the infant has not received the first milk (colostrum) from its mother within 24 hours as it will make the infant more susceptible to infections.
- Gloves and facemasks should be used by keepers at all times when they have contact with the infant until it has stabilized (Campbell, 2008)
- Washing hands is necessary before and after handling the infant gibbon.
- The infant should have exposure to as little keepers as possible to avoid exposure to infections in the first few days.
- Human illnesses such as colds, flus and herpes simplex (cold sores in people) are easily transferrable to gibbons so facemasks are a definite.
- “Care should be taken to correctly handle and clean the infants feeding utensils. Teats and bottles should be soaked in Milton's formula after each use and rinsed in boiling water prior to use” (Campbell, 2008).
- Nappies can be used to help keep the infant clean but must be checked and changed at regular intervals.

11.8 Behavioural Considerations

- Infant gibbons require a lot of attention and affection from their keepers when hand raised but care should be taken to avoid imprinting. Imprinting can lead to behavioural problems later in life and lead it to never live life as a gibbon should.
- Socialization with other gibbons is vital when they are hand raised. This can mean sitting its cage near the main exhibit for a few hours a day. Iwani the male hand raised Siamang at Auckland Zoo was placed in a cage built especially for him beside the public Siamang enclosure. He was there during the day so he could touch his family and vice versa (Tintinger, 2010).
- Male gibbons, which were hand raised, appear to be more adversely affected sexually than female gibbons. Although females may be sexually inadequate they can usually be induced to present sexually by dominant male partners (Mootnick & Nadler 1997, as cited in Cocks 2000, p. 15).
- Infant gibbons would experience a level of discipline from their parents and siblings. It is vital that they have an understanding of this prior to re-introduction. The keepers should provide a level of discipline (Campbell, 2008).
- Chances to develop natural behaviours should occur e.g. locomotion, brachiation and vocal (Campbell, 2008).
- Calling behaviours appear to be instinctive and the behaviours should develop in the infant prior to exposure or experience with adult gibbons (Campbell, 2008).

- The development of normal gibbon behaviours is the primary concern for hand raised infants. Opportunities to socialize with other infant or juvenile gibbons are ideal and provide exposure to the full range of normal behaviours (Campbell, 2008).

11.9 Use of Foster Species

- There have been no known published cases of fostering/rearing by another species. Only of a grand-mother Siamang fostering her grandchild when the mother rejected the infant at Howletts Wild Animal Park in 1991 (Thetford 1991, p. 28).
- “It is obviously very important to give young primates that have this clinging instinct a substitute mother in the form of a cloth, piece of animal skin, etc, to hold on” (Sasaki 1963, p. 290).
- It would be possible for rearing to occur by a different gibbon species but there would be considerations such as song development. The song is different for every species and the social structure also is varied. For example Siamang fathers help raise the young but in White-Handed Gibbons the father does not play a part.

11.10 Weaning

Tintinger (2010) suggests the following schedule from weaning to solids for a Siamang infant.

- 5 weeks – when rejected 30mls 50/50 SMA (human baby milk powder).
- 6 weeks – 70% SMA and 30% Vytrate. Milk powder changed to Karicare. 7-8 feeds a day from 6:30am – 10pm.
- 2 months – introduce infant to puree baby food with 6 milk feeds still.
- 3 months – Offer infant apple, pear and banana with 5-6 milk feeds.
- 4 months – Offer variety of vegetables, fruit, dried fruit, bread, greens with 4-5 milk feeds still (60ml).
- 5 months – Has access to solids in cage ad lib with 3 milk feeds only in the daytime.
- 6.5 months – milk feeds are reduced to two a day – am and pm. Begin drinking from water bottle.
- 7.5 months – milk feed once a day and milk remains at 60mls.
- Juvenile was fully weaned off the milk feeds at 14 months 2 weeks.

Weaning can begin at 60-90 days and be complete by approximately 440 days.

Weights of Iwani the hand raised male Siamang gibbon at Auckland Zoo.

43 days	723 grams	6/5/2003
74 days	800 grams	6/6/2003
105 days	921 grams	6/7/2003
138 days	1168 grams	6/8/2003
169 days	1411 grams	6/9/2003
197 days	1651 grams	6/10/2003
227 days	1837 grams	6/11/2003
256 days	2038 grams	6/12/2003
287 days	2282 grams	6/1/2004
318 days	2428 grams	6/2/2004
347 days	2645 grams	6/3/2004
378 days	2810 grams	6/4/2004
405 days	3104 grams	3/5/2004 (fully integrated with family so weighing discontinued)

11.11 Rehabilitation and Release Procedures

- Imprinting or the chances of imprinting should be watched out for as this can lead to behavioural and social problems in the future.
- Keepers should provide stimulation to develop the infant gibbons natural behaviours eg ropes, branches and toys.
- The infants should be given chances to learn the natural gibbon behaviours e.g. locomotion, brachiation and song development. They should also be given visual and olfactory access to other gibbons.
- Successful reintroduction of hand-reared gibbons has been documented. A training program at Disney's Animal Kingdom allowed a male infant white cheeked gibbon to be reintroduced to his mother and older sister while still bottle feeding. The mother had two previous offspring removed from her and had shown poor maternal skills (Richards et al., 2000, cited in Ihaka, 2008). This training may be appropriate for future hand raising of White-Handed Gibbons.

Reintroduction information taken from Campbell (2008)

- Reintroduction should be attempted at the earliest possible opportunity that will not compromise the well being of the infant. This does not have to be at the time of weaning as mothers and infants can be trained (operant conditioning) to get supplementary feeds after reintroduction. The infant should be able to maintain its own body temperature and be independent enough to be mobile should the mother leave it for short periods or abandon it.

The keys to a successful reintroduction are:

- The mother has some recognition of what the infant is.
- During contact sessions there should not be any obvious aggression from the parents or enclosure mates.
- The infant should recognize a food source either from the keeper or its natural mother.
- The mother should have the ability to handle the infant. Also be able to carry it depending on the age it is reintroduced and groom also.
- Any staff involved in the reintroduction should have a good understanding of the individual characters involved and also have established a good rapport with the animals.



Image 25: White –cheeked gibbons being introduced gradually at Perth Zoo.
(Campbell, 2008)

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JESS



JO

PHOTOS: (SOPHIE MILLER, 2009)

13 References

- ARAZPA Standards – Provision of Food and Water. (2009). Viewed Sep 20, 2009. www.arazpa.org.au
- ARAZPA. (2009). *Census of Mammalia in ARAZPA Institutions*. Australasian Region of Zoological Parks and Aquaria, 91 pages.
- Brockelman, W & Geissman, T. (2008). *Hylobates lar* IUCN Red List of Threatened Species, Viewed March 15, 2010. www.iucnredlist.org/details/10548
- Campbell, C. (2008). *Gibbon Handraising at Perth Zoo: Analysis of methods and suggested guidelines*, Perth Zoo, WA, 31 pages.
- Chan, J. (1998). *Live Animal Regulations*. 25th Edition, International Air Transport Association, Montreal, Geneva.
- Chivers, DJ & Raemaekers, J. (1986). *Natural and synthetic diets of Malayan gibbons*. Primate Ecology and Conservation, Volume 2, Cambridge University Press, pp. 39-56.
- CITES -Convention on International Trade in Endangered Species. (2010). Viewed March 7, 2010. www.cites.org
- Cocks, L. (2000). *Husbandry Manual for the Javan Gibbon (Hylobates moloch)*. Perth Zoo, 24 pages.
- Geissman, T. (1991). *A reassessment of age of sexual maturity in gibbons (Hylobates spp.)*. American Journal of Primatology 23, pp. 11-22.
- Dal Pra, G and Geissman, T. (1994). *Behavioural Development of twin Siamangs (Hylobates syndactylus)*. Primates 35 (3), pp. 325-342.
- Geissman, T. (1995). *Gibbon systematics and species identification*. International Zoo News 42, pp. 467-501.
- Geissman, T. (2010). *Gibbon Research Lab*. Last Viewed March 29, 2010. www.gibbons.de
- Gron, K.J. (2009). Primate Fact Sheets: Lar Gibbon (*Hylobates lar*) Behaviour. Last Viewed March 29, 2010. http://pin.primate.wisc.edu/factsheets/entry/lar_gibbon/behav.
- Harvey, P, Martin, R & Clutton-Brock, T. (1987). *Life histories in comparative perspective*. Primate Societies, University of Chicago Press, Chicago, pp. 181-196.

- Ihaka, M. (2008). *Husbandry Manual for the Siamang Gibbon (Hylobates syndactylus)*. Auckland Zoo.
- Kirkwood, JK & Stathatos, K. (1992). *Biology, Rearing, and Care of Young Primates*, Oxford University Press, New York, USA.
- Mootnick, A. (1996). *Captive Management and the reproduction of the Pileated Gibbon (Hylobates pileatus) at the International Center for Gibbon Studies*, California, International Zoo Yearbook 35, The Zoological Society of London.
- Mootnick, A. (1997). *Management of Gibbons (Hylobates spp.) at the International Center for Gibbon Studies*. International Zoological Yearbook 35, The Zoological Society of London , pp. 271-279.
- Mootnick, A & Nadler, R. (1997). *Sexual behaviour of maternally separated gibbons (Hylobates spp.)*. Developmental Psychobiology 31, pp. 149-161.
- NSW Agriculture. (2000). *Policy on Exhibiting Primates in New South Wales*, Exhibited Animals Protection Act, 74 pages.
- Oakland Zoo. (2009). *White-Handed (Lar) Gibbon*, Viewed August 12, 2009. <http://www.oaklandzoo.org/animals/mammals/white-handed-lar-gibbon/>
- Pappas, K & Luckner-Loveless, B. (2002). *White-Handed Gibbon Enrichment*, Zookeepers Journal, Viewed Sep 11, 2009. www.honolulu zoo.org
- Pappas, K & McLennan, L. (2002). *White-Handed Gibbon*. Zookeepers Journal. Viewed Dec 7, 2009. www.honolulu zoo.org
- Primate Store. (2009). Viewed Aug 12, 2009. www.primat estore.com
- Raemaekers, J. (1979). *Ecology of sympatric gibbons*. Folia Primatol 31, pp. 227-245.
- Riley, R (2008). *Husbandry Manual for Siamang (Hylobates syndactylus)*. Western Sydney Institute of TAFE, Richmond, 57 pages.
- Roonwal, ML & Mohnot, SM. (1977). *Primates of South Asia: Ecology, Sociology and Behaviour*. Harvard University Press, Cambridge.
- Rowe, N. (1996). *The Pictorial Guide to the Living Primates*. Pogonias Press, USA.
- Sasaki, T. (1963). *Hand-rearing a Baby Gibbon (Hylobates lar)*. International Zoo Yearbook, Vol 4, Issue 1, The Zoological Society of London, pp. 289-290.

Thetford, E. (1991). *A siamang fostered at Howletts Zoo Park*. International Zoo News 38/8 (233, Dec,1991), pp.28-30.

Tintinger, C. (2010). *Hand raising baby Siamang at Auckland Zoo: personal notes*. Email and phone correspondence.

Van Schaik, C & Dunbar R. (1990). *The evolution of monogamy in large primates: a new hypothesis and some crucial tests*. Behaviour 115 (1-2), pp 30-59.

White-Handed (Lar) Gibbon. (2010). Last Viewed Feb 12, 2010.
www.oaklandzoo.org/animals/mammals/white-handed-lar-gibbon/

White-Handed Gibbon Species Fact Sheet. (July 2006). Durrell Wildlife Conservation Trust.

White-Handed Gibbon. (2010). Jungle Walk, Viewed Oct 18, 2009.
<http://www.junglewalk.com/popup.asp?type=a&AnimalAudioID=11024>

Wolkin, JR & Myers, RH. (1980). *Characteristics of a Gibbon-Siamang Hybrid Ape*. International Journal of Primatology 1, pp. 203-221.

Yang, CW & Yang, CJ. (2009). *The Foraging Behaviour Enrichment of Primates in Taipei Zoo*. Viewed July 24, 2009.
http://www.seaza.org/scientific_papers/foraging_behavior_enrichment_of_.htm

14 Bibliography

ARAZPA Standards – Provision of Food and Water. (2009). Viewed Sep 20, 2009.

www.arazpa.org.au

ARAZPA. (2009). *Census of Mammalia in ARAZPA Institutions*. Australasian Region of Zoological Parks and Aquaria, 91 pages.

Barelli, C & Heistermann, M. (2007). *Sexual swellings in wild white-handed gibbon females (H. lar) indicate the probability of ovulation*. Hormones and Behaviour 51, pp. 221-230.

Bartlett, TQ. (2003). *Intragroup and Intergroup Social Relations in White-Handed Gibbons*, International Journal of Primatology 24(2), pp. 239-259.

Bartlett, TQ. (2007). *Feeding and Ranging Behaviour of the White-Handed Gibbons (Hylobates lar) in Khao Yai National Park, Thailand*. PhD Thesis, Washington University, St Louis, 193 pages.

Brockelman, W & Geissman, T. (2008). *Hylobates lar IUCN Red List of Threatened Species*, Viewed March 15, 2010. www.iucnredlist.org/details/10548

Campbell, C. (2008). *Gibbon Handraising at Perth Zoo: Analysis of methods and suggested guidelines*, Perth Zoo, WA, 31 pages.

Chan, J. (1998). *Live Animal Regulations*. 25th Edition, International Air Transport Association, Montreal, Geneva.

Chivers, DJ & Raemaekers, J. (1986). *Natural and synthetic diets of Malayan gibbons*. Primate Ecology and Conservation, Volume 2, Cambridge University Press, pp. 39-56.

CITES -Convention on International Trade in Endangered Species. (2010). Viewed March 7, 2010. www.cites.org

Cocks, L. (2000). *Husbandry Manual for the Javan Gibbon (Hylobates moloch)*. Perth Zoo, 24 pages.

Dahl, J & Nadler, R. (1992) *Genital swelling in female of the monogamous gibbon (Hylobates (H) lar)*. American Journal of Physical Anthropology 89, pp. 101-108.

Dal Pra, G and Geissman, T. (1994). *Behavioural Development of twin Siamangs (Hylobates syndactylus)*. Primates 35 (3), pp. 325-342.

Fisher, JO & Geissman, T. (1990) *Group Harmony in gibbons: Comparison between white-handed gibbon (Hylobates lar) & Siamang (Hylobates syndactylus)*. Primates 31, pp. 481-494.

Geissman, T. (1991). *A reassessment of age of sexual maturity in gibbons (Hylobates spp.)*. American Journal of Primatology 23, pp. 11-22.

Geissman, T. (1995). *Gibbon systematics and species identification*. International Zoo News 42, pp. 467-501.

Geissman, T & Orgeldinger, M. (1995) *Neonatal weight in gibbons (Hylobates spp.)*. American Journal of Primatology 36, pp. 179-189.

Geissman, T. (2002). *Duet-splitting and the evolution of gibbon songs*. Biological Reviews 77, pp. 57-76

Geissman, T. (2010). *Gibbon Research Lab*. Last Viewed March 29, 2010. www.gibbons.de

Gron, K.J. (2009a). Primate Fact Sheets: Lar Gibbon (*Hylobates lar*) Behaviour. Last Viewed March 29, 2010. http://pin.primate.wisc.edu/factsheets/entry/lar_gibbon/behav.

Gron, K.J. (2009b). Primate Fact Sheets: Lar Gibbon (*Hylobates lar*) Conservation. Last viewed March 29, 2010. http://pin.primate.wisc.edu/factsheets/entry/lar_gibbon/cons.

Gron, K.J. (2009c). Primate Fact Sheets: Lar Gibbon (*Hylobates lar*) Taxonomy, Morphology and Ecology. Last Viewed March 29, 2010. http://pin.primate.wisc.edu/factsheets/entry/lar_gibbon/taxon.

Harvey, P, Martin, R & Clutton-Brock, T. (1987). *Life histories in comparative perspective*. Primate Societies, University of Chicago Press, Chicago, pp. 181-196.

Ihaka, M. (2008). *Husbandry Manual for the Siamang Gibbon (Hylobates syndactylus)*. Auckland Zoo.

Kalaweit Project for Rescue of Gibbons in Indonesia. (2010). Last Viewed March 29, 2010. www.kalaweit.org/index_eng.php

Kirkwood, JK & Stathatos, K. (1992). *Biology, Rearing, and Care of Young Primates*, Oxford University Press, New York, USA.

Lappan, S & Whittaker, D. (2009). *The Gibbons- New Perspective on small ape socioecology and population biology*. Springer, New York, USA.

Mootnick, A. (1996a). *Captive Management and the reproduction of the Pileated Gibbon (Hylobates pileatus) at the International Center for Gibbon Studies*, California, International Zoo Yearbook 35, The Zoological Society of London.

Mootnick, A. (1996b). *Gibbon (Hylobatidae) Species Identification Recommended for Rescue or Breeding Centers*. Gibbon Conservation Center, California, Primate Conservation, pp. 103-138.

Mootnick, A. (1997). *Management of Gibbons (Hylobates spp.) at the International Center for Gibbon Studies*. International Zoological Yearbook 35, The Zoological Society of London, pp. 271-279.

Mootnick, A & Nadler, R. (1997). *Sexual behaviour of maternally separated gibbons (Hylobates spp.)*. Developmental Psychobiology 31, pp. 149-161.

NSW Agriculture. (2000). *Policy on Exhibiting Primates in New South Wales*, Exhibited Animals Protection Act, 74 pages.

Pappas, K & Luckner-Loveless, B. (2002). *White-Handed Gibbon Enrichment*, Zookeepers Journal, Viewed Sep 11, 2009. www.honolulu zoo.org

Pappas, K & McLennan, L. (2002). *White-Handed Gibbon*. Zookeepers Journal. Viewed Dec 7, 2009. www.honolulu zoo.org

Primate Store. (2009). Viewed Aug 12, 2009. www.primat estore.com

Raemaekers, J. (1979). *Ecology of sympatric gibbons*. Folia Primatol 31, pp. 227-245.

Riley, R (2008). *Husbandry Manual for Siamang (Hylobates syndactylus)*. Western Sydney Institute of TAFE, Richmond, 57 pages.

Roonwal, ML & Mohnot, SM. (1977). *Primates of South Asia: Ecology, Sociology and Behaviour*. Harvard University Press, Cambridge.

Rowe, N. (1996). *The Pictorial Guide to the Living Primates*. Pogonias Press, USA.

Sasaki, T. (1963). *Hand-rearing a Baby Gibbon (Hylobates lar)*. International Zoo Yearbook, Vol 4, Issue 1, The Zoological Society of London, pp. 289-290.

Tintinger, C. (2010). *Hand raising baby Siamang at Auckland Zoo: personal notes*. Email and phone correspondence.

Van Schaik, C & Dunbar R. (1990). *The evolution of monogamy in large primates: a new hypothesis and some crucial tests*. Behaviour 115 (1-2), pp 30-59.

White-Handed (Lar) Gibbon. (2010). Last Viewed Feb 12, 2010.
www.oaklandzoo.org/animals/mammals/white-handed-lar-gibbon/

White-Handed Gibbon Species Fact Sheet. (July 2006). Durrell Wildlife Conservation Trust.

White-Handed Gibbon. (2010). Jungle Walk, Viewed Oct 18, 2009.
<http://www.junglewalk.com/popup.asp?type=a&AnimalAudioID=11024>

Wildlife Friends of Thailand. (2010). Viewed March 17, 2010. www.wfft.org/index.html

Wolkin, JR & Myers, RH. (1980). *Characteristics of a Gibbon-Siamang Hybrid Ape*. International Journal of Primatology 1, pp. 203-221.

Yang, CW & Yang, CJ. (2009). *The Foraging Behaviour Enrichment of Primates in Taipei Zoo*. Viewed July 24, 2009.
http://www.seaza.org/scientific_papers/foraging_behavior_enrichment_of_.htm

15 Glossary

Arboreal – Means living in trees. The animal lives off the ground.

Bipedal – Means walking on 2 rear limbs or legs using locomotion.

Brachiation – is a form of arboreal locomotion in which primates swing from tree limb to tree limb using only their arms (modified from Wikipedia, March 29, 2010).

Conspecific – Two or more individuals belonging to the same species are called conspecific.

Coprophagy – Refers to eating faeces whether it's own or another of the same species in this instance.

Duet – Two individuals that perform a song together. This is usually performed by the adult pair. Other family members may join in. It can also be called a song or a call.

Hysterectomy – is the surgical removal of the uterus (modified from Wikipedia, March 29, 2010).

Locomotion – It means movement or travel by propelling ones self forward.

Monogamy – is two individuals remaining exclusive to each other with no outside sex partners. They will only have one partner at a time (modified from Wikipedia, March 29, 2010). This can also be called a pair bond in gibbons.

Peripheralization – The isolation or out casting of a younger member of the group. This usually occurs when the member reaches sexual maturity.

Polyandry – A sexual union when a female is with one or more males at the same time (modified from Wikipedia, March 29, 2010)

Symatric/Sympatry – Is where two or more species have ranges that overlap and they can live in the same habitat in relative harmony.

Zoonoses/Zoonotic – is an infectious disease that can be transmitted (by a vector) from non-human animals both wild and domestic to humans or vice versa (modified from Wikipedia, March 29, 2010).

16 Appendix

Appendix 1

Animal House – Sold by Glason

http://www.glason.com.au/index.php?option=com_content&task=view&id=31&Itemid=36



Virkon by DuPont available through

http://www2.dupont.com/DAHS_EMEA/en_GB/products/disinfectants/virkon_s/index.html



Appendix 2 – Feed Supplement

Primate Pellets “Leaf Eater Primate 3” by Specialty Feeds available through
www.specialtyfeeds.com/sp-frameset.html?standiets/zooanimals.html



Specialty Feeds

www.specialtyfeeds.com

3150 Great Eastern Highway,
 GLEN FORREST
 Western Australia, 6071
 Phone 61 8 9298 8111
 Fax 61 8 9298 8700
 E-mail info@specialtyfeeds.com

DIET

LEAF EATER PRIMATE 3

A fixed formulation diet for Leaf Eating Primates.
 Updated formulation to improve palatability 20/7/2006
 Diet is packed under nitrogen in oxygen impermeable bags to improve shelf life.

Calculated Nutritional parameters

Protein	25 %
Total Fat	6 %
Crude Fibre	11 %
AD Fibre	16 %
Digestible Energy	11 MJ / Kg

Ingredients

A fixed formula ration using the following ingredients.
 Lupins, Millmix (Bran and pollard), Soya meal, Torula yeast, Guar gum, Molasses, Methionine, Lysine, Dicalcium Phosphate, Calcium carbonate, Magnesium oxide, Sodium chloride and a Vitamin and Mineral premix.

Added Trace Minerals

Magnesium	150 mg / Kg
Iron	93 mg / Kg
Copper	21 mg / Kg
Iodine	1 mg / Kg
Manganese	93 mg / Kg
Zinc	80 mg / Kg
Molybdenum	1 mg / Kg
Selenium	0.1 mg / Kg

FEEDING RECOMENDATIONS

Feed ad-lib to animals of all ages in combination with fresh fruit, vegetables and leafy materials.

DIET FORM

8mm diameter cubes. Packed in 10 Kg boxes under nitrogen or 20 Kg bags.

Added Vitamins

Vitamin A (Retinol)	13,000 IU / Kg
Vitamin D3 (Cholecalciferol)	> 2,600 IU/Kg
Vitamin K (Menadione)	26 mg / Kg
Vitamin E (αTocopherol acetate)	130 mg / Kg
Vitamin C	455 mg / Kg
Vitamin B1 (Thiamine)	106 mg / Kg
Vitamin B2 (Riboflavin)	40 mg / Kg
Niacin (Nicotinic acid)	130 mg / Kg
Vitamin B6 (Pyridoxine)	33 mg / Kg
Calcium Pantothenate	66 mg / Kg
Biotin	400 ug / Kg
Folic acid	7 mg / Kg
Vitamin B12 (Cyanocobalamin)	200 ug / Kg

Calculated Amino Acids	
Valine	1.0 %
Leucine	1.6 %
Isoleucine	0.9 %
Threonine	0.8 %
Methionine	0.2 %
Cystine	0.4 %
Lysine	1.2 %
Phenylalanine	1.0 %
Tyrosine	0.8 %
Tryptophan	0.2 %

Calculated Total Minerals	
Calcium	0.5 %
Phosphorous	0.6 %
Magnesium	0.7 %
Sodium	0.3 %
Chloride	0.3 %
Potassium	1.2 %
Sulphur	0.3 %
Iron	180 mg / Kg
Copper	34 mg / Kg
Iodine	0.7 mg / Kg
Manganese	160 mg / Kg
Cobalt	0.03 mg / Kg
Zinc	140 mg / Kg
Molybdenum	0.7 mg / Kg
Selenium	0.4 mg / Kg
Cadmium	trace
Chromium	no data

Calculated total Vitamins	
Vitamin A (Retinol)	15,000 IU / Kg
Vitamin D3 (Cholecalciferol)	> 2,600 IU / Kg
Vitamin E (Tocopherol)	150 mg / Kg
Vitamin K (Menadione)	27 mg / Kg
Vitamin C (Ascorbic acid)	500 mg / Kg
Vitamin B1 (Thiamine)	110 mg / Kg
Vitamin B2 (Riboflavin)	44 mg / Kg
Niacin (Nicotinic acid)	190 mg / Kg
Vitamin B6 (Pyridoxine)	38 mg / Kg
Pantothenic acid	82 mg / Kg
Biotin	470 ug / Kg
Folic acid	8 mg / Kg
Inositol	no data
Vitamin B12 (Cyanocobalamin)	200 mg / Kg
Choline	800 mg / Kg

Calculated Fat Composition	
Myristic Acid 14:0	trace
Palmitic Acid 16:0	0.6 %
Stearic Acid 18:0	0.1 %
Palmitoleic Acid 16:1	0.01 %
Oleic Acid 18:1	1.1 %
Gadoleic Acid 20:1	0.02 %
Linoleic Acid 18:2 n6	1.9 %
a Linolenic Acid 18:3 n3	0.3 %
Steridonic acid 18:4 n3	trace
Total Carotenoid	no data
Total Phospholipid	no data
Cholesterol	trace

Calculated data uses information from typical raw material composition. It could be expected that individual batches of diet will vary from this figure.

We are happy to provide full calculated nutritional information for all of our products, however we would like to emphasize that these diets have been specifically designed for manufacture by Glen Forrest Stockfeeders.

Appendix 3 – Drug Information

All dose rates should be calculated in conjunction with a veterinarian

- Ketamine is a general anesthetic given intravenously or intramuscularly and used especially for minor surgical procedures in which muscle relaxation is not required.
- Domatol is a deep sleep drug used for restraint purposes.
- Acetylpromazine is used as a tranquilizer, esp. to immobilize large animals, and to relieve nausea: also called *acetyl promazine*.
- Diazepam used as an anti-anxiety agent, sedative, antipanic agent, antitremor agent, skeletal muscle relaxant and anticonvulsant.
- Atropine sulphate is used as an anticholinergic drug and smooth muscle relaxant drug for animals.
- Isoflurane is a widely used inhalation anesthetic.

Appendix 4 – Browse Information

Plant Species Used in Feeding Captive Primates

National Research Council of the National Academies

Nutrient Requirement of Nonhuman Primates

Second Revised Edition, 2003

Alder (*Alnus* spp.)

Alfalfa (*Medicago sativa*)

American holly (*Ilex opaca*)

Bamboo (*Pseudosasa* spp., *Phyllostachys* spp.)

Beech (*Fagus* spp.)

Blackberry (*Rubus betuifolius*)

Brush cherry (*Syzygium paniculatum*)

Buckthorn (*Bumelia tena*)

Cabbage palm (Sabel palmetto)

Carolina cherry laurel (*Prunus caroliniana*)

Chinaberry (*Melia azedarach*)

Common Nightshade (*Solanum nigrum*)

Cup-of-gold (*Solandra guttata*)

Fig (*Ficus carica*)

Fig (*Ficus glomerata*)

Fig (*Ficus macrophylla*)

Fig (*Ficus nittida*)

Fig (*Ficus retusa*)

Fig (*Ficus rubiginosa*)

Fig (*Ficus rumphii*)

Fig (*Ficus thonningii*)

Flowering dogwood (*Cornus florida*)

Grape (*Vitis* spp.)

Giant cane (*Arundinaria gigantea*)

Hackberry (*Celtis occidentalis georgiana*)

Hercules' club (*Zanthoxylum clava-herculis*)
Hibiscus (*Hibiscus rosa-sinesis*)
Kudzu (*Pueraria hirsuta*)
Live oak (*Quercus virginiana*)
Loblolly pine (*Pinus taeda*)
Mangrove (*Rhizophora* spp.)
Maple (*Acer* spp.)
Mexican tea (*Chenopodium ambrosioides*)
Mulberry (*Morus* spp.)
Muscadine grape (*Vitis rotundifolia*)
Nut muscadine (*Vitis cinerea*)
Persimmon (*Diospyros virginiana*)
Red bay (*Persea borbonia*)
Red cedar (*Juniperus silicicola*)
Resurrection fern (*Polypodium polypoides*)
Small pignut (*Carya ovalis*)
Southern bayberry/wax myrtle (*Myrica cerifera*)
Southern magnolia (*Magnolia grandiflora*)
Spanish moss (*Tillandsia usneoides*)
Sparkleberry (*Vaccinium arboreum*)
Sugarberry (*Celtis laevigata*)
Virginia creeper (*Parthenocissus quinquefolia*)
Weeping Chinese banyan (*Ficus benjamina*)
Willow (*Salix* spp.)
Yaupon (*Ilex vomitoria*)

Appendix 5 – Hand Raising Equipment



Humidicrib (Campbell, 2008)



Infant teats that can be used as suggested (Campbell, 2008)



To help maintain a stable temperature (Campbell, 2008)



Infant White-Cheeked Gibbon in cot with ropes and toys (Campbell, 2008)

Appendix 6 – Milk Formulas

S26 Gold Alpha Pro is available from most supermarkets and pharmacies.

www.wyethnutrition.com.au for more information.



From birth to six months is a period involving significant development.

While your baby will happily sleep and feed for most of this time, he or she is expected to go through an amazing time of change.

Growth occurs rapidly during infancy and is tracked by measuring body weight, length and head circumference.

Internally, baby's digestive processes are also developing and adjusting which may then affect their bowel motion. You may find that these little deposits will also change colour, consistency and regularity but this is not to be confused with constipation.

Nutritional needs change as they grow. Therefore you need to ensure baby receives the appropriate nourishment that will help through this significant stage of development.

S-26 Gold Newborn with Alpha Pro is a premium infant formula specially designed to meet these needs of babies from birth to at least six months of age. It contains complete nutrition to provide a strong start for formula fed babies.

Be sure to correctly measure each feed. Each feed gives baby the nutritional benefit of higher levels of:

- [alphalactalbumin](#)

(Alpha Protein, 0.22g/100ml)* - enriched whey for easy digestion

- [Omega 3](#)

(DHA 7.1mg/100mL, ALA 45mg/100ml), to help support brain and eye development

- [Nucleotides](#)

(2.6mg/100mL), to help support immunity and a healthy digestive system

- [Lutein](#)

(5.8ug/100mL), to help support an infant's sensitive eyes, plus

- age-appropriate vitamins and minerals.

*compared to Standard infant formula

[Where to buy](#)

S-26 GOLD NEWBORN with Alpha Pro is available in groceries, pharmacies and other retail outlets.

[Packs available](#)

S-26 GOLD NEWBORN with Alpha Pro comes in:

- easy-mix powder: 900g can
- easy to prepare powder: 6 x 17g stick pack
- ready made liquid: 250mL or (4x250mL multi-pack)

S-26 GOLD® NEWBORN with Alpha Pro

BABY'S AGE	FEEDS PER DAY	POWDER FORMULA		LIQUID FORMULA
		COOLED BOILED WATER (mL)	LEVEL SCOOPS OF POWDER	VOLUME OF FEED (mL)
Up to 2 weeks	7	60	1	60
2 weeks – 2 months	6	120	2	120
2 – 4 months	5	180	3	180
4 – 6 months	5	240	4	240
Over 6 months	4	240	4	240

- Note that your baby may need more or less than indicated.
- Ideally, formula should be prepared just prior to feeding. Otherwise, refrigerate prepared formula and use within 24 hours.
- Discard any unfinished feeds.
- As your baby grows, consult your healthcare professional regarding moving from Step 1 to Step 2 formula.
- Solid food should be offered to your baby from 6 months.

GUARGOL is a thickening agent made from Guar Gum which is added to milk formula during periods of unexplained diarrhoea. It is made and sold through www.orion.net.au