Husbandry Manual for the Javan Gibbon (*Hylobates moloch)*

Status Classifications:

ASMP Management Category:	1A
IUCN Status of Threat:	Endangered
CITES Appendices:	1

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1.0 Introduction

1.1 Taxonomy

- SPECIES: *Hylobates moloch*
- FAMILY: Hylobatidae
- ORDER: Primates
- CLASS: Mammals (Infra-class Eutheria)

1.2 Subspecies

During the February 2008 Indonesian Gibbon Workshop there was some suggestion that two subspecies existed, *Hylobates moloch moloch* from West Java and *Hylobates moloch pangoalson* from Central Java. Current taxonomy however (Geisseman, 2007) does not recognise subspecies for this taxon.

1.3 Common Names

English

- Silvery Gibbon,
- Javan Gibbon,

Indonesian

- Owa Jawa
- Wau Wau
- Uwo Uwo
- Kuweng

2.0 Natural History

2.1 Morphometrics

• Sexual Dimorphism:	None
• Diagnostic Features:	Relatively long grey hair with a dark cap. Some individuals also have dark chests. Lighter pelage and cap may be indicative of Central Javan subspecies. (Mootnick, pers comm)
• Birth Weight:	340-400 grams
• Adult Weight:	6.5 - 8 kg
• Adult Measurements:	
Head/Body:	480 - 560mm
Hand:	135 - 150mm
Arm:	440 - 490mm
Leg:	350 - 380mm

2.2 Distribution

The first population survey of the Javan gibbon was carried out in 1978 by Kappeler (1984). He identified 25 populations in forest patches in West and Central Java. Asquith *et al*. (1995) resurveyed the populations located by Kappeler and identified further populations in western Java close to Gunung Simpang. The report on the 1994 Javan Gibbon and Javan Langur (PHVA) Workshop indicated no more than 400 Javan gibbons in protected areas (30 of them), with a further 386 to 1,957 living in 23 forest patches elsewhere (Supriatna *et al*. 1994). Asquith *et al*. (1995) estimated less than 3,000 individuals in central and western Java. A subsequent survey from 1994 through 1997 uncovered a number of new sites and populations in Ujung Kulon and Gunung Halimun national parks, now two of the species' major strongholds (Supriatna *et al*. 1998). Supriatna *et al.* (2001) estimated a population of 400 to 2,000. Further populations were brought to light by Nijman and his colleagues; one in small area of forest in West Java, and others in three large and significant forests in Central Java, on the southern slopes of Gunung Segara (Pembarisan Mountains), Gunung Cupu-Simembuat, and Gunung Jaran (Nijman and Sözor 1995; Nijman and van Balen 1998; Nijman 2004). Nijman (2004) indicated the total number of wild gibbons in Java to be between 4,000 and 4,500. Following a year-long survey, Djanubudiman *et al*. (2004) estimated a population of between 2,600 and 5,304 (Made *et al*, 2008). Figure 1 gives a good general overview of the likely distribution of Javan gibbon populations.

Estimates of actual population numbers for Silvery Gibbons vary greatly. Many surveys are based on extrapolations of actual sightings however gibbons generally do not occupy entire forests so caution must be taken with such results. Despite the lack of definite information on numbers there can be no question in regards to the significant threats that current populations face.

Only the three National Parks in West Java, Gunung Gede Pangrango, Gunung Halimun, and Ujung Kulon, have the potential to maintain populations of more than 100 individuals, but some protected areas (Gunung Simpang, Gunung Tilu dan Telaga Warna) and protected forests for watersheds (Gunung Kendeng, Gunung Papandayan) also have significant numbers of gibbons (Made *et al*, 2008).

Fig. 1. Javan Gibbon Distribution

Nijman, 2001

2.3 Habitat

Although presently thought to occupy lowland, hill and lower montane rainforest ranging from 1,500m to sea level (Kappeler 1984) almost all remaining Javan gibbon habitatas are submontane and montane forests. (Made *et al*, 2008) Both primary and secondary forest are utilised (Leighton 1987).

2.4 Wild Diet

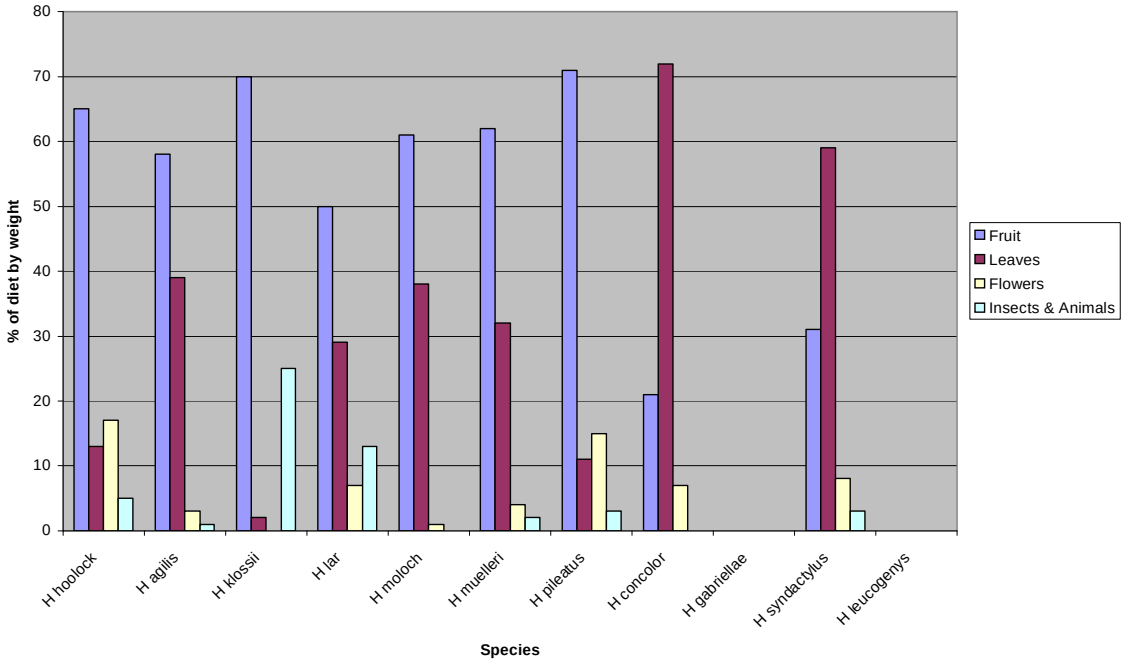
The study of the five primates (White-handed Gibbon *H. lar*, siamang *H. syndactylus*, two leaf monkeys and two macaques) in Krau Reserve rainforest in Malaysia has been the most extensive research on the ecology of *Hylobates* (Chivers 1972, 1977; Ellefson 1967, 1974; Gittens & Raemaekers 1980; Richard 1985). For this reason much of the following information reflects the diets of these two species (Collier 1999).

Gibbons are highly selective hand to mouth feeders, are able to feed from the terminal foliage thus preventing unnecessary competition with other primates. Gibbons are more dependent on ripe fruit than cercopithecids (e.g. macaques, guenons and baboons), while appearing to avoid unripe fruit, seeds and mature leaves. Gibbons appear to be specialised towards a life as fig exploiters (Richard 1985). They also tend to concentrate on new leaves and buds from a few species. Gibbons appear to be anatomically less efficient than cercopithecids in extracting energy from carbohydrates eaten (Gittens & Raemaekers 1980; Kay & Covert 1984). Described as unusual among primates in their dependence of a highly frugivorous diet (Chivers 1972).

Gibbons are active from dawn (approx. 6.40am) and retire to night several hours before dusk (approx. 3.00 to 4.30pm). During this time they tend to forage during two main periods: 8.30am to 11.00 and 12.30 to 4.30pm. Mostly fruit is eaten during the first part of morning, which provides an immediate energy source following the fast overnight.

Foliage is mostly consumed in the later part of the day, where the slower digestion helps through the night (Gittens & Raemaekers 1980; Raemaekers 1984). Foraging for other items also correlates to certain periods of the day, such as arthropod hunting mostly around midday (Ellefson 1984).

In total 125 plant species are known to be consumed; Fruit (61%), Flowers and Buds (1%), Leaves (38%). In addition, honey and animal prey including caterpillars, termites and other insects are eaten (Kappeler 1984). There is some varaition recorded in diet composition between gibbon species, which are plotted in Figure One (Baker 1999).



2.5 Social System

Silvery gibbons are found in monogamous family groups consisting of a mated pair and up to four dependent offspring. Each family occupies a territory, which is defended against conspecifics.

2.6 Life History

- Gestation Period: 210 days
- Number of Young: 1 (rarely twins)
- Age at Weaning: 18-24 months
- Age at Independence/dispersal: 6 - 8 years
- Sexual Dimorphism: None
- Age at Sexual Maturity: Male 7 years; Female 8 years
- Longevity: Wild: 30+ years; Captive: 30 - 50 years

A number of reproductive values were assigned at the PHVA for VORTEX modelling (CBSG 1994):

- Age at First Reproduction : 8 years.
- Litter Size: one
- Gestation: 210 days
- Inter Birth Interval: 2-3 years
- Life Expectancy: 25 years (up to 50 in captivity)

3.0 Conservation

3.1 Status of Wild Population

According to the 2006 IUCN Red List of Threatened Animals, all the Indonesian gibbon species are classified as Endangered. This suggests that, based upon its present distribution, the effective size of its remaining population, and the rate at which its numbers in the wild appear to be declining, the Javan gibbon stands a 50% or more chance of going extinct within the next 10 years or three generations, whichever is longer (Made *et al*, 2008).

The principle threats to the conservation of this species include continuing habitat degradation and fragmentation, and the poaching of adult females to provide infants for the pet trade. Recent evidence has also shown some hunting for gibbons as a food source in Central Java.

Both habitat loss and capture have effectively depleted western Java's remaining lowland forests of wild gibbon populations; those that survive are found at altitudes of 1,000-1,500m, which appears to be close to their natural limit (Made *et al*, 2008).

3.2 Conservation Measures

The three largest wild populations are located in Gunung Halimun, Ujung Kulon, and Gunung Gede Pangrango National Parks administered by the Indonesian Forest Protection and Nature Conservation Agency (PHKA). Many of the remaining populations occur outside protected areas.

There are currently 27 ex pet gibbons housed at the Javan Gibbon Centre near Bogor as well as approximately 62 housed in Indonesian zoos. The international captive population currently stands at 52.

A recent workshop on the conservation of Indonesian gibbon species (Campbell *et al*, 2008) recognised the necessity to improve habitat protection and to begin the development of reintroduction protocols. Research is currently underway to assess population viability and to establish suitable areas for future reintroduction programs

3.3 History in Captivity

A total of 17 founders (seven still living) and two potential founders were imported by zoos outside of Indonesia from the 1960s through the 1980s. It is assumed that they were obtained from the wild, confiscated as pets, and then placed in Indonesian zoos or with dealers. All other existing stock can be traced back to founders.

A fluctuating number of animals are known to be held in Indonesian zoos and an assessment of these populations is expected in 2009 providing the opportunity for these animals to be included in the global management of the captive population. At present, there are 52 silvery gibbons living in nine institutions outside Indonesia, with six successful breeding pairs- at Howletts Zoo, the Gibbon Conservation Centre and at Perth Zoo, Australia (Cocks 2000).

The husbandry and breeding of this species does not appear to differ from other gibbon species and therefore should not present significant difficulties within the framework of a conservation breeding program. Many animals within the captive population have been determined to be antigen, and/or, antibody positive for the Hepatitis B virus. The significance of this situation still requires further investigation.

4.0 Suggested Housing Parameters

4.1 General Parameters

Due to the different circumstances and outcomes required in rehabilitation centres as opposed to zoos, exhibit design will differ to suit purpose and financial constraints. Gibbons held within zoos are generally in this environment long term and should be provided with maximum space and opportunity to exhibit normal behaviours. Exhibits should also be able to accommodate the normal social structure. Financial constraints of rehabilitation centres often require a large numbers of enclosures and therefore must be built relatively cheaply and make good use of available space. Gibbons held within these centres ideally should be there short term and whilst the animals behavioural and social requirements must still be met, the size and construction of the enclosures could be compromised to meet the practicalities of the situation. Minimum standards highlighted below should be adhered to.

4.1.1 The Zoo Environment

- Gibbon exhibits should ideally be longer than wide to maximise ability to brachiate in a given area (See Fig.2).
- The exhibit should also be as high as possible in relation to both the ground and public viewing areas.
- Public viewing (i.e. head height of the public) should be from one point only and below the majority of the usable area of the exhibit.
- The enclosure should contain visual barriers, which allow visual escape from both cage mates and the public.
- The exhibit should be designed with a minimum flight distance of 5m, i.e. the distance from the public the average gibbon feels comfortable.
- Recommended enclosure size: 30m x 7m x 8m high.
- For safety all doors should open into the exhibit.
- Fresh water should always available in the exhibit, the holding area and the night quarters.
- Water sources should be placed in the enclosure in such a way as to reduce contamination.

4.1.2 General Parameters for Rehabilitation Centres

- Gibbon exhibits should be a minimum of 6 m x 6m x 6m and triangular in shape to minimise opportunities for aggression during introduction (See Fig. 3).
- Visual barriers should be present between each exhibit
- A raceway containing a slide should be incorporated for easier capture and restraint and animals should be conditioned to enter and/or fed from this area.
- Animals should be discouraged from using the ground, either through the provision of a false floor on the enclosure, undesirable vegetation or where possible, flooding of enclosures.
- Fresh water should be available in the enclosure at all times.
-

4.2 Enclosure Furniture

- Climbing structures need to have a large percentage of movablity.
- Ideal inter-structure distance (e.g. bars and ropes) is 2m. *NB The larger the enclosure the greater the gaps can be made between ropes and branches. Larger gaps allow greater speed and leaping distances for the gibbons (Mootnick, Haimoff and Nyunt-Lwin 1987).*
- Structures should be designed to prevent subordinate animals being trapped by dominant animals.
- Climbing structures must be a least 2 meters from the ground
- There should be at least two platforms for every gibbon housed in an exhibit (At least 1m x 1m where possible).
- Ropes should be of sufficient diameter or have limited movement (e.g. fixed tightly at both ends) in order to prevent accidental hangings.
- Rope diameter between 25mm and 40mm is recommended.
- In a zoo environment 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.

4.3 Climate Control

- Shelters must provide protection from rain, sun and wind.
- If daytime temperatures fall below twelve degrees Celsius heating is also required in the holding cage.
- If possible, three quarters of the exhibit should be in shade in summer and one quarter in winter.
- Sufficient amount of shelters must be provided to prevent dominant animals from denying access to the subordinate animals.
- In open enclosures shade structures at least 3m above climbing structure.

4.4 Night Quarters

Night quarter areas are not essential in the rehabilitation centre environment providing adequate shelter is provided. Where possible, in the zoo environment there should be;

- One night quarter per gibbon.
- Recommended size for each night quarter: 1.6m wide x 2m deep x 2.4m high.
- If night time temperatures fall below twelve degrees Celsius heating is required in the night quarter.
- 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.
- Recommended minimum ventilation: 15 air changes per hour, without re-circulation.
- Floors should be concrete and should slope to the drain. Where possible they should be covered with epoxy-based paint.
- Drainage is recommended to be outside of the night quarters and flow into a large industrial sized grease trap. All surfaces must slope towards this point.
- Where possible, walls should be also coated with a smooth easily cleanable and durable surface such as epoxy-based paint.
- Roof ideally should allow for arboreal locomotion, i.e. mesh roof.
- Unless the zoo already has a quarantine area suitable for gibbons, one should be incorporated into exhibit design, including a separate drainage system.
- The area must be rodent proof.
- Adequate lighting needs to be provided for gibbons occasionally confined during the day and inspection of the animals by the keeper (minimum 30 foot candles, 1m above the floor).
- Public or other noise especially above the gibbons should be eliminated, or at least reduced to a minimum.
- Night quarters need to provide arboreal platforms above the head height of the keepers.
- Steel Bars allow potentially dangerous contact between gibbons and keepers and are therefore not recommended.
- Maximum gaps between doors, etc: 3cm
- A safety race should be provided.

4.5 Winter Enclosures

- Zoos in colder climates which have to provide enclosed winter exhibits should provide areas of at least 6m x 9m x 3.5m high (NSW Agriculture 2000).
- Recommended minimum ventilation: 15 air changes per hour, without re-circulation.
- Recommended minimum temperature: 18 degrees Celsius
- Recommended maximum temperature: 28 degrees Celsius
- Recommended humidity: 30 to 70%

4.6 Breeding Enclosures

- Where possible, in enclosures housing breeding groups, it is recommended that an additional holding cage (Recommended size: 5m x 4m x 2.4m high) should be provided.
- At least three night quarter areas. This allows, when necessary the easy separation of individuals.

4.7 Cage Enclosures

- Recommended mesh size is 3.15mm wire, 50mm x 50mm.
- The mesh should extend at least 50cm under the ground.

4.8 Open Enclosures

- Wall or fence height minimum 4.5m.
- It is recommended that the last 3m of a wall or fence must be un-climbable.
- The fence or wall should extend at least 50cm under the ground.
- Recommended enclosure size: 30m x 7m.

4.9 Island Enclosures

- The recommended minimum moat width is 5m with a minimum moat depth of 0.9m (NSW Agriculture 2000).
- 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.

NB Island exhibits are not recommended due to the high reported incident of drowning in gibbons. (Gibbons are unable to swim.) In addition, fully enclosed exhibits provide more usable arboreal space than island or moated enclosures of similar surface area.

Fig.2 Suggested Enclosure Design in the zoo environment

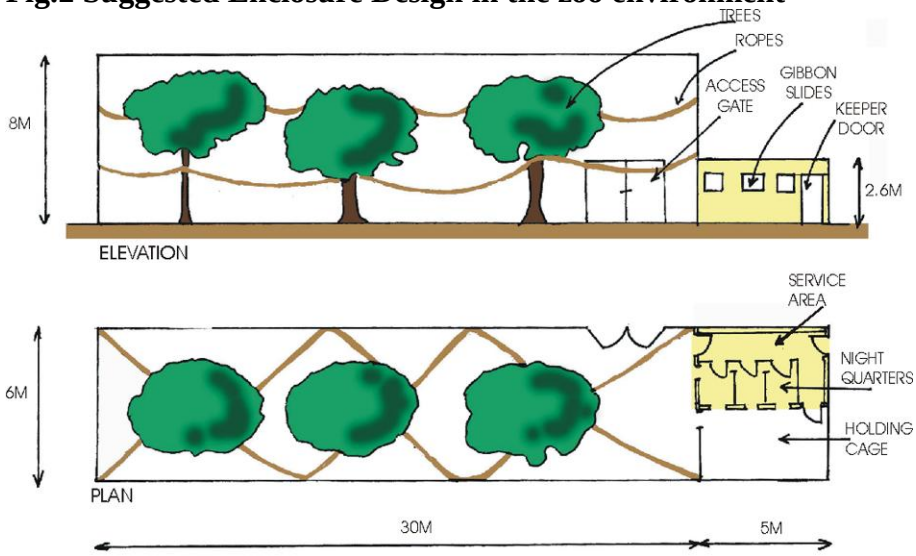


Fig.3 Suggested Enclosure Design for Rehabilitation Centre

4.10 Position of Enclosures

Gibbon pairs are highly territorial. Aggression between gibbons in adjacent enclosures have been known to cause the failure of pair formation and the miss-mothering or even killing of infants by gibbon parents (personal observation, C. Campbell).

- 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,1996). Space restrictions in Rehabilitation centres may require enclosures to be closer than this but visual barriers should still be maintained.

4.11 Interspecific Compatibility

Silvery Gibbons have a low compatibility to other species they are housed with.

- It is recommended mixed species exhibits should be approached with caution.

5.0 Capture and Handling

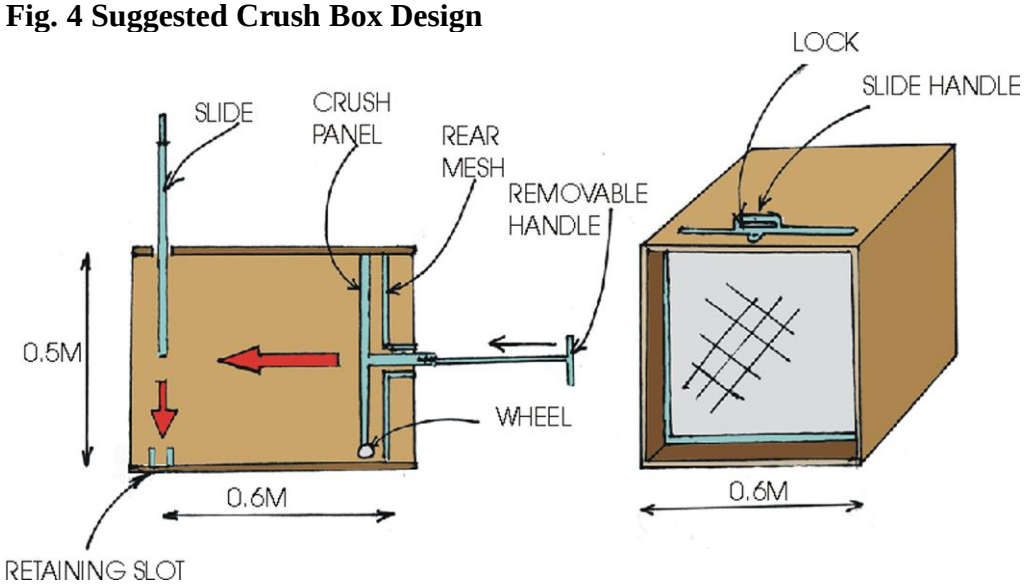
There are several methods currently practiced for capture and restraint of gibbons, each with its merits and dependant on the situation.

In rehabilitation centres the most effective method of chemically restraining an animal is simply manual injection by grabbing the gibbons arm through the mesh. This method should only be employed by suitably experienced handlers and is only suitable if the gibbon has access to a small area and cannot be harmed when it succumbs to the sedation.

Gibbons can also be restrained by driving them out through a night quarter slide into a crush box (See Fig. 4). They can then be crushed for hand injection or transferred to another exhibit of transport container. This method can be drawn out and stressful to the animals especially once they are familiar with the process (Personal observation, C. Campbell) however is useful if the animal is not required to be sedated.

- Recommended dimensions are 60cm x 60cm x 50cm high, but these may need to be varied according to slide dimensions.
- The inside of the mesh panel should be overlaid with fine mesh to prevent the gibbon from injuring their canines during confinement.

Fig. 4 Suggested Crush Box Design



Oral sedation is currently being trialled and despite variable results appears to be a relatively stress free way of capture and restraining gibbons. Animals require training and conditioning in order to accept sedation orally via syringe and must also be confined to a small area when effects begin to take place.

- Other methods of restraint are darting with a blow pipe or dart gun. This can also be quite stressful unless carried out precisely and quickly.
- Catching gibbons with a hoop-net is possible, but due to risk of injury to the keeper, is not recommended with adults.
- With all methods of capture it is important that the procedure is performed quickly as gibbons quickly overheat, which in some cases can lead to death.
- Food and water should be with held from gibbons prior to general anaesthetic to prevent regurgitation.

6.0 Captive Diet

Although gibbons easily adapt to a captive diet of fruit and vegetables balanced with animal protein (Chivers and Raemaekers 1986), 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 (Orgeldinger 1995).

Zoos usually feed gibbons on a mixture of fruit and vegetables either once or twice a day (Chivers and Raemaekers 1986). Although in captivity there may be continual access to food, gibbons differ in their daily feeding activities compared to the wild. When offered food early in the morning, the feeding activities increase steadily throughout the day with a slight decrease at midday and a peak at approximately 4.00pm. Wild gibbons have a more stable feeding pattern throughout the day, with a small peak between 7.00 to 8.00am. The first feeding bout is the concentrated energy food such as ripe fruit or young leaves to fill the empty stomach overnight (Orgeldinger 1995). 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). This is most likely directly connected to lower activity levels in captive gibbons.

6.1 Composition of Diet

- Fruit, vegetables, browse, cooked chicken, cheese and eggs (See Appendix 1 for Perth Zoo diet).
- Dietary supplements: Primate pellets (See Appendix 2 for Nutrient Composition).
- 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).
- Celery is recommended to be cut into 5cm pieces to prevent choking (Mootnick 1996). Browse with long fibres should also be avoided.
- Peanuts are avoided because they can be a source of aflatoxin which, when ingested, can contribute to liver cancer (Margen 1992).

6.2 Presentation of Food

- Behavioural enrichment plus at least two feeds each day.
- Fruit should be predominately fed in the morning and vegetables in the afternoon.

6.3 Activity Patterns and Behavioural Enrichment

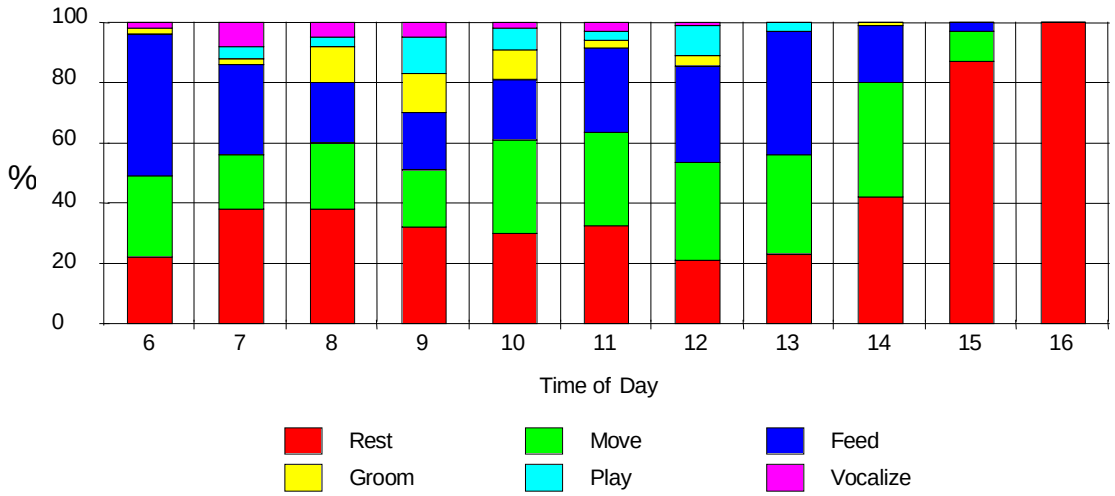
It is well documented that the captive environment can impose severe restrictions on the ability of animals to display the full repertoire of species typical behaviour. Not only this, but a lack of adequate stimulation may affect the behaviour, psychological welfare and health of animals; commonly referred 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 (Leivers 1998).

Behavioural enrichment should be provided to meet levels of activity of wild counterparts and the activity patterns should broadly reflect the patterns of wild gibbons. Srikosamatara, 1984 produced an activity pattern for wild Pileated Gibbons (*Hylobates pileatus*), which can be used as a guide for providing feeding and behavioural enrichment devices at appropriate times (See Fig. 5). Examples of behavioural enrichment are endless, but include:

- ice blocks with low joule cordial and fruit frozen inside,
- scatter feeds of nuts, primate pellets and seeds,
- cardboard boxes with seeds hidden in straw, and
- low joule jam smears.

Fig. 5 Activity Patterns for Wild Pileated Gibbons, *Hylobates pileatus*



(Srikosamatara 1994)

7.0 Captive Breeding

7.1 Suggestions for Pair Formation

Varying strategies are employed throughout zoos and rehabilitation centres in terms of successful pair formation of gibbons. In general;

- Unrelated pairs should be introduced in a neutral territory.
- "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, in press, as cited in Mootnick & Nadler 1997).
- 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, in press, as cited in Mootnick & Nadler 1997).
- Triangular shaped enclosures are very effective for conducting introductions as they restrict the opportunity for aggression and allow gibbons to remain facing their partner at all times. (Pers comm. Chanee)
- When necessary and where possible, introduced gibbons could be allowed to interact for approximately five minutes to one hour per day under constant human observation until the keeper is assured that no fighting will occur. The interaction time could be increased each day, if no aggression is observed (Mootnick 1996).
- Indications of compatibility are grooming, copulating, food sharing and vocal duetting. During the introduction phase, gibbons should be closely observed for signs of aggression and incompatibility.
- Gibbons should not continue to be housed as an incompatible pair as this results in stress to one or both individuals.
- To prevent aggression it is recommended that newly introduced gibbons have separate feeding areas.
- If one or both of the gibbons is very aggressive, Mootnick 1996 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.

7.2 Removal of Offspring

- The breeding pair performs a vocal defence against conspecifics and become aggressive towards maturing same sex offspring in the family group.
- Adult offspring should be removed from the natal group before they are peripheralized (Mootnick 1996).
- Peripheralization can occur from about five to eight years of age.

7.3 Hand Raising

- Hand raising should be avoided if at all possible.
- 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).
- Hand raised gibbons should be socialised with other gibbons or reintroduced to a family unit as early as possible.
- Further information on handraising gibbons can be found in Campbell, C (2008) Gibbon Handraising at Perth Zoo.

7.4 Identification Methods

- Transponder implants
- Tattoos

7.5 Sexing Techniques

- Visual
- Blood sampling.

8.0 Health Requirements

8.1 Preventative Medicine and General Health

A preventative medicine programme will include all medical, husbandry and management decisions that decrease the incidence of disease or injury (Junge 1991). A comprehensive preventative medicine programme for the Silvery Gibbon (*Hylobates moloch*) will include protocols for quarantine procedures, vaccination programmes and parasite control as well as basic medical care. Preventative medicine protocols and procedures will vary between zoological institutions, depending upon the location of the institution and the availability of veterinary and laboratory services. Basic guidelines for the establishment of zoo veterinary medical programmes have been published by the Veterinary Standards Committee of the American Association of Zoo Veterinarians (Joslin *et al* 1990).

A number of disease issues that are of importance in the captive management of the Silvery Gibbon (*Hylobates moloch*) are discussed below, but readers are advised to consult appropriate literature for more comprehensive and detailed information about specific medical conditions. Comprehensive reviews of diseases affecting non-human primates are readily available in zoo medicine texts (*e.*g. Martin 1986a, 1986b; Ott-Joslin 1986, 1993, McClure 1980, Bielitzki 1999).

8.2 Parasitic Disease

Non-human primates are potential hosts to a large number of parasites. Faecal examinations should be performed on all primates at least twice annually, and should be carried out as part of routine quarantine procedure. Standard floatation techniques will allow identification of most parasite infestations via identification of ova. Direct examinations of fresh faeces as wet preparations in saline are generally recommended in addition to flotation for non-human primates, to allow identification of protozoa.

Many of the parasites encountered in non-human primates can potentially be transmitted to humans (notable examples include *Giardia intestinalis*, *Entamoeba histolytica* and *Balantidium coli*). Readers are advised to consult appropriate veterinary and human medical texts for further information about potentially zoonotic parasites of non-human primates (*e.g.* Schultz 1986, Ott-Joslin 1993).

8.3 Parasite Species that may be Observed on Examination of Faeces (Bodley 2000)

Some of the parasites that may be encountered on examination of faeces from *H. moloch* are listed below. Readers are advised to refer to appropriate veterinary texts for details of epidemiology, clinical signs of infection and treatment.

i) Protozoa:
Balantidium coli
Entamoeba histolytica
Giardia intestinalis

ii) Nematodes:

Rhabditoids	*e.g. Stongyloides stercoralis*
Trichurids	*e.g. Anatrichosoma cynomolgi*
Oxyurids	*e.g. Enterobius* spp.

iii) Cestodes:
e.g. Hymenolepis nana

8.4 Zoonotic Diseases

As all non-human primate species are considered taxonomically closely related to humans, those involved in the care of non-human primates should be aware of the potential for exchange of pathogens between the animals in their care and humans. Similarly, consideration should be given to the potential spread of disease from keepers to animals and appropriate precautionary measures taken. There are a large number of potentially zoonotic pathogens carried by non-human primates, including bacteria (*e.g. Salmonella* spp., *Shigella* spp., *Mycobacterium* spp.), viruses (*e.g.* measles (rubeola) 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 tissues (blood, faeces, secretions), via airborne particles that are aerosolised, via ingestion, via insect vectors and via indirect transfer on fomites (*e.g*. cleaning equipment used for servicing enclosures, keeper uniforms). In many instances, non-human primates may carry and potentially transmit pathogens without any overt clinical signs of disease. For these reasons, persons working with non-human primates (both directly *e.g*. keepers and veterinarians, and indirectly *e.g*. laboratory technicians involved with handling animal tissues) are advised to follow precautionary measures. Adherence to such precautionary measures will reduce the risk of zoonotic transmission.

8.5 Suggested Precautionary Measures to be Followed when Dealing with Nonhuman Primates (Adapted from Ott-Joslin 1993)

1. "Hands should be washed frequently, especially after handling the animal, its food, bedding, enclosure materials, excrement, and/or tissue and body fluids. This includes washing the hands, even if gloves are worn. Anything that comes in contact with the nonhuman primate should be considered contaminated."
2. "Cages should be cleaned so as to minimise the risk of creating aerosols or droplets of potentially infectious materials." "Manual removal of bedding, food and faecal material before hosing decreases the risk of creating aerosols or droplets. Scrubbing heavily soiled areas with disinfectants should be done before hosing down areas. The use of high pressure water hoses and steam cleaners should be kept to a minimum, because these methods can increase the risk of creating potentially infectious sprays, which are a risk to workers and to other nonhuman primates housed nearby."
3. Staff members who are ill with a cold and/or have cold sore should avoid working around the nonhuman primates until they are well or should wear a facemask while preparing food and working around the nonhuman primates.
4. "If staff members who work with nonhuman primates get sick (e.g. have fever, chills, diarrhoea or open sores), they should seek medical attention and inform the physician that they work with nonhuman primates."
5. "Staff members should take precautions to prevent monkey bites or scratches. However, if they do get injured, they should wash the wound thoroughly with disinfectant soap and water, notify the supervisor about the injury and seek medical care, if indicated."
6. "An effective means for handling, reporting, evaluating and treating occupational exposures to possible zoonotic infections should be developed for institutions."
7. "Pregnant women should be considered at risk."
8. "Personnel who have open cuts or sores on their hands should wear gloves while working around animals and their faeces."
9. "An active insect and rodent control program should be instituted in the facility."

There are several potentially zoonotic diseases that are of particular importance with respect to captive management of *H. moloch.*.

8.6 Tuberculosis

The bacterial organisms *Mycobacterium tuberculosis* and *Mycobacterium bovis* can cause tuberculosis in non-human primates. Non-human primates may acquire tuberculosis via contact with infected humans or 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 the location of the lesions and disease severity), and can include any of the following: chronic cough, anorexia, weight loss, lethargy, diarrhoea, 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 intra-dermal skin testing and blood testing (Primagam®, CSL Ltd, Parkville, Victoria) is recommended.

8.7 Hepatitis B Virus

A recent serological survey of 30 captive gibbons revealed that 47% were positive for at least one marker of ongoing or previous infection with hepatitis B virus (Lanford *et al* 2000). Humans are the natural host for Hepatitis B (HBV) and serve as the primary reservoir for infections in non-human primates (Bielitzki 1999). 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.

Serological testing of captive Silvery Gibbons for HBV antigen and antibody is recommended. Serum specimens can be collected during routine medical examinations and frozen at -70°C for future virus testing. Testing is available at some Australian human medical laboratories or via BioReliance Corporation, 14920 Broschart Rd, Rockville, Maryland 20850-3349 USA (this laboratory will test for a large number of viral diseases specific to non-human primate species).

NB *The gibbon Hepatitis B strain represent an early lineage of the virus, indicating that the virus is indigenous to Hylobates moloch and is not a recent acquisition from man (Norder et al 1996).*

All Silvery Gibbons should be tested for Hepatitis B. If any gibbons are Hepatitis B positive, keepers should be vaccinated and tested periodically. All offspring to at least one Hepatitis B positive parent should undertake a vaccination program from birth.

First Vaccination:

- As soon as possible after birth (preferably within twelve hours of birth; this time frame is more critical for the immunoglobulin rather than the vaccine, which could be given any time within the first seven days of life)
- 0.5ml of 100U Hepatitis B immunoglobulin IM
- 0.5ml Hepatitis B vaccine (Engerix B 10 micrograms) IM
- Give the vaccines in different limbs

Second Vaccination:

- One month after the first vaccination
- 0.5ml Hepatitis B vaccine (Engerix B 10 micrograms)

Third Vaccination:

- Six months after the first vaccination
- 0.5ml Hepatitis B vaccine (Engerix B 10 micrograms)

NB *In humans, blood tests to detect HB_sAg and HB_sAb are recommended at 12 and 15 months of age.*

Section 8.0 Animal health Requirements *formulated by K. Payne, K. Bodley, C. Monaghan and S. Vitali)*

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Appendix One

Species Diet

ORDER:	Primates
FAMILY:	Hylobatidae
SPECIES: *moloch*	*Hylobates*
COMMON NAME:	Silvery Gibbon

Feeding program - *quantities* *fed per animal. Units-grams*

Time	**Food - Item**	**Preparation**	**Wt. / Animal (gm`s)**	**Total Weight (gm`s)** **RF2** **Gibbons 3.1.0**
AM	Fruit	No citrus	300g	**1.2 kg**
	Leaf eater pellets		40g	**160g**
PM	Vegetables	Provide a variety of raw mixed vegetables. Provide greens, especially broccoli & capsicum. All root vegetables are given raw. MONITOR RAW ROOT VEGETABLES ACCORDINLY FOR ANY DIFFICULTIES EATING OR RAW ROOT VEGETABLES BEING LEFT inparticular for Helca. Cut celery no longer than 5cms. <u>No Beetroot.</u>	300g	**1.2 kg**

	Lamb Heart / chicken or mealworms	Cook Lamb Heart / chicken	25g	**100g**
	Egg or cheese	Cooked / peeled eggs	1 or 30g	**4 or 120g**
	Browse		Browse	**Browse**

Other: Fresh water is available at all times.

Presentation

Food is placed on the benches to encourage animals into night quarters; remaining food is hidden around the enclosure.

The animals are fed a variety of foods as a substitute for their varied natural diet.

Cut celery no longer than 5cms.

Peel eggs.

Variations to main diet

Late pregnancy/Lactation: During late pregnancy/lactation, please increase Hecla's daily diet by:

- 1 extra portions of both lamb heart and cheese/egg
- 1/2 extra ration of vegetables (especially greens)

Supplements

Leaf eater Pellets / Omnivore Primate Pellets.

Variations

Behavioral enrichment schedule and type – as per the rainforest procedures folder.

Pellet Ball Recipe for Gibbons occasional Behavioural Enrichment

900g Leaf Eater Pellets

1 banana

1 tub or 4 tablespoons of yoghurt

1 tablespoon of honey in 200-400ml of boiling water

Soak Pellets in boiling water (400ml)

Mix in banana and yoghurt followed with dilute honey.

Make into 2 lots of 8 firm balls (16 in total approximately 90grams each - small handful size)

Put in fridge and when AM feeds made up place in bags and in buckets for the following days feed.

This amount makes ups up pellet balls for two days.

Withhold leaf eater pellets from AM food when pellet balls as Behavioral Enrichment.

Two pellet ball bags for the White Cheeked Gibbons on P13
Three pellet ball bags for the White Cheeked Gibbons on P113
Three pellet ball bags for the Silvery Gibbons on RF2

Species Information

Adult weights: Male and female - 5.0 - 8.0kg

Diet in the wild (refer to husbandry manual for information)

Fruit (6%), leaves (38%), flowers (1%), buds, animal prey including caterpillars, termites and other insects, honey.
These gibbons use 125 plant species.

Ref. 1

Diet in captivity

Variety of fruits (including tropical) and vegetables. Leaf eater Pellets. Also cooked chicken, egg or cheese

Nutritional analysis

Comments

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Appendix Two

Data Sheet for Suggested Primate Pellet

Ingredients

Barley, Lupi, Mill Run, Oats, Soya Bean Meal, Wheat, Yeast, Sucrose, Mollases, Dicalcium Phosphate, Lucerne, Methionine, Meat meal, Tallow, Salt, Vitamin/mineral premix. Manufactured into 8mm diameter pellets.

Calculated Analysis

Protein	17.5%
Phosphorous	0.6%
Fat	4.4%
Salt	0.7%
Crude Fiber	9.6%
Metabolisable Energy	9.4mj/kg
Calcium	1.0%

Amino Acid Composition

Lysine	0.86%	Leucine	1.1%
Methionine	0.38%	Isoleucine	0.64%
Cystine 0.24%		Arginine 1.4%	
Threonine	0.61%	Tyrosine	0.55%
Tryptophane	0.21%	Phenylalanine	0.95%

Added Vitamin and Minerals per Kilogram

Vitamin A	20,000IU	Vitamin D	4,000IU
Vitamin E	200mg	Vitamin K	4mg
Vitamin B_{12}	60ug	Vitamin C	325mg
Nicotinic Acid	50mg	Calcium Pantothenate	40mg
Folic Acid	4mg	Riboflavin	12mg
Thiamine	12mg	Biotin	200ug
Pyridoxine	12mg		
Copper	32mg	Iron	1.0mg
Magnesium	200mg	Manganese	140mg
Selenium	0.2mg	Zinc	120mg
Molybdenum	1.0mg	Iodine	1.0mg