

## Management of gibbons

*Hylobates* spp

at the International Center for Gibbon Studies,  
California: with a special note on Pileated gibbons

*Hylobates pileatus*

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The International Center for Gibbon Studies, which was established in 1977, is involved in the conservation and breeding of gibbon species and behavioural, reproductive and nutritional research. This paper provides an overview of the management techniques used at the Center, including diet, housing, introductions, veterinary care and handling techniques. The breeding history of one ♂ Pileated gibbon *Hylobates pileatus* and behavioural observations on two breeding pairs are also described.

*Key-words:* behaviour, enclosure design, immobilization, maintenance, nutrition, pileated gibbon, psychological well-being, quarantine, sanitation, squeeze cages

Established in 1977, the International Center for Gibbon Studies is a non-profit organization dedicated to the study of the

taxonomy, genetics, behaviour, husbandry, reproduction and nutrition of gibbons *Hylobates* spp. The Center assists other facilities in the identification of captive gibbons and has a research library which contains over 1700 publications on *Hylobates* dating from 1735 to 1996.

Eleven gibbon species are currently recognized (Geissmann, 1994; Mootnick & Sheeran, in press). At time of writing the Center maintains five species including 4.1 Pileated gibbons *Hylobates pileatus* (Table 1). Four species have bred successfully at the Center and offspring either form the basis of new breeding pairs or are transferred to AZA institutions or facilities that participate in captive-breeding programmes which are approved by the International Center for Gibbon Studies.

#### ENCLOSURES

The gibbons are housed outdoors in 10 × 3 × 4 m high enclosures with access to a secondary area which is 4 × 3 × 2.5 m high. Because *Hylobates* are extremely territorial and live in widely separated groups, the enclosures should, ideally, be a minimum of 75 m apart. Individuals at

the Center that are particularly territorial are housed so that they have no visual contact with gibbons in other enclosures.

The gibbons sleep outdoors in thermal plastic shelters (Dogloo) which are large enough for one or two animals. These shelters are fastened to platforms 3 m above the ground and are protected from the elements by tarpaulins.

The enclosures have an earth substrate and branches and ropes are installed so that full use can be made of vertical space. Branches and vertical ropes should be spaced at a distance which allows the animals to brachiate. This distance will vary depending on the size of the enclosure and the age and physical condition of the gibbons. The larger the enclosure the further apart vertical and horizontal supports may be placed (Mootnick *et al.*, 1987). Owing to the flexibility of horizontal ropes, the distance that the gibbons can leap is reduced from what they might achieve if branches were provided for brachiation. Horizontal ropes are not used at the Center. For enclosure furnishings plastic, metal and cement materials are preferable to wood, which is difficult to clean unless properly sealed; metal bars

SPECIES	SEX	SEX RATIO	AGE (years)	
			WILD-BORN	CAPTIVE-BORN
Mountain agile gibbon	3.5	♂		3, 15, 18
<i>Hylobates a. agilis</i>		♀	24, 25	2, 3, 6
Lowland agile gibbon	2.1	♂		11, 15
<i>Hylobates a. unko</i>		♀		9
Pileated gibbon	4.1	♂		1, 8, 15, 16
<i>Hylobates pileatus</i>		♀		8
Moloch gibbon	4.1	♂	21, 22	9, 13
<i>Hylobates moloch</i>		♀		6
Siamang	2.3	♂		3, 14
<i>Hylobates syndactylus</i>		♀		1, 5, 12
White-cheeked gibbon	1.1	♂		13
<i>Hylobates l. leucogenys</i>		♀		10
Hybrid				
<i>Hylobates l. siki</i> × <i>H. gabriellae</i>	0.1	♀	2	

**Table 1. Gibbon *Hylobates* species and subspecies housed at the International Center for Gibbon Studies as at July 1996.**

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.

should not be provided for brachiation because under extreme temperatures they may cause frost-bite or burning.

Newly acquired gibbons or those requiring medical care may be housed in REC squeeze cages for *c.* 30 days. Because the majority of gibbons housed in REC cages will not drink from the sipper tube, water is offered in a polycarbonate bowl. The LC-1441-A (LC-1502) and LC-1503 (LC-1451) (interior dimensions 1.45 × 1 × 1.64 m high and 1.56 × 1 × 1.6 m high, respectively) are ideal in size but the squeeze mechanism takes 12 times longer to operate than the smaller LC-1104. These squeeze cages are 1 m wide so the doorways must be at least 1.22 m wide. The LC-1302 (LC-1431) (interior dimensions 1.07 × 0.81 × 1.4 m high) could be used to house gibbons for up to 30 days if a 1.22 m wide doorway is not available.

At the Center 61 adult gibbons have been housed for *c.* 30 days in REC squeeze cages of various sizes, either because they required medical care or

were newly acquired and in quarantine. Behavioural problems (e.g. depression, self mutilation) were observed in three of the 28 adult ♂♂ that were housed in the REC LC-1104 (interior dimensions 0.89 × 0.74 × 1.17 m high).

#### DIET

The gibbons are fed four times a day and all uneaten food is removed after 3 hours. The diet varies with each species, season and individual (Tables 2 and 3). All food is inspected, washed and placed in a 20 litre container which is positioned 1 m above the ground. Green vegetables are placed on the wiremesh top of the secondary enclosure to encourage foraging. Water is provided in a 20 litre container which is only a quarter filled and is changed daily.

Daily food intakes are recorded so that the behavioural and physical condition of the animals can be monitored. A faecal analysis and behavioural observations are carried out for gibbons that have a loss of

FOOD ITEM	ALTERNATIVE FOOD ITEMS
Greens	romaine, escarole and endive are alternated weekly; occasionally substituted with arugala, radicchio, mustard greens, Swiss chard, collards or dandelions
Green beans	snap peas, China peas
Kale	green kale, purple or white kale
Broccoli	cauliflower, broccoflower
Spinach	mizumi spinach
Yams	sweet potatoes
Apples	Red delicious, Golden delicious, Pippin, Granny smith, Braeburn, Macintosh, Fuji, Gala
Bananas	occasionally substituted with either macho or apple bananas

**Table 3. Variety of food items fed to gibbons at the International Center for Gibbon Studies.**

appetite for more than 2 days. Various physiological, psychological or environmental factors can lead to appetite loss and nutritious foods that the gibbons prefer are offered if they are reluctant to eat (Mootnick *et al.*, 1987). A full medical examination may be warranted if loss of appetite persists and the cause has not been identified by faecal analysis and behavioural observations. Gibbons have a sensitive digestive system and fruits with a high acid content, such as tomatoes, grapes, pineapples or citrus fruits, may cause severe physiological reactions, such as swollen eyes and diarrhoea (Mootnick *et al.*, 1987). Instead of providing citrus fruits as a source of vitamin C the gibbons at the Center are offered kiwi, broccoli, papaya, bell pepper, cantaloups and multi-vitamins (with Vitamin C derived from rosehips and acerola). Carrots, sweet potatoes and yams are steamed to make them more digestible and broccoli is steamed to improve the flavour. Figs, mangos, guavas, apple pears, cherimoyas, star fruit, passion fruit, artichoke hearts, asparagus and roses are given as treats when in season. Celery is cut into 5 cm pieces to prevent choking. Bananas are peeled if they have not been grown 'organically' without the use of pesticides. Approximately one Zu/Preem primate dry pellet is fed per 1 kg body weight per day.

For protein raw and shelled cashew nuts, macadamias, walnuts, pecans, Brazil nuts, almonds, pine nuts, pumpkin seeds, sunflower seeds, mealworms, grasshoppers, spiders, boiled chicken, tofu, bee pollen and hard-boiled eggs are offered. Raw peanuts are avoided because they can be a source of aflatoxin which can contribute to liver cancer (Margen, 1992).

If a gibbon is constipated, foods that cause loose stools, such as dried fruit, cherries, grapes, citrus fruits, berries, plums, peaches, nectarines, apricots and pears, are given. If a gibbon does not eat or defecate in 2 days it is tranquilized and a 150 ml enema of mineral oil or saline solution is given, and 400 ml of Lactated Ringer's solution is administered subcutaneously in the scapular region.

Gibbons will often refuse to take oral medication. Unpalatable medicines can be compounded at a pharmacy in fruit flavours. The medication may also be disguised by being placed inside ripe fruits or mixed with jam, nut butter, molasses, honey or three drops of fruit extract and placed on a honey nut, apple cinnamon or banana flavoured (Hain) rice cake.

#### MEDICAL

All gibbons transferred to the Center must undergo a minimum 33 day quarantine at our quarantine station which is licensed

by the Center for Disease Control. All primates imported to the USA must be housed in squeeze cages during their quarantine period. During this time faeces are examined twice for parasites and bacteria. A complete blood count and chemistry panel are taken and blood is examined for viruses. Gibbons are tested for tuberculosis (with Cooper's Tuberculin Mammalian, Human Isolates Intradermic) and after three consecutive negative results they can be housed outdoors. The faeces of all gibbons are monitored daily and are analysed four times a year. A blood analysis and tuberculosis test are performed approximately once a year and tetanus vaccinations are given every 7 years.

Before entering the Center visitors must disinfect the soles of their shoes with phenolic/quaternary disinfectant spray (Staphene). People that have had recent exposure to flu, measles or other infections are not given access. Visitors must stay at least 2 m away from enclosures. Strict procedures have been instituted to prevent the spread of Herpes simplex virus infection and other zoonotic diseases between gibbons. Protective clothing is worn inside the enclosures and disposable gloves, which have been disinfected with foamed hand ethanoled degermer (Alcare), are worn during feeding and cleaning (Mootnick *et al.*, in press). Cleaning equipment is specific to each enclosure. Staphene is sprayed onto the soles of rubber boots before entering and leaving an enclosure.

#### IMMOBILIZATION

When handling gibbons it is advisable to wear overalls, a 3M 8710 disposable respirator, a face shield, disposable gloves and two-ply elbow length leather gloves. Physical examinations are usually carried out in the morning before food is offered. Three different methods are used to immobilize animals in outdoor enclosures: (1) the gibbon is encouraged to extend its hand outside the enclosure or a member

of staff grooms the gibbon's back so that it can be injected in the outer thigh, biceps or lumbar region. A 3 ml syringe with a 1.60 cm × 25 gauge needle is used. The syringe is placed in a 20 ml syringe cover and carried in a pocket so that the gibbon cannot see it; (2) the gibbon is caught in the 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 into the outer thigh; (3) a dart gun (Telinject) or blow gun is used. The outer thigh is the ideal place to dart, however, the majority of gibbons at the Center recognize a dart gun and alter their posture from a relaxed sitting position to a standing position with their inner arms and legs exposed. The outer biceps can be darted but only if the gibbon is subdued or unsuspecting. Gibbons that anticipate a dart can move quickly, particularly when they hear the sound of the dart being blown. The blow gun is slower than the dart gun and three of the gibbons at the Center are capable of catching or deflecting the darts from a blow gun with their hand. The blow gun is only used within a range of 0.5–3 m. A 2 ml syringe with a 0.9 × 25 mm needle is used with both the blow and dart guns and needles are always pre-coated with Betadine ointment to reduce the chance of infection and to facilitate easier penetration.

The dose of tranquilizer depends on physical condition and age of the gibbon, and the outdoor temperature. As a general rule 90 mg of Ketamine hydrochloride and 0.5 mg Acetylpromazine are administered per 10 kg body weight. When necessary, 0.5 mg Diazepam Intensol per 10 kg body weight has been administered to reduce rigidity and tremors from the Ketamine hydrochloride. Individuals that are known to hypersalivate when tranquilized with Ketamine are given an intermuscular injection of 0.15 ml Atropine sulphate.

INSTITUTION	SEX	AGE (years)		
		IMMATURE (MOTHER-REARED)	PROVEN/ BREEDING	NON-PROVEN
Brownsville, TX	♂ ♀	4	28, 30, 33 29	23, 27 33, 35
International Center for Gibbon Studies, CA	♂ ♀	1	8, 15, 16 8	
Omaha, NE	♂ ♀			19
Payson, AZ	♂ ♀		36 <sup>1</sup>	
Waccatee Zoo, SC	♂ ♀			29

<sup>1</sup>Positive antigen for hepatitis B.

**Table 4. Reproductive status of Pileated gibbons *Hylobates pileatus* in North American Institutions as at July 1996.**

#### INTRODUCTIONS

Gibbons that are intimidated easily, especially those that have been housed alone for a long period of time, should not be introduced to aggressive conspecifics (Mootnick & Nadler, in press). Similarly, submissive hand-reared gibbons should be introduced to conspecifics in familiar surroundings (Breznock *et al.*, 1979; Mootnick & Nadler, in press). Recently introduced gibbons are allowed to interact for between *c.* 5 minutes and 1 hour each day and, provided that no aggression is observed, interaction time is increased daily. Newly introduced gibbons are fed in separate areas to avoid fighting. Compatibility is indicated by grooming, mating, food sharing and duets. If one or both animals are aggressive, three connecting enclosures are used so that the gibbons have visual contact with each other before they are housed in adjoining enclosures. If the pair proves to be incompatible they are separated and introduced to other mates at a later date. When first introduced either the ♂ or ♀ can be dominant but once pregnant the ♀ is usually

dominant with respect to food. Same-sexed adults are not housed together as this may result in fighting and, because gibbons are monogamous, adult offspring are removed from the natal group before they are ostracized.

#### STATUS OF PILEATED GIBBONS IN THE WILD AND IN CAPTIVITY

As at 1 January 1994 there were 28.28.1 Pileated gibbons in 14 collections (*Int. Zoo Yb.* **34**: 494) of which 9.11 are captive bred. The species is currently listed as Endangered by IUCN (Groombridge, 1993).

At time of writing there are 17 *H. pileatus* housed at five institutions in North America (Table 4). There are only two breeding pairs in the North American region and no ♀♀ are available to form additional pairs. Three ♀♀, which are either post-reproductive or hand-reared and incompatible with adult ♂♂, have been housed with numerous breeding ♂♂ but no births have occurred. The 36 year-old ♂, a proven breeder that has produced four offspring of which only one has sur-

vived to adulthood, is positive antigen for hepatitis B and has been recommended for removal from the breeding programme. There are three additional breeding ♂♂ which are 15, 30 and 33 years of age and one 8 year-old, mother-reared ♂. With such a small gene pool it is unlikely that a breeding programme can exist in North America.

#### BREEDING PILEATED GIBBONS AT THE CENTER

One of the breeding ♂♂ at the Centre was born in 1980 at Phoenix Zoo where he was housed in his natal group until he had become dominant over his 27 year-old sire and had been observed copulating with his dam (Table 5). In 1987 the ♂ was transferred to the Center where he was paired with a 23 year-old, hand-reared ♀ which was arthritic and subordinate to him. On 24 March 1988 a ♂ infant was born to this pair. The adult ♂ was removed on day 8 after birth because he was observed trying to remove the infant from the ♀ and once he was observed holding the infant, biting its head and then dropping it from a height of 3 m. On 7 October 1989 the adult ♂ was reintroduced to the ♀ but he persistently chased the infant during the brief intervals that it was shifted into the primary enclosure, and 2 days after the reintroduction the

infant was removed. Because the infant had a decreased appetite after separation from its mother after 11 days he was reintroduced to the ♀ and the adult ♂ was removed. The juvenile was weaned 9 months later, after which he was housed alone for 11 months and then introduced to a 38 year-old post-reproductive ♂ Eastern hoolock gibbon *Hylobates hoolock leuconedys* for a further 10 months. He was subsequently paired with a 15 year-old, hand-reared ♀ Pileated gibbon for 26 months.

On 17 September 1992, when the breeding ♂ was 12 years old he was paired with a 4.5 year-old, mother-reared ♀ on loan to the Center from Gladys Porter Zoo, Brownsville. Although the ♀ solicited the ♂, mating was only observed twice in the first 2 months after introduction. Mating was observed again on 14 September 1993. Unlike other ♀♀ in the same subgenus (except Kloss' gibbon *Hylobates klossi* for which information is not known) Pileated gibbons do not have as obvious a genital swelling and menstruation was not visible with this particular ♀. The pair became increasingly interested in the aggressive displays of a ♂ Lowland agile gibbon *Hylobates agilis unko* housed in an enclosure 20 m away. The Agile gibbon was housed with a 23 year-old ♀ which did not act aggressively towards the

DATE	COMMENTS
27 April 1980	1.0 born; mother-reared; housed with natal group for 7 years
16 August 1987	paired with hand-reared, 23 year-old ♀
24 March 1988	1.0 infant born; adult ♂ bit and dropped infant so adult was removed for 19 months
7 October 1989	adult ♂ reintroduced to ♀ and juvenile for 11 days; juvenile had to be removed after 2 days owing to persistent chasing by adult ♂
17 September 1992	the now 12 year-old ♂ paired with a 4.5 year-old, mother-reared ♀
1 September 1995	1.0 infant born; ♀ is able to protect infant from the adult ♂'s incompetent paternal behaviour

**Table 5. Breeding history of a ♂ Pileated gibbon mother-reared at the International Center for Gibbon Studies.**

Pileated gibbon pair. During aggressive displays the ♂ Agile gibbon would shake the enclosure wire, repeatedly hit the enclosure roof and make high pitched chirruping vocalizations. The Pileated gibbons spent a large portion of the day looking for the ♂ Agile gibbon. When the ♀ Pileated gibbon could see the ♂ Agile gibbon she would try to tear at the tarpaulin attached to the enclosure and look through the small openings she had made. The ♂ Pileated gibbon would brachiate quickly. Both Pileated gibbons would shake the enclosure wire, turn their backs in a sitting posture, or flatulate with their backs towards the ♂ Agile gibbon. In addition the ♀, in a crouched position and with her lips flattened and pushed forward, would shake the enclosure in a vibrating motion and produce a short bubbling sound. These behaviours were observed throughout the day. On 26 June 1993 the ♂ Pileated gibbon was removed from the enclosure for 5 weeks for treatment with Baytril twice a day for 10 days for *Trichomonas* sp and *Campylobacter jejuni*. To create a visual barrier between the Pileated gibbons and Agile gibbons the trees between the enclosures were not trimmed and, on 28 February 1994, a larger tarpaulin was attached to the Agile gibbon enclosure. From April the Pileated gibbons were observed mating but by July 1994, when they needed to be treated for *Campylobacter jejuni*, mating had ceased. By November copulation, play and grooming were observed frequently.

On 1 September 1995 a ♂ infant was born. The ♀ is dominant to the breeding ♂ which, to date, has shown little interest in his offspring. This may be either because he is older or because the ♀ is dominant and more protective of her young. Young adult ♀♀ at the Center appear to be more territorial towards other pairs of *Hylobates* of the same sub-genus than the older ♀♀.

## RESEARCH

Gibbons at the Center are anaesthetized for an annual physical examination. Bone measurements are taken and a small amount of hair is plucked and placed in ethyl alcohol to be used for DNA studies. Blood samples are analysed, for CBC, chemistry panel and viral analysis, and are stored for future virus testing and DNA studies. Pelage is also examined for taxonomic comparative studies. Pelage data compiled from live animals are useful because it is sometimes difficult to detect the true colour in study skins from museums. All studies conducted at the Center are non-invasive.

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## PRODUCTS MENTIONED IN THE TEXT

**Alcare:** surgical scrub, manufactured by Calgon Vestal Laboratories, Inc., St Louis, MO 63110, USA.

**Baytril:** broad-spectrum antibiotic, manufactured by Miles, Inc., Agricultural Division, Animal Health Products, Shawnee, KS 66201, USA.

**Betadine ointment:** manufactured by Purdue Frederick Company, Norwalk, CT 06850-3590, USA.

**Coopers:** Tuberculin Mammalian, Human Isolates Intradermic, manufactured by Coopers Animal Health, Inc., Kansas City, KS 66103-1438, USA.

**Dogloo:** thermal plastic containers, manufactured by Dogloo, Inc., 1241 Old Pemescal Road, Corona, CA 91719, USA.

**Flexi-Nets:** flexible hoop net, manufactured by Fuhrman Diversified, Inc., Seabrook, TX 77806, USA.

**Hain:** rice cakes, manufactured by Hain Food Group, Inc., Uniondale, NY 11553, USA.

**Lactated Ringer's:** electrolyte solution, manufactured by McGaw, Inc., Irvine, CA 92714-5895, USA.

**REC:** primate cages, manufactured by Research Equipment Company, Inc., Bryan, TX 77803, USA.

**Staphene:** disinfectant, manufactured by Calgon Vestal Laboratories, Inc., St Louis, MO 63110, USA.

**Telinject:** tranquilizing equipment, distributed by Telinject USA, Inc., Saugus, CA 91350, USA.

**3M 8710 respirator:** disposable dust respirator, manufactured by 3M, St Paul, MN 55133-3275, USA.

**Zu/Preem:** primate diet, manufactured by Premium Nutritional Products, Inc., Topeka, KS 66606, USA.

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