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SOCIAL BEHAVIOURS OF CAPTIVE *Hylobates moloch* (PRIMATES: HYLOBATIDAE) IN THE JAVAN GIBBON RESCUE AND REHABILITATION CENTER, GEDE-PANGRANGO NATIONAL PARK, INDONESIA

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Abstract
Hylobates moloch, Silvery Gibbon occure on the Java island (in the western half of Java), Indonesia. This study presents preliminary data on social behaviours for Silvery Gibbon in captivity. All the individuals had an average active period from 6:30 hr to 16:00 hr (total 9.5 hours). Resting behaviour had the highest percentage (57.05% ± 0.45), followed by movement (21.99% ± 0.14), feeding (15.73% ± 0.34), courtship (5.16% ± 0.03), calling (2.35% ± 0.02), social behaviours (1.6% ± 0.09), agonistic behaviours (0.37 % ± 0.01), and copulation (0.05% ± 0.01). Gibbons showed two peaks of feeding, from 06:35 to 07:30 and from 14:35 to 15:30. Gibbons in the JGC made two types of calls: male solo and female solo calls. Males had a lower time budget for calling behaviour than females. All the gibbons showed four types of locomotor behaviours: brachiating, climbing, jumping (including ricocheting) and bipedal. The most frequent locomotor behaviour was brachiation type. All individuals in the study groups showed autogrooming. Courtship included approach, follow, and contact behavior. The copulation position was dorso-ventral. Stages of copulation consisted of intromission, pelvis thrusting, ejaculation, and dismounting except mounting.

Keywords: Silvery gibbon, feeding, calling, locomotor, resting, affiliative

Introduction

The family Hylobatidae in Indonesia consists of 7 species (Geissmann, 1995; Geissmann *et al.*, 2000; Groves, 2001, 2005): the White Handed Gibbon (*Hylobates lar*), Black Handed Gibbon (*Hylobates agilis*) and Siamang (*Symphalangus syndactylus*) in Sumatra; the Kelawat Gibbon (*Hylobates muelleri*) and White bearded Gibbon (*Hylobates albibarbis*) in Kalimantan; the so-called "Dwarf Siamang" or

Kloss Gibbon (*Hylobates klossii*) in the Mentawai Islands; and the Silvery Gibbon (*Hylobates moloch*) in the western half of Java. Of the latter, most of the remaining populations are in the province of West Java (Asquith *et al.*, 1995; Groves, 2001; Kappeler, 1984), but a few populations remain in the Central Java (Nijman, 1995, 2004).

Adult Silvery Gibbons have a grayish body, and the eyebrows and the region around the mouth are white (Burton, 1995; Groves, 2001). They are sexually monomorphic in pelage, cranial, dental and skeletal characters, except that males have darker hair in the genital area (Burton, 1995; Napier & Napier, 1985).

Gibbons of most or all species are thought to reach sexual maturity at about 6 to 8 years of age (Geissmann, 1991). The adults live as solitary individuals or in pairs, and mated pairs defend territories. In this monogamous mating system, in which an adult male is paired with one adult female (Reichard, 1995), the pair bond has been supposed to be life-long, ending with one partner's death, although in studies of *H.lar*, *H.agilis* and *S.syndactylus* the situation has proved to be much more complex (Palombit, 1994).

They are mostly arboreal, living generally at a height of 20 - 25m (Nijman, 2001). As specialised frugivores, they eat more fruits (61%) than shoots and young leaves (38%), and flower buds (1%), and they consume some types of insects such as termites (Kappeler, 1981; McConkey & Chivers, 2007). Within and among groups they communicate through a series of long calls (songs). The song types produced by mated gibbons differ among the species (Geissmann, 1995, 2002). Silvery Gibbon females and males sing different solo songs, but not duet songs as do some other hylobatids (Geissmann & Nijman, 2006). They also have various species-specific threat calls and group calls.

The Silvery Gibbon is Critically Endangered (IUCN, 2010; Supriatna *et al.*, 2010). Habitat loss and fragmentation, habitat degradation, hunting (food, medicine, and sport), and illegal trade (pets, medicine) are the top four threats (Geissmann, 2003; Supriatna, 2006; Supriatna *et al.*, 2010). Because of this, vigorous rescue and rehabilitation programs are needed. Only a handful of researchers have made comprehensive studies on the behavioural ecology of wild Silvery Gibbons, and their behaviour in captivity has not been investigated.

Materials and Methods

***Study area*:** The Javan Gibbon Centre (JGC) is situated at 6^{o} 46' 28.8" S and 106^{o} 50' 24.0" E, approximately 56 km away from Bogor and 150 km from Jakarta in Bodogol Resort, Section II of Bogor Conservation Area, Mt. Gede Pangrango National Park, at a mean elevation of 750 m above sea level in the highland wet zone of Java. Its area is approximately 2.5 ha. The JGC receives 500 mm mean annual rainfall, with a mean annual temperature ranging from approximately 18 ^{o}C to 32 ^{o}C; it includes several habitat types that can be categorized as man-made small grasslands, scrublands, several small ponds, home gardens and large shady trees (i.e. *Agathis damaraa*, *Calliandra callothyrsus*).

Study group: Twelve one-male/one-female separate pairs (P^{A-L}) of Silvery Gibbons were studied at the JGC (see Table 1). Each couple resided in a triangular prism-shaped 7x7x7x9 m naturalistic outdoor enclosure during the whole day. The enclosure includes a place to rest for each individual, two food containers, a drink container, saplings on the bottom of the cage, and exercise facilities such as bamboo, rope and old tires for swinging. At the beginning of the study, they were twelve adult males (M^{A-L}) and twelve adult females (F^{A-L}); accordingly, data for twenty four individuals were entered into the analysis. Individual identifications were based on the thickness of the eyebrows, the eye rings and the white muzzle, as well as the brightness of the colour in the depigmented skin area on the belly. One female (F^{M}) was placed with M^{L} to replace F^{L} by the JGC, at the end of the study the group had thirteen females. Afterwards F^{L} lived alone. Also in P^{K} there was an infant (I) with F^{K}, which was born before the study. JGC has six stages of rehabilitation of the gibbons from receiving the individual to post-release in the forest: (1) quarantine, (2) socialization, (3) pairing, (4) soft release, (5) release, (6) monitoring. We studied behavior of gibbons in the pairing stage. All the males were between 6 and 12 years old and the females 5-18 year old. In four pairs, both were the same age, in five pairs the male was younger than female, and in three the male was the elder. Mean weight of individual males was 5-6 kg and females 5.2-5.3 kg.

***Data collection and analysis*:** The pairs were observed during all-day sessions from 5:00 hr to 17:00 hr from 10 July to 01 September 2009 (on each of the 54 calendar days). The total recording time was 1596 (133 hours/each pair) hours, and 3

observers participated in data collection. All behaviours were assessed via direct observation 4-8 m away from animals. Within the pair, focal animal observation time was identical per individual. Additional behaviours were noted whenever they were observed (ad libitum sampling method). All feeding, agonistic, locomotor, contact, self-directed and solitary behaviours and vocalization were included in the analysis. We determined the overall rates of each behaviour (N per individual observation hour). We calculated the percentage of each observed behaviour, and we here present the time budget in the form of bar charts along with descriptive analysis.

Results

All the individuals had an average active period from 6:30 hr to 16:00 hr (total 9.5 hours). Resting behaviour had the highest percentage (57.05% ± 0.45), followed by movement (21.99% ± 0.14), feeding (15.73% ± 0.34), courtship (5.16% ± 0.03), calling (2.35% ± 0.02), social behaviours (1.6% ± 0.09), agonistic behaviours (0.37 % ± 0.01), and copulation (0.05% ± 0.01).

Table 1: Gibbons housed at the JGC with time budget for each pair

Pair No.	Male age (Yr.)	Female age (Yr.)	Allogrooming	Copulation	Aggressive behavior	Affiliative behavior	Pairing time (months)
P^A	M^A =11	F^A =11	1.12	0	0.44	4.245	26
P^B	M^B =9	F^B =9	2.57	0	0.18	10.85	17
P^C	M^C =10	F^C =10	1.45	0.2	0	13.855	17
P^D	M^D =9	F^D =18	0.88	0.12	0	7.34	17
P^E	M^E =10	F^E =10	0.16	0.27	0.785	1.18	13
P^F	M^F =9	F^F =10	1.76	0	0	2.875	10
P^G	M^G =7	F^G =5	0	0	0.115	1.79	3
P^H	M^H =8	F^H =9	0.13	0	0	0.435	3
P^I	M^I =7	F^I =9	0.17	0	2.51	11.205	3
P^J	M^J =6	F^J =7	2.96	0	0.035	4.805	1
P^K	M^K =12	F^K =8	0	0	0.375	2.57	3
P^L		F^L =9	0	0	0.03	1.41	0

***Feeding behaviour*:** At 7:30 hr, 10:00 hr, 13:00 hr and at 15:30 hr, JGC staff feed the animals. At 7:30 and 13:00 they provide a mixture of fruits (mango, banana, papaw, pineapple, tamarind, apple, etc.), at 10:00 a mixture of vegetables, and at 15:30 peanuts. Gibbons did not respond equally to these feeding types, and showed two peaks of feeding, from 06:35 to 07:30 and from 14:35 to 15:30. Among these various foods their favorite is mango. There was a massive competition among the group to take foods. Five of the pairs did not feed at the time of receiving their last meal, but would eat it next day. All individuals consumed fruits faster than vegetables.

At 7:30 hr, the gibbons would start to search for food in the cage. M^G most often went to the floor of the cage to seek food, and both members of the pair P^G spent more than 5% of the time seeking food in the bottom strata of the cage. The other pairs always used middle strata of the cage when seeking food. Each individual maintained ownership of certain food containers and ate only from his/her own container without moving far after the staff filled the containers. When they ate, they were quiet, making no noise. Pairs P^A to P^H showed food sharing cooperative behavior while eating, while the other four pairs exhibited agonistic behaviours toward their partners. The mean percentage of time males and females spent on each activity was approximately the same.

Calling behaviour: Calling started at 5:30 and reached a peak at 8:35 to 09:30. Again at 12:35 they started to call, and reaching a peak at 15:35 to 16:30. When they were calling they used the top strata of the cage. Gibbons in the JGC made two types of calls: male solo and female solo calls. All the females made solo calls apart from F^H, accounting for P^H's had low time budget of calling behaviour. P^J also showed a low time budget of calling behaviour. During the study, threat call behaviour was not observed even though several stimuli, such as Javan hawk-eagle (*Spizaetus bartelsi*) and leopard (*Panthera pardus*) in wild, triggered calls or defensive movements among other primate species at the JGC, such as long-tailed macaque (*Macaca fascicularis*). F^C and F^E

often initiated solo calls together and continuously. Males had a lower time budget for calling behaviour than females.

***Locomotor and resting behaviour*:** All the gibbons showed four types of locomotor behaviours: brachiating, climbing, jumping (including ricocheting) and bipedal. The most frequent locomotor behaviour was brachiation type. F^{A}, F^{C}, F^{E}, F^{F}, F^{G}, F^{K} and F^{L} would brachiate while reaching the peak of their solo calls, whereas five other females including F^{L} tended to be quiet. Resting behaviour reached a peak at 10:35 to 11:30, and increased again at 13:30 and then continued until the afternoon siesta and then woke up again later. The high percentage of time allocated to resting was apparently caused by the high availability of food; they tended to wait until feeding instead of searching for food themselves. The gibbons would always select a place high up in the cage to sleep, and P^{B}, P^{C} and P^{E} were always together in their shelter during sleep. While resting, a sitting position was most common.

In pair P^{L}, the time budget did not show any significant difference after F^{L} was replaced with F^{M} (Fig. 1), but the new pair P^{M} allocated less time to resting behavior compared to the previous P^{L}, and *vice versa* for locomotor behaviour, evidently exhibiting some territorial behaviours towards each other.

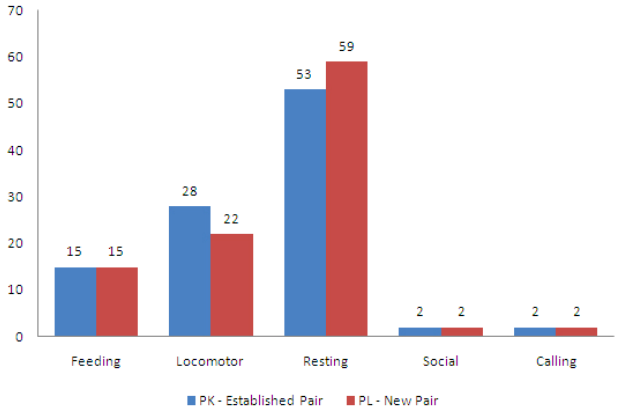

Fig. 1: Frequency changes after replacing F^{L} with F^{M}

Affiliative behaviour: (see Figs. 2 & 3) from 05:30 until 13:35, reached a peak at 10:35 to 11:30, we would observe affiliative and play. All individuals in the study groups showed autogrooming. Play behaviour encountered during the research period included both object play and locomotor play. Object play included the use of branches, fruit, and stones. Locomotor play involved a jump in place and/or swinging. Only F^{B}, M^{E}, M^{F}, F^{F}, F^{G}, F^{I} and F^{L} exhibited play behaviour. Sexual behaviour was observed after 05:30 and reached peaks at 10:35 to 11:30 and again at 13:35 to 14:30; these were mainly courtship and copulation. Males and females showed the same time budget for affiliative behaviours while females act as perpetrators and males receivers. Courtship included approach, follow, and contact behaviour in P^{B}, P^{C}, P^{D}, P^{F}, P^{J} and P^{L}. Contact behaviour was generally took the form of an individual resting together or each individual performing autogrooming. A common social behaviour consisted of the pair kissing each other's body, starting from the head and continuing dorsally. Allogrooming occurred in all pairs except P^{G}, P^{K} and P^{L}. Females more often initiated allogrooming, and males received grooming and returned the favour. Grooming was not seen in pair P^{K}, even in M^{K}. Only three of twelve pairs copulated: P^{C} (0.2%), P^{D} (0.4%), and P^{E} (0.3%).

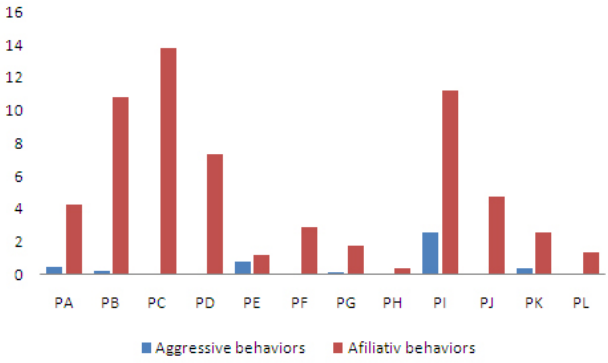

Fig. 2: frequency in affiliative & aggressive behavours

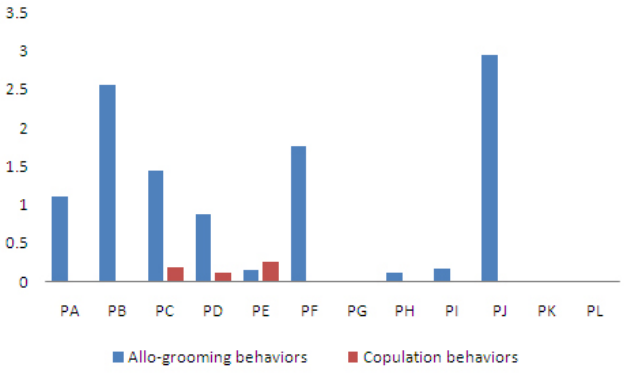

Fig. 3: Time budget in allo-grooming and copulation

The copulation position was dorso-ventral. P^{D} and P^{I} often copulated from 09:00 to 11:00, while P^{C} did so from 14:00 to 15:00. Some copulation stages occurred without the usual preceding locking of the male to the female body (i.e., without mounting). Stages of copulation consisted of intromission, pelvis thrusting, ejaculation, and dismounting except mounting. Females showed genitals to attract males to come closer. F^{E} kissed the body and

then M^E showed intromission and pelvic thrusting. Pelvic thrusting was observed by naked eyes, so, it was difficult to confirm ejaculation had happen. However hairs around female genital were wet and male was licking the vagina to clean. End of the study we observed F^C and F^E was pregnant.

Discussion

The total active period of 9.5 hours per day is consistent with other reports (e.g., Leighton 1986) that the active period for Hylobatidae in the wild is 8 to 10 hours. In JGC, pairs were kept in cages of 7x7x7x9 m, whereas in the wild Silvery Gibbons have an average home range of 17 ha (Supriatna, 2006). Since Kappeler (1981) recorded sleeping trees concentrated in a small portion of the home range and few in the periphery, we believe the cage conditions may directly affect the daily activity patterns. Also, inhabiting an artificially limited space results in decreasing the time budget of movement behaviours (Ravasi, 2004). In this study, locomotor behaviour increased from 05:30 until around 08:35 to 09:30, with a second peak at 13:35 to 14:30. This pattern overlaps with the locomotor pattern in the wild as described by Ravasi (2004).

Since females play a wider role in guarding the home range by calling, female Silvery Gibbons allocate more time to calling than the males (Geissmann *et al.*, 2005); this was also shown in this study. Long-distance sound transmission by forest-dwelling animals increases with height above the ground, intensity (loudness), and calling at dawn or dusk (Marten *et al.*, 1977). This explains, at least in part, why primate groups, including female Silvery Gibbons, give loud morning calls around dawn, before they leave the sleeping tree (Kappeler, 1984). Nijman (2001) mentioned that Silvery Javan Gibbon females will reduce the frequency of calling while they are taking care of infants, a probable explanation for the very low time budget allocated to calling by F^K, the only female with an infant.

The peak time of feeding behaviour in JGC was obviously closely associated with feeding time by the staff, but the feeding peak found in this study overlaps with that of wild populations described by Iskandar (2007), who reported that even wild populations feed throughout the day. In the study, five pairs retained sweet potatoes until next morning –a rare observation of food cacheing in gibbons– possibly, we speculate, in anticipation of the high energy requirements in the morning to start the daily activities. As in the wild population (Farida & Harun, 2000; Kappeler, 1981), this group also consumed more fruits than any other food type. The time budget of feeding at JGC was lower than that of gibbons in the wild (Kleiman *et al.*, 1996). Although wild gibbon populations do not seek food in the lower forest strata (Cheyne, 2004), one pair in this group utilized the bottom strata of the cage more than 5% of the time. We surmise from this that the gibbons perceived the non-risk of predation and adopted freer movements accordingly. This may also be the reason for not responding to predators' calls, because wild Silvery Gibbons emit loud screams mixed with bursts of agitated movement in the presence of leopards (Kappeler, 1981). Reichard (1998) suggested that communal sleeping in one tree and/or a variable sleeping pattern perhaps reflects variation in predation pressure from pythons in different gibbon habitats, but, although this captive population was not subject to predation, they also slept communally. This suggests that communal sleeping has more of a social than an anti-predator basis.

All the gibbons used the middle strata when they ate; this was related to the location of the food container for each individual provided by JGC, yet, interestingly, even when the food container was absent, they used the middle strata for feeding. Although JGC provides similar food for each individual gibbon, adjusted for the number in each cage and their weights, many individuals were interested in their partners' food. We see this food sharing as an indicator of pair bonding (cf. Koontz & Roush, 1996). Also, strongly bonded pairs showed less aggression during feeding, as also observed by Cheyne (2004).

During the study period, neither gender dominated any of the behaviours (Fig. 4). This is consistent with sexually monomorphic primates not showing any tendency towards dominance by one particular gender (Jolly, 1972). Males and females therefore have equal opportunities to initiate affiliative behaviours. The reason for the lack of affiliative behaviours by F^J to M^J may have been that she was still caring for her infant. According to Becker *et al.* (1992), when lactation, follicular maturation and ovarian steroid production are inhibited and there is no or a low concentration of ovarian steroids, females do not exhibit sexual behaviours. M^J, however, also did not show any affiliative behaviours, possibly because the females who were in lactation had inhibited estrous cycles and this also affected their receptivity to males (Becker *et al.*, 1992).

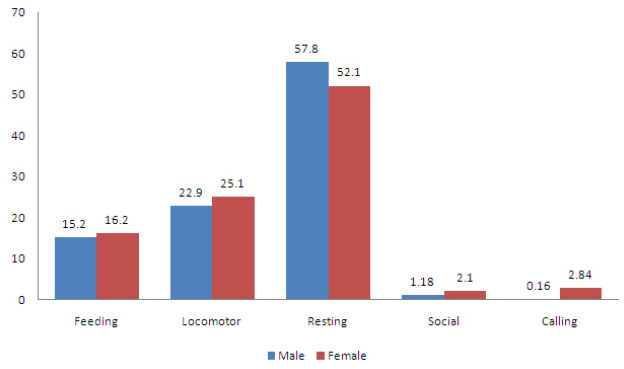

Fig. 4: Frequency changes in behaviours with the gender

According to data from JGC, P^A and P^B have been paired for more than one year, but during the study period we did not observe any copulation behavior (Fig. 1), and it may be that the female did not come into estrus. Copulation occurs when a female is characterised by attractiveness, proceptivity, and receptivity and stages of copulation consist of mounting, intromission, pelvis thrusting, ejaculation, and dismounting (Estep & Dewsbury, 1996). However the same publication mentioned silvery gibbon is a group of primates that do not perform mounting during copulation and we also did not observe any mounting stage. Courtship behaviour shows attractiveness and proceptivity in pairs that can initiate copulation when the female is receptive (Estep & Dewsbury, 1996), and P^A and P^B did perform courtship behaviour with a percentage of 8.49% and 10.85% respectively. We believe that a pairing period of less than one year may not be sufficient to create a strong bond between sexual partners, resulting in a low percentage of courtship of 0.43 to 1.79 %.

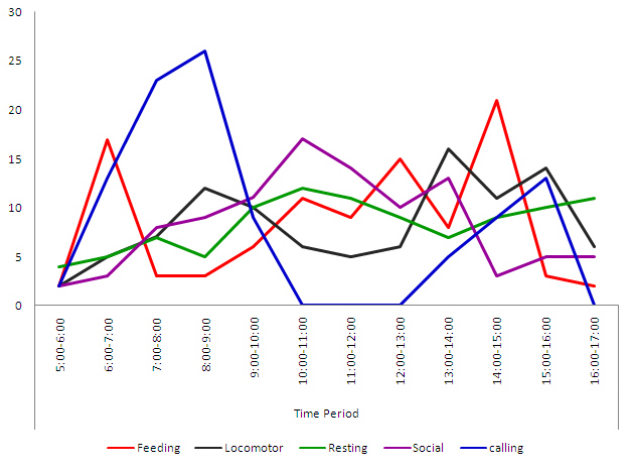

Fig. 5: Frequency changes in behaviours with the time period

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