REINTRODUCING JAVAN GIBBONS (HYLOBATES MOLOCH): AN
ASSESSMENT OF BEHAVIORAL PREPAREDNESS

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ABSTRACT OF THE THESIS

Reintroducing Javan Gibbons (*Hylobates moloch*): An Assessment of Behavioral Preparedness

by

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The purpose of this thesis is to contribute knowledge to the reintroduction program for Javan gibbons (*Hylobates moloch*) in West Java, Indonesia in an effort to improve the conservation of the species in the wild. Reintroduction programs provide an opportunity for animals that have lived in captivity to have another chance at living in the wild, and may be one way of reestablishing populations that have become locally extinct. It is crucial that release candidates either maintain or develop the appropriate behavioral repertoire necessary for living in the wild, and have undergone an extensive period of rehabilitation. My research goal was to examine whether select pairs of Javan gibbons living at the Javan Gibbon Rescue and Rehabilitation Center (JGC) in Gunung Gede-Pangrango National Park, Java, Indonesia exhibit the appropriate behaviors necessary for survival before they are released back into the wild. Behavioral data were collected from July to November 2009, yielding a total of 337 hours. I conducted pre-release behavioral observations on three pairs of Javan gibbons that were deemed potential candidates for release by the staff of JGC. I observed each individual gibbon utilizing focal animal time-interval sampling and *ad libitum* as necessary. I also conducted post-release observations on the first pair of Javan gibbons released in October 2009. Pre-release results indicate the pairs of Javan gibbons in this study did not satisfy all of the suggested behavioral criteria. However, the behavior that did not match the recommendations (time spent in positive pair association) will not necessarily hinder the gibbons’ survival when they are released. It is recommended that rehabilitated gibbons spend at least 7% of total time active engaged in positive association behavior (i.e., groom, play, and copulation); not one of the pairs of Javan gibbons in this study met that criteria. This specific criterion was determined to not be a valid measure with regards to pair-bond cohesiveness, because it fails to include maintenance of close-proximity - one of the primary social interactions for adult gibbons. In addition, the other behavioral criteria the gibbons did satisfy (i.e., effectively brachiating, remaining in upper level of enclosure, feeding/foraging) are those that will be most beneficial for their survival in the wild. Post-release observations indicate that the gibbon pair was successful at locating and procuring the appropriate food sources. They jointly defended their territory against sympatric monkeys, and they remained in the upper level of the canopy. Most importantly, the pair remained together after release and the female regularly vocalized. However, the gibbons exhibited a high level of aggression towards human observers. The results from this thesis can inform a revision of the proposed recommendations for evaluating the behavioral preparedness of rehabilitated gibbons. Based on the overall behavioral profile of the released gibbons, it would seem that at least some Javan gibbons are capable of acquiring the necessary survival skills to live in
the wild after a period of rehabilitation. At the same time, considering the aggressive behavior that the gibbons displayed towards humans, caution must be taken for future observation and monitoring of reintroduced Javan gibbons and future release sites should have very minimal human activity.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT ........................................... iv</td>
</tr>
<tr>
<td>LIST OF TABLES ................................. viii</td>
</tr>
<tr>
<td>LIST OF FIGURES ................................. ix</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS .............................. x</td>
</tr>
<tr>
<td>CHAPTER</td>
</tr>
<tr>
<td>1 INTRODUCTION ..................................... 1</td>
</tr>
<tr>
<td>2 LITERATURE REVIEW ............................ 5</td>
</tr>
<tr>
<td>Gibbon Behavior and Ecology .................... 5</td>
</tr>
<tr>
<td>Threats to the Survival of Javan Gibbons ....... 9</td>
</tr>
<tr>
<td>Loss of Habitat/Habitat Fragmentation ........... 9</td>
</tr>
<tr>
<td>Illegal Pet Trade .................................... 13</td>
</tr>
<tr>
<td>Small Population Processes ..................... 15</td>
</tr>
<tr>
<td>Rehabilitation and Reintroduction ............... 19</td>
</tr>
<tr>
<td>Gibbon Rescue and Rehabilitation Centers ....... 23</td>
</tr>
<tr>
<td>Gibbon Rehabilitation Project (GRP) ............. 23</td>
</tr>
<tr>
<td>Kalaweit Gibbon Center (KP) ...................... 24</td>
</tr>
<tr>
<td>The Javan Gibbon Rescue and Rehabilitation Center (JGC) ....... 25</td>
</tr>
<tr>
<td>3 RESEARCH QUESTION AND METHODS ........... 27</td>
</tr>
<tr>
<td>Research Question .................................. 27</td>
</tr>
<tr>
<td>Methods .............................................. 27</td>
</tr>
<tr>
<td>Study Site .......................................... 27</td>
</tr>
<tr>
<td>Study Group ........................................ 28</td>
</tr>
<tr>
<td>Data Collection .................................... 30</td>
</tr>
<tr>
<td>Pre-Release ........................................... 31</td>
</tr>
<tr>
<td>Post-Release ......................................... 31</td>
</tr>
<tr>
<td>Data Analysis ....................................... 34</td>
</tr>
<tr>
<td>4 RESULTS ........................................... 40</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1. Description and Pair Names of the Study Gibbons</td>
<td>31</td>
</tr>
<tr>
<td>Table 2. Ethogram for Javan Gibbon</td>
<td>32</td>
</tr>
<tr>
<td>Table 3. Proposed Criteria for Assessing the Suitability of Gibbons for Release</td>
<td>35</td>
</tr>
<tr>
<td>Table 4. Summary of Behavioral Criteria for Pre-Release Observations</td>
<td>49</td>
</tr>
<tr>
<td>Table 5. Revised Behavioral Checklist</td>
<td>67</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

PAGE


Figure 2. Map illustrating the location of JGC. .................................................................26

Figure 3. Naturalistic enclosure at Javan Gibbon Rescue and Rehabilitation Center. ..........29

Figure 4. Release site, Patiwell. ..........................................................................................30

Figure 5. Septa and Echi being released from their enclosure at (Photo by Duhe Anfield). ..................................................................................................................33

Figure 6. Septa after release (Photo by Duhe Anfield). ....................................................34

Figure 7. Average percent of observation records gibbons spent in activity at JGC, KP, and CALS. Data represent combined percentage of male and female gibbons in each activity. JGC-6 individuals (3 adult males; 3 adult females); CALS-5 individuals (3 adult males; 2 adult females); and KP-41 individuals (number of each sex is unknown). ................41

Figure 8. Percent of observation records the gibbons spent in different activities..........42

Figure 9. Percent of observation records gibbons spent in proximity. ............................45

Figure 10. Percent of observation records spent in location of enclosure. .........................46

Figure 11. Percent of observation records gibbons spent in different modes of locomotion. ..................................................................................................................47

Figure 12. Percent of observation records gibbons spent in different modes of locomotion. ..................................................................................................................48

Figure 13. Percent of observation records gibbons spent in different modes of locomotion. ..................................................................................................................48

Figure 14. Septa and Echi post-release (Photo by Anton Ario/CI-Indonesia). .................50

Figure 15. Septa and Echi post-release (Photo by Anton Ario/CI-Indonesia). ........................68
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CHAPTER 1

INTRODUCTION

It is estimated that almost half of the world’s nonhuman primates are threatened with extinction and 29 percent are categorized as Endangered or Critically Endangered (International Union for Conservation of Nature and Natural Resources [IUCN], 2010). Current conservation efforts seek to preserve the diversity of the Primate Order and ensure the survival of representative populations of species in their natural habitats (Southwick & Blood, 1979). In order for these efforts for primates to be successful, as well as for other wildlife, it is crucial that the cause of the threats faced by the different species in their habitats are thoroughly understood (Nijman, Yang Martinez, & Shepherd, 2009). The primary extrinsic threats to the majority of primates are undoubtedly loss of habitat and hunting. In addition, as remaining populations continue to decrease, the effects of secondary threats, such as the use of primates in traditional medicine and the illegal pet trade, become more important (Cowlishaw & Dunbar 2000; Nijman et al., 2009). The illegal trade of primates can have a drastic effect on the last surviving populations of already rare species. Young primates are removed from the wild and most often, reproductively viable adults are killed in the process. In addition, as a result of the illegal trade network, primates are becoming displaced and orphaned, which brings them into various types of rescue and rehabilitation centers (Cheyne, 2004).

Rehabilitation and reintroduction programs have been widely used as a method of conservation for endangered species for some time (Kleiman, 1989). Reintroduction programs provide an opportunity for animals that have lived in captivity to have another chance at living in the wild, and may be one way of reestablishing populations that have become locally extinct (Komdeur & Deerenberg, 1997). Reintroduction addresses conservation on two different levels. First, animals that are kept illegally as pets are rescued, rehabilitated, and then returned to the wild; and second, by reintroducing animals into areas where they are locally extinct, the wild populations are supplemented and potentially more forest can be protected (Cheyne, 2006; Kleiman, 1989). It has been acknowledged that
preservation of wild populations and their habitats is imperative for the conservation of many wild species, and rehabilitation and reintroduction may play a significant role in supporting the wild populations, as well as raising awareness of the plight of these species (Cheyne, Chivers, & Sugardjito, 2008).

All species of gibbons (Hylobatidae) have been in decline over the past 30–40 years, primarily due to loss of habitat and the subsequent fragmentation of forests through timber felling, charcoal burning, encroachment cultivation, rubber plantations, and tea and pine plantations (Cheyne, 2004; Nijman & van Balen, 1998). Other factors contributing to their demise include the illegal wildlife trade, hunting, and the use of their body parts in traditional medicine (Cheyne, 2004). Rehabilitation and reintroduction of gibbons is a relatively new conservation strategy. There are very few data published on the successful reintroduction of gibbons back into their native habitat. With 15 of the 17 gibbon species currently listed as Endangered or Critically Endangered (IUCN, 2010; Van Ngoc et al., 2010), the future of all gibbons is truly in peril (Cheyne et al., 2008). Many gibbons are kept illegally as pets and a large number of these end up in rescue and rehabilitation centers when the owners realize they can no longer control the gibbon. The reintroduction of former pet gibbons may be one way to ensure the survival of many of these threatened species of gibbons in the wild (Cheyne et al., 2008).

The Javan Gibbon Rescue and Rehabilitation Center (JGC) was established in 2003 and is a collaborative effort between Conservation International-Indonesia, the Silvery Gibbon Project, University of Indonesia, and the Indonesian Ministry of Forestry. The center receives donated or confiscated pet Javan gibbons (*Hylobates moloch*) with the goal of restoring their physical and psychological health back to as high a level as possible. This process includes assessing their medical and behavioral status and placing them into an appropriate social environment of an adult male and female (Supriatna, 2006). In the wild, Javan gibbons generally live in two-adult group units consisting of an adult male and female and their dependent offspring (Fuentes, 1999, 2000; Palombit, 1994; but see Malone, 2007). Therefore, this is the preferred social environment for gibbons at the center and it is recommended that the gibbons are released in pairs. By releasing gibbons in established pairs, this will hopefully ease the transition from captivity to the wild and eliminates the need for the gibbon to have to find a mate and establish a territory when released (Cheyne, 2004).
In addition to the rehabilitation process, JGC also conducts non-invasive behavioral research and provides public awareness and conservation education programs that focus on the preservation of the Javan gibbon (Supriatna, 2006). The ultimate goal of JGC is to release rehabilitated Javan gibbons back into the wild.

The objective of this thesis project was to contribute to the Javan Gibbon Rescue and Rehabilitation Center’s goal of rehabilitating and reintroducing Javan gibbons back into their native habitat. The study consisted of conducting behavioral observations on pairs of Javan gibbons living at JGC in order to determine if they were suitable candidates for release. Gibbons that have been removed from the wild at a young age and have lived as pets for most of their adult lives face a variety of challenges in the rehabilitation process. These challenges include: learning how to vocalize in the appropriate social context, appropriately socializing with conspecifics (Mootnick & Nadler, 1997), overcoming the potential prevalence of stereotypic or human-directed behaviors, learning how to locomote efficiently (i.e., brachiate, developing balance), and learning how to locate and procure food (Cheyne, 2004; Kleiman, 1989). It is imperative to have an understanding of gibbon behavior during both the pre-and post-release phases of the rehabilitation process, in order to help ensure the gibbons will have the best opportunity to adapt to a life free from human dependency in the wild. Many of the earlier reintroduction projects with lar gibbons (Hylobates lar) in Thailand were unsuccessful because of inadequate planning throughout the rehabilitation process and a lack of knowledge pertaining to the behavior and ecology of the species (Cheyne, 2004; Clemmons & Buchholz, 1997).

Behavioral studies can contribute a significant amount of knowledge to reintroduction programs by examining the underlying evolutionary mechanisms of species’ behavior, such as the driving forces behind social and spatial organization, and by developing an understanding of how they respond to different social and environmental conditions (Clemmons & Buchholz, 1997). The rehabilitation process will vary depending on the species. Species that spend an extended period of time learning valuable social and life skills from their parents, such as monkeys and apes, may prove more challenging in the rehabilitation/reintroduction process (Cheyne, 2004). As Cheyne (2004) demonstrated in her work at the Kalaweit gibbon center in Central Kalimantan, Indonesia, during the rehabilitation process it is crucial to document the behavior of gibbons in captivity prior to
their release, so that we are able to compare the pre- and post-release behavior as a way to
determine the relative success of the reintroduction project. Therefore, monitoring the
gibbons’ behavior before they are released is a crucial component in the reintroduction
program for the Javan gibbon and hopefully will ensure a successful release.

In addition to fully documenting pre-release behavior of the gibbons, it is critical to
monitor them for an extended period of time after they are released and their behavior should
be compared to wild conspecifics. There are very few data available on the behavior of
reintroduced gibbons and their ability to adapt to a new environment (Cheyne, 2004;
Kleiman, 1989). Cheyne (2004) presents the only comprehensive study of the rehabilitation
process and reintroduction of white-bearded gibbons (Hylobates albibarbis) and Mueller’s
gibbons (Hylobates muelleri) to date. This study constitutes the first step at developing a
more systematic approach to the rehabilitation process at JGC by fully documenting the
gibbons’ behavior both pre- and post-release. Considering the behavioral ecological data on
wild Javan gibbons is extremely limited (Kappeler, 1981; Malone, 2007), if the
reintroduction project is to persist as a conservation mechanism for Javan gibbons, we must
also engage in further studies on their behavior and ecology in the wild to increase our
knowledge.
CHAPTER 2

LITERATURE REVIEW

The literature review comprises a discussion of research relevant to this thesis including: gibbon behavior and ecology, threats to the survival of Javan gibbons, and rehabilitation and reintroduction programs.

**Gibbon Behavior and Ecology**

Gibbons, whose family name, Hylobatidae, is Greek for “dweller in the trees”, are the smallest of the apes and are distributed throughout tropical and subtropical forests of South, East, and Southeast Asia. Their range extends from northeastern India to southern China, Bangladesh, Myanmar, Vietnam, Lao PDR, Cambodia, the Malay Peninsula, Java, Borneo, Sumatra, and the Mentawai Islands (Cheyne, 2004; Malone, 2007). In terms of numbers of species and individuals, gibbons are the most successful and widely distributed of all the extant apes (Cheyne, 2004). Nonetheless, they are threatened throughout their range primarily due to loss of habitat, the illegal pet trade, use in traditional medicine, and poaching all contribute to their decline. All gibbon species are listed on Convention on International Trade of Endangered Species (CITES) and hold various positions on the World Conservation Union (IUCN, 2010) Red List (Cheyne, 2004).

The Hylobatidae have been divided into four different genera based on their number of chromosomes, as well as morphological, vocal, and behavioral differences that exist throughout the family. The four genera are: *Hoolock, Hylobates, Nomascus,* and *Symphalangus* (Bartlett, 2007; Malone, 2007; Mootnick & Groves, 2005; Roos & Geissmann, 2001). There are currently 17 different species recognized in the Hylobatidae (Van Ngoc et al., 2010). The focus species of my study is the silvery or Javan gibbon. It is endemic to the island of Java and is considered one of the rarest hylobatids (IUCN, 2010; Supriatna, 2006).

The Javan gibbon is currently listed as Endangered on the IUCN Red List of Threatened Species (IUCN, 2010) based on the 2001 criteria C2a(i), which refers to a
“population estimated to number less than 2500 mature individuals and a continuing decline, observed, projected, or inferred, in numbers of mature individuals and no subpopulation estimated to contain more than 250 mature individuals.” Currently, it is estimated that 4,000 to 4,500 Javan gibbons remain in the fragmented forests of Java (Supriatna, Mootnick, & Andayani, 2010). The threats to the survival of Javan gibbons are loss of habitat/habitat fragmentation, small population processes, and the illegal pet trade. The Javan gibbon was among the first species to become protected by Indonesian law in 1925, and is listed in Appendix I of CITES, which prohibits all international trade of the species, its parts, and derivatives (Geissman & Nijman, 2006; Nijman, 2006). There are possibly two recognized subspecies, *Hylobates moloch pongoalsoni* and *Hylobates moloch moloch* (Andayani et al., 2001). The Javan gibbon is found only in forest remnants of western (*H. moloch moloch/H.moloch pongoalsoni*) and central Java (*H. moloch pongoalsoni*) in the remaining lowland and lower montane forest (Andayani, Morales, Forstner, Supriatna, & Melnick, 2001; Supriatna et al., 2010). It is estimated that the Javan gibbon has lost up to 96 percent of its original habitat and should receive the highest priority of protection for Asian primates (Malone, 2007; Supriatna, 2006).

Javan gibbons tend to exhibit a socially monogamous mating pattern (i.e., the adults may not be sexually exclusive) (Marshall, 2009). They generally live in small, familial social units consisting of an adult pair and their dependent offspring, typically averaging three to five individuals (Bartlett, 2007; Fuentes, 2000). The onset of sexual maturity for females is on average eight and half years, and around age ten for males. The age at first birth for females usually occurs around age nine or ten (Brockelman, Reichard, Treesucon, & Raemaekers, 1998). Interbirth interval falls between two to three years (Hodgkiss, Thetford, Waitt, & Nijman, 2009). Adult gibbons were traditionally believed to force their same-sexed offspring out of the family group upon sexual maturity via aggressive behavior (Chivers, 1978; Fuentes, 2000). However, the dynamics of dispersal (e.g., the age and sex) by young adult gibbons has been shown to vary and they may disperse as near as the neighboring group, leading to potentially a certain degree of relatedness amongst neighboring family groups (Brockelman et al., 1998; Fuentes, 1999, 2000). Furthermore, there is evidence that young adult gibbons may be tolerated within their groups for at least two years (possibly more) past sexual maturity and they may benefit the group by aiding in territorial defense.
There is also increasing evidence of behavioral flexibility and higher levels of affiliative interactions between neighboring groups across the Hylobatidae, including Javan gibbons, and intergroup encounters are not always agonistic (see Bartlett, 2007; Malone, 2007). Bartlett (2003) suggests that intergroup encounters between adult gibbons provide an opportunity for the young adult gibbons to meet and identify potential mates and therefore, facilitating dispersal from their natal group. Data collected from field studies has shown that there is a significant rate of movement by individual gibbons across groups and home ranges, suggesting a larger, more fluid, social network among groups of gibbons (Malone, 2007). Though gibbons generally do spend the majority of their time living in a two-adult unit, there have been observations of gibbons living solitary, in greater-than-two-adult groups, and movement between those groups (Fuentes, 2000; Palombit, 1994). In addition, gibbons are known to engage in extra-pair copulations with individuals from adjacent territories (Reichard, 1995). Malone (2007) observed at least one group of wild Javan gibbons living in a multi-male/uni-female group in Cagar Alam Leuweung Sancang (CALS) in West Java, Indonesia.

Javan gibbons are one of only two gibbon species not known to produce duet songs (Kloss’s gibbon (Hylobates klossii) being the other). Instead, most of the singing is produced by females and mated females appear to be the vocal “representative” of the family (Geissmann, 2002). Male Javan gibbons will sometimes produce their own specific vocalizations, or contribute to the female’s great call, especially during territorial disputes (Malone, 2007). Although gibbons are considered to be territorial, they do not necessarily defend their entire home range. Both male and female Javan gibbons will attempt to defend their territories by engaging in vocal and/or physical displays and chasing intruders out. Each family group typically occupies a home range of approximately 15-37 hectares (Kim, Lappan, & Choe, 2010; Malone, 2007; Nijman, 2004, 2006; Supriatna, 2006). The home range of Javan gibbons may vary depending on resource abundance, habitat disturbance, and altitude. Furthermore, these factors also influence the daily path length (dpl) exhibited by Javan gibbons, which ranges from 835 – 1,400 meters/day (Kappeler, 1981; Kim et al., 2010; Malone, 2007). Javan gibbons are exclusively arboreal and prefer the upper canopy of lowland (≤ 500 m asl) to lower montane tropical forest (1,000 – 1,500 m asl) (Kim et al., 2010; Malone, 2007). Lowland forests tend to exhibit higher plant diversity and fruit
availability, as well as a higher density of large trees having a diameter at breast height (dbh) of greater than or equal to ten centimeters (Kim et al., 2010). The majority of Javan gibbons in the wild inhabit hill (500-1,000 m asl) and lower montane forest (Kim et al., 2010).

Gibbons are the most suspensory of all the primates and utilize brachiation as their main form of locomotion. However, they will also traverse through the canopy by climbing, leaping, and running or walking bipedally along the branches. Brachiation is a unique form of movement in which the gibbon uses its pectoral limbs to support the full weight of its body in suspension beneath a superstratem, as it moves utilizing a hand over hand locomotion along a branch. They have precise adaptations for maximizing the forward momentum gained from the pendular motion of the body during brachiation (Cheyne, 2004; Fleagle, 1976). The gibbons’ thumb is greatly reduced to hook onto branches during brachiation, rather than grasping, allowing them to move at a greater pace through the canopy. In addition, they have a well developed scapular spine, long forearms relative to their body size, and they also raise and lower their legs in order to maximize momentum while brachiating (Fleagle, 1976). In order for gibbons to efficiently travel through the forest they require primary, continuous canopy forest with dense foliage and horizontal growth (Asquith, 1995; Bartlett, 2007). Only captive-raised gibbons have a tendency to travel on the ground (Cheyne, 2004). Gibbons and siamangs are considered the only true brachiators of all the nonhuman primates, moving through the canopy at speeds as high as 40 kilometers per hour, leaping as far as 15 meters, and traveling as far as 6 meters with each swing (Fleagle, 1988). They are incredibly agile and exceptional acrobats when traversing through the forest.

Gibbons are predominantly frugivorous, but will also consume insects, flowers, and leaves (Bartlett, 2007; Groves, 1984; Leighton, 1987). They require a wide variety of tree species that will fruit at different times of the year to support their dietary needs. They are one of the most important frugivores in Southeast Asian forests, typically dispersing over 81 percent of the species they consume (Bartlett, 2007; McConkey, 2000). They tend to disperse few seeds under parent trees with more than 90 percent distributed over 100 meters away (McConkey, 2000). McConkey (2000) also reported that gibbons actually improve the chance of germination of some of the species in their diet; many fig seeds will not germinate without prior passage through the gut. It is very unlikely that gibbons will inhabit secondary
forest or cross open sections of forest, thus they will contribute very little to forest regeneration in secondary forests by seed dispersal. Secondary forests have gaps in the canopy and the growth is sparse, thus restricting the gibbon's ability to efficiently move around. There is also less of a variety of fruiting trees in new growth forest (McConkey, 2000) which potentially cannot support the dietary needs of the Javan gibbon. Therefore, the role of gibbons, and primates in general, in maintaining forest biodiversity is an area of increasing interest and has significant implications for conservation programs, including reintroduction efforts and increasing the amount of protected areas in primary forest (Bartlett, 2007; Chapman, 1995). Educating local communities about the importance of primates in maintaining forest biodiversity via seed dispersal, may aid in gathering more support for reintroduction programs and habitat protection.

In comparison to other small bodied primates, gibbons have very few natural predators (i.e., leopards, birds of prey, pythons) and a relatively low predation rate, with the exception of humans (Kappeler, 1981). As a result, gibbons are able to avoid predation mostly by remaining in the upper levels of the forest canopy. Gibbons are rarely found less than ten meters below the ground. Leopards and pythons are most often found in the lower levels of the forest canopy (Kappeler, 1981). Most species of gibbons, particularly Javan gibbons with their silvery gray fur, are well camouflaged within the canopy. Gibbons are naturally vigilant creatures, exceptionally so during feeding and grooming where they will actively scan the area in an attempt to avoid possible predators (Kappeler, 1981). After gibbons engage in singing or other noisy behavior, they tend to quietly move on to a new area of the forest in an attempt to avoid being discovered by potential predators (Kappeler, 1981).

**THREATS TO THE SURVIVAL OF JAVAN GIBBONs**

The following section provides an overview of the threats to the survival of Javan gibbons in the wild.

**Loss of Habitat/Habitat Fragmentation**

Indonesia belongs to the Sundaland Biodiversity hotspot (Mittermeier et al., 2005; Supriatna et al., 2010). It is rich in endemic species and has the third largest forested area in the world. Unfortunately, Indonesia is also experiencing the highest rate of deforestation in
the world and its ecosystems are constantly under threat from human activities (Mittermeier et al., 2005; Siscawati, 2010). The deforestation rate in Indonesia is almost three times higher than the average rate of tropical deforestation in the world. There is only about 37 percent of the original primary forest remaining out of the total forest area that existed in 1966. Prior to 1966, Indonesia had not yet suffered from structural adjustment programs, debts, and aggressive private capital flows (Siscawati, 2010). These contributed to policies including inequitable land tenure and incentives that lead to deforestation and forest degradation. The accompanying social, economic, cultural and spiritual exploitation caused the suffering of more than 40 million indigenous people and many local communities in Indonesia (Siscawati, 2010).

The island of Java is one of the most densely populated areas in the world with over 115 million inhabitants and an average population density of more than 900 people/kilometers² (Nijman, 2006; Supriatna, 2006; Supriatna et al., 2010). Java has had a long history of cultivation and deforestation that began in 1000 AD. It is now largely deforested and the majority of the forest fragments cover parts of the many volcanoes on the island. The remaining land of Java is a mosaic of cities, villages, and rice fields (Nijman, 2006). The Dutch arrived on Java in 1830 and began heavily exploiting the natural resources of the island. The Dutch colonial government initiated a state forestry system and required farmers to grow export crops on communal grounds, which was often the forest (Nijman, 2004; Peluso, 1993). By the end of the 19th century the natural forest was severely fragmented, especially in western and central Java. Presently, the major cause of loss to remaining forest is due to illegal small-scale logging (i.e., tree cutting for subsistence plots, firewood, forest fires, and charcoal production), much of what goes unpunished by law, as opposed to the industrial scale logging of the past (Malone, 2007; Smiet, 1992; Supriatna, 2006; Supriatna et al., 2010). It is estimated that less than ten percent of the original forest on Java remains, including 19 percent of hill forest (500-1000 m asl), and only two percent of the lower montane forest (<500 m asl) is still present (Nijman, 2004). The Javan gibbon prefers relatively undisturbed lowland and lower montane rainforest, ideally below 1600 meters. Due to human encroachment, gibbons are being pushed up into higher elevations where the habitat is less suitable for them (Nijman, 2004). However, there are groups in Cagar Alam Leuweung Sancang (CALS) that inhabit edge and disturbed forest fragments
(Malone, 2007). The behavioral and ecological flexibility demonstrated by some Javan gibbons, may pave the way for future studies with regards to their response to anthropogenic disturbance.

The Indonesian government owns most of Java's forests and manages them through the State Forestry Corporation (Peluso, 1993). Teak wood is still exported by Java, but is regulated by the government which sets rules about the size and number of trees to be exported. Environmental groups have applauded the management of teak plantations, largely due to the improvement of well managed rotation of the crops and the government's attempt to implement a social forestry program. The social forestry program was created with the goal of including local people in forest resource management, but has not been entirely successful (Hidayat, 2008). In general, local people are only given a limited amount of control and only if they participate in the system working as forest laborers (Hidayat, 2008; Peluso, 1993). In 2001, legislation for regional autonomy went into effect and forest management was given over to local governments, except for in conservation areas (Supriatna et al., 2010). Local governments tend to focus on short-term economic gains such as logging, instead of long-term sustainable management of natural resources (Malone, 2007; Supriatna, 2006; Supriatna et al., 2010). The decentralization of the government has both positive and negative implications for conservation and the livelihood of the local people. The positive outcome is the increased ability for NGOs to lobby for local regulations that recognize the indigenous rights to natural resources and promote sustainable forest use. On the negative side, local districts can now issue a larger number of permits for local companies that may potentially exploit the forests (Supriatna, 2006; Supriatna et al., 2010). The local people, including the decision makers, are not provided with adequate information regarding the importance of conservation and the long term benefits they can derive from the forests (i.e., watershed protection) (Supriatna, 2006). Moreover, the concept of forest management developed by the Department of Forestry itself does not ensure conservation. The logging companies never comply with their own policies in consistently implementing forest management concepts (Hidayat, 2008). Concessionaires breach the limits of logging areas and illegal logging of small diameter trees is permitted. In addition, they do not replant or renew trees and they forge timber transport documents, as well as log on upland areas.
Therefore, the management concept of Indonesian forests has not been entirely successful and the forests continue to disappear (Hidayat, 2008).

It is imperative to raise awareness for the local people in regards to the benefits they will appreciate from sustainably utilizing forest resources. The rich forests of Gunung Gede-Pangrango, Gunung Halimun, and Gunung Salak are primary water catchment areas for over 20 million people in the surrounding area, including the city of Jakarta. It is crucial to protect these forests in order to ensure a long time water supply for the people (Supriatna et al., 2010). Furthermore, Javan gibbons, like all of the hylobatids, tend to prefer full, closed canopy within mature forest for sleeping, eating, and singing. Female gibbons prefer taller trees that extend beyond the canopy for performing their 'great calls' and accompanying displays (Whitten, 1982). Gibbons can be sensitive to disturbance and will often alter their behavior in response to frequent logging, collection of forest resources, human encroachment, or hunting (Nijman, 2006). This behavior can potentially be manifested in several ways, including an increase in vigilant behavior resulting in avoidance, retreat or hiding behaviors, the gibbons may move lower in the canopy, and ultimately, suppress their vocalizations (Malone, 2007; Nijman, 2006). Gibbons produce loud vocalizations in order to defend their territory, attract mates, and potentially reinforce the pair bond. Although Javan gibbons are not known to duet, males will occasionally contribute to the females’ great call or during territorial disputes (personal observation) and this could be considered a form of pair bond reinforcement. In addition, calling frequency in gibbons is dependent on, amongst others, the density of gibbons (Chivers, 1978). If wild gibbons are suppressing their vocalizations, or engaging in other types of cryptic behavior due to anthropogenic disturbance, it may prove difficult for researchers to obtain an accurate count of gibbons in the wild, which can influence conservation strategies aimed at protecting them.

In 2008 the IUCN downlisted the Javan gibbon from Critically Endangered to Endangered. This recommendation came from more intensive surveys that were conducted in the western and central part of the island that indicated a larger population in the wild than was previously believed (Nijman, 2004). The underestimation of Javan gibbons in the wild seemingly was the result of methodological differences in population estimation (i.e., actual numbers of gibbons observed in a few areas vs. extrapolation from density estimation at varying geographic and altitudinal zones) (Malone, 2007; Nijman, 2004). Based on a review
of the literature, there has been a variety of methods used to determine the actual number of Javan gibbons left in the wild, all yielding different estimates. Methods range from rapid presence-absence surveys, range mapping, fixed line transects to fixed-point counts (Nijman, 2004) and population estimates have ranged from as few as 400 individuals to as many as 7,900 individuals remaining in the central and western parts of Java (Kappeler, 1981; Nijman, 2004). The current population is estimated at 4,000-4,500 Javan gibbons (Nijman, 2004; Supriatna et al., 2010). Wild Javan gibbons prefer to avoid humans when they encounter them in the forest. This could potentially make it more difficult for researchers to actually detect them in the wild and may lead to inaccurate counts of individuals (Nijman, 2004). Most primates in the wild are elusive, however, gibbons live in smaller groups and therefore, tend to be more difficult to detect in the wild. If the number of gibbons are estimated too low in the wild, this could potentially lead to focusing conservation efforts more on saving the ex-situ population (i.e., the captive population), as opposed to providing more protection in their natural habitats (in-situ) (Nijman, 2004). It could potentially be beneficial to focus efforts on establishing a captive breeding population /metapopulation that could then be used to supplement the population of Javan gibbons in the wild.

**Illegal Pet Trade**

It is believed that the equivalent of an entire population of Javan gibbons (approximately 300 individuals) is held illegally in captivity in Indonesia (Nijman, 2006; Supriatna, 2006). The north coast of the island of Java is a major route for the trafficking of Indonesian nonhuman primates, possibly including the Javan gibbon (Malone, Fuentes, Purnama, & Adi Putra, 2004; Supriatna, 2006). The majority of Javan gibbons held in captivity in Indonesia are directly derived from the wild, as opposed to captive breeding programs, including the individuals who are in zoos and wildlife rescue centers (Nijman, 2006). When infant gibbons are removed from the wild, it is usually after their mother (and perhaps other family members) have been shot and killed. This has potentially detrimental effects on the wild Javan gibbon population because aside from the young gibbons being removed, viable female gibbons are also being removed from the total population (Malone, 2007). Furthermore, if the infant does survive the pet trade and become a household pet, it will most likely never have the opportunity to reproduce and contribute to any population of
wild Javan gibbons. One of the major challenges in the enforcement of illegal wildlife trade regulations is the willingness of the authorities to become engaged in and carry through the required judicial procedures (Supriatna et al., 2010). As a result, current offenders of wildlife laws are rarely prosecuted (Malone, 2007; Nijman, 2006; Supriatna, 2006). The current system in Indonesia allows for individuals to donate their pet gibbons to zoos, wildlife rescue centers, and rehabilitation programs when they realize they can no longer manage the gibbon as a pet. As a result, it becomes easier for private owners to dispose of their adult gibbon and potentially obtain a younger individual from the wild, perpetuating the illegal pet trade system (Supriatna, 2006). Malone (2007) provides an excerpt from a report discussing a potential link between the Ministry of Forestry and the illegal trade of wildlife, including Javan gibbons:

Contesting the official lament about the plundering of Indonesia's natural wealth is Iwan Setiawan, staff member of the Indonesian Environment Information Center (PILI). In September, he led a team to research the trafficking in endangered species in the Pramuka and Barito pet markets. He said he found some protected animals on sale and evidence of transactions, and reported his findings to the ministries of Forestry and Environment, the Nature Conservation Body and the police. The result? Nothing, said Iwan, which has led him to conclude that there is a nexus between the smugglers of endangered species and the authorities. It is a view that is repeated by the Gibbon Foundation, a conservation group based in Jakarta. A member of the group's office explained that the foundation had at one time entered into a cooperation agreement with the Forestry Ministry to map wild-animal populations using satellite imagery. The aim was to identify the remaining concentrations of wild species. “But this invaluable information was leaked out,” said the staffer, “then we found traces of professional hunters in the regions and the animals had gone.” (Malone, 2007, p. 32)

The illegal pet trade is unfortunately a valuable mode of profit for individuals in Indonesia. Internal exploitation and corruption is undoubtedly contributing to deforestation rates in the country, as well as the disappearance of wildlife, and is the result of a system that perceives natural resources as a means of revenue that can be exploited for political and social gain (Malone, 2007). The ownership of an endangered nonhuman primate is portrayed as a symbol of status and economic success. It is reported that many government officials, army officers, and entertainers own pet nonhuman primates, especially orangutans (Malone et al., 2004). This practice unfortunately encourages other people to purchase nonhuman primates, and enhances the symbolic status of owning an endangered species. As a
consequence, the reported public display of nonhuman primate pets by the wealthy and influential serves as a demonstration of political power, and ultimately, the selective enforcement of Indonesian law (Malone et al., 2004). This information exemplifies the challenges that conservationists face when developing conservation programs that seek to preserve the remaining forests and wildlife of Indonesia. Furthermore, regarding the primary issues of habitat loss and the illegal trade in gibbons, local people will have to be involved in the long-term effective management of forest resources and they must demonstrate the will to report and prosecute individuals who are involved in the illegal pet trade (Malone, 2007).

**Small Population Processes**

Due to the severe fragmentation of Java's forests, the only suitable habitat remaining on the island for Javan gibbons is small isolated patches of forest. The fragmented nature of this remaining habitat makes the species highly vulnerable to extinction via small population processes, including environmental stochasticity, demographic stochasticity, and loss of genetic diversity (Cowlishaw & Dunbar, 2000). In general, extinction risk is a function of population size. If populations are large, the risk of extinction is relatively low, but if species exist in smaller populations, the risk of extinction becomes much greater (Cowlishaw & Dunbar, 2000). If gibbons are unable to disperse into new territory and acquire new mates, the isolated populations could potentially be at great risk for extinction through loss of genetic variability. A reduction in genetic diversity of a population (i.e., decreased heterozygosity, increased homozygosity) is considered undesirable for two reasons. The first reason being, the loss of heterozygosity means that populations have less genetic flexibility allowing them to respond to changes in the environment. Secondly, there is a potential increase in the likelihood of inbreeding depression (i.e., the phenotypic expression of deleterious recessive genes). As population size decreases, the effect of such an impact becomes disproportionately severe (Cowlishaw & Dunbar, 2000).

In order to increase genetic diversity in small populations of Javan gibbons, it could prove beneficial for conservation efforts to translocate gibbons between forest patches and establish a metapopulation between wild and captive individuals. Researchers have suggested the need of establishing a metapopulation management program through some form of genetic supplementation. This would include capturing young individuals who are
preparing to leave their natal groups and transferring them to other areas (translocation) (Nijman, 2004, 2006). This conservation strategy was utilized in an effort to save the golden lion tamarin (*Leontopithecus rosalia*) from going extinct in the Atlantic coastal forest of Brazil. Similar to Javan gibbons, golden lion tamarins are found only in isolated forest patches and are vulnerable to extinction via small population processes. The golden lion tamarin wild population was estimated at only 100-200 individuals in the 1970s. A metapopulation was established and the first captive-bred tamarins were released in the mid 1980s, and by 1994 the wild population had grown to approximately 450 individuals with an additional 550 in captivity (Ballou et al., 2002; Britt, Welch, & Katz, 2003; Kleiman, 1989). For Javan gibbons, another conservation strategy that may prove beneficial in supplementing the wild populations is the rehabilitation and reintroduction of individuals from rescue centers into isolated forest areas without resident gibbons (Nijman, 2006; Supriatna, 2006).

The reintroduction of Javan gibbons back into their native habitat, as well as the establishment of a metapopulation, may prove to be a more complicated conservation strategy based on the fact that there are potentially two identified subspecies living on the island. In a molecular genetics study, Andayani et al. (2001), found that two lineages of Javan gibbons may exist: a western lineage (*H. moloch moloch*) that is represented by a large population in Gunung Halimun and an central lineage (*H. moloch pongoalsoni*) consisting of isolated populations around the Gunung Masigit/Simpang/Tilu complex, Gunung Gede-Pangrango, and Gunung Slamet in central Java (Andayani et al., 2001; Asquith, 1995; Supriatna, 2006) (see Figure 1). The morphological differences between the two populations are quite subtle, so additional research on the phylogenetic analyses of mtDNA and vocalizations may shed further light on the finding (Mootnick, 2006; Supriatna et al., 2010). Furthermore, to the best of my knowledge, there are not published scientific data from wild studies as to exactly how the two potential subspecies of Javan gibbons differ in terms of their behavior and ecology. According to the study conducted by Andayani et al. (2001), the discovery of the two lineages has potential implications for conservation policy and reintroduction programs and they make the following recommendations: (1) the western population should be managed as a separate and distinct population unit and should not be used to reinforce the central population; (2) the gibbons from the Gunung Masigit/Simpang/Tilu complex, Gunung Gede-Pangrango, and Gunung Slamet represent a
second distinct unit and can be moved between the surrounding areas; and (3) the gibbons from Gunung Slamet are not evolutionarily distinct from the gibbons directly to the west. However, the gibbons from Gunung Slamet do merit special attention because they may represent a case of peripheral isolation (Andayani et al., 2001; Supriatna, 2006). Stanford (2001) argues that splitting primate taxa into subspecies should be done cautiously and conservatively, because it will heavily influence conservation initiatives. There should be a
consensus of biogeographic, genetic, morphological, behavioral, and ecological factors that are used to distinguish the subspecies from one another, all of which are limited (if not absent) for Javan gibbons. Considering Andayani et al. (2001) represents the only molecular study conducted on Javan gibbons to date, it would seem necessary to engage in further behavioral and ecological studies on determining the level of distinction between the two subspecies, prior to developing conservation policies aimed at protecting them in the wild. Groves (2001), Mootnick (2006), and Geissmann, Dallmann, and Pastorini (2002) do not acknowledge the subspecies level of classification for the Javan gibbon. Also, the 2006 Asian Primate Red List workshop assessed the conservation status of all species of gibbons and the Javan gibbon was listed as *Hylobates moloch*, with no regards to the two lineages. This assessment would seem to suggest that conservation initiatives aimed at preserving them in the wild are considering the Javan gibbon to be a monotypic species. Supriatna et al. (2010) suggests that reintroduction efforts should be conducted with caution until further genetic and vocalization studies have verified the evidence of the two lineages of Javan gibbons and if there are any detrimental effects if the two subspecies were to interbreed. This recommendation potentially raises the issue of the validity of the subspecies classification regarding conservation measures, particularly for species that are considered highly endangered (Smith, Chiszar, & Montanucci, 1997). Considering the threats to Javan gibbons in the wild are persistent, should conservation efforts focus on preserving the Javan gibbon at the species level, or attempt to preserve the two lineages? I would argue that conservation efforts should prioritize eliminating the extrinsic threats, loss of habitat and the illegal pet trade, before we can afford the luxury of managing the two subspecies separately. It is important to consider the feasibility of the subspecies concept with regards to reintroduction efforts. It would be necessary for JGC to determine the lineage to which each Javan gibbon belongs prior to release, and then this would determine where the pair was to be reintroduced in the wild. However, at this time, JGC does not identify the subspecies level of classification for the individuals at JGC prior to placing them in pairs or before locating a potential release site. Considering there are perhaps as few as 4,000 to 4,500 Javan gibbons remaining in the wild, if we could obtain an accurate population count for each potential subspecies, perhaps a higher level of conservation priority aimed at protecting the species and its habitat in the wild could be developed.
Riley (2010) presents information on a similar scenario regarding the conservation status of the crested black macaque (*Macaca nigra*) on the island of Sulawesi. Currently, it is estimated that only 4,000 to 6,000 crested black macaques remain on Sulawesi. However, there is a larger, introduced population of approximately 100,000 individuals on Bacan Island (~300 km east). Although the population of crested black macaques on Sulawesi and the Bacan population are essentially identical with regards to their behavior and morphology, genetic analysis (i.e., dermatoglyphics, polygenetic differences) has revealed a significant divergence from the mainland population (Froehlich, Supriatna, & Muskita, 1996). In spite of this finding, the crested black macaque is considered a monotypic species. However, Froehlich et al. (1996) state the Bacan macaques should not be considered a genetic reservoir for the threatened mainland populations, unless they become totally extinct on Sulawesi. As of present, the IUCN does not include the Bacan population in its conservation assessment of the crested black macaque, in order to maintain the focus of conservation priority on eliminating the extrinsic threats to the survival of the species on Sulawesi (Riley, 2010).

**Rehabilitation and Reintroduction**

The American National Wildlife Rehabilitation Association defines rehabilitation as “the treatment and temporary care of injured, diseased and displaced indigenous wildlife, and the subsequent return of healthy viable animals to appropriate habitats in the wild” (Atkinson, 1997; Cheyne, 2004). The IUCN (2002) defines reintroduction as the “introduction of a species in a previously occupied area in order to improve the conservation of the species” (p. 6). It is crucial that the individuals that are to be released have either maintained or developed the appropriate behavioral repertoire necessary for survival in the wild, and have gone through an extensive period of rehabilitation (Cheyne et al., 2008). Reintroduced individuals may be translocated from other wild populations or may come from captive breeding programs (IUCN, 2010; Sarrazin & Barbault, 1996). In its recommendation section for reintroduction, the IUCN (2002) states that programs should incorporate feasibility studies and preparatory, and pre-and post-release monitoring periods. In order for a reintroduction program to be successfully implemented, there must be adequate funding, local agreement, and the population viability of a species (i.e., demographic, genetic, behavioral, and ecological processes) within their natural environment must be
thoroughly understood (Sarrazin & Barbault, 1996). A population viability analysis typically includes an examination of a species’ characteristics and environmental variability in order to determine population health and extinction risk (IUCN, 2010). The reintroduction of endangered species to their original habitat is often a very attractive, although expensive and highly involved, measure for conservation and is sometimes used as a last resort for saving species that are almost extinct in the wild (Ballou et al., 2002; Kleiman, 1989). Unfortunately, through the years very few reintroduction programs have been successful, presumably due to inadequate pre-release preparation and post-release monitoring (Cheyne, 2004; Stoinski, Beck, Bloomsmith, & Maple, 2003). In order to gain insight on how species adapt to the rehabilitation process, and to ensure that they have acquired the appropriate behavioral repertoire and survival skills that can then be compared when they are released, it is imperative that individuals are monitored during both the pre-and post-release phases of the project (Cheyne et al., 2008).

Reintroduction programs involving nonhuman primates have been in place since the early 1960s. In the 1970s perhaps one of the most successful captive breeding/reintroduction programs was established with the golden lion tamarin in Brazil’s Atlantic coastal forest (Ballou et al., 2002; Britt et al., 2003). The golden lion tamarin became the first example of a “flagship species” that served to ignite conservation efforts not only for the species itself, but also for the Atlantic coastal forest ecosystem as a whole. The golden lion tamarin wild population was estimated at only 100-200 individuals in the 1970s due to extensive habitat destruction and the illegal pet trade (Ballou et al., 2002). The first captive-bred tamarins were released in the mid 1980s, and by 1994 the wild population had grown to approximately 450 individuals with an additional 550 in captivity (Ballou et al., 2002; Britt et al., 2003; Kleiman, 1989).

A common challenge in rehabilitating nonhuman primates is they have often had very little exposure to their native habitats before they were subjected to a life in captivity (usually via illegal pet trade), and therefore lack the appropriate knowledge and experience necessary for surviving in the wild (Britt et al., 2003). In field studies, zoo observations, and laboratory experiments the great apes (as well as monkeys) have demonstrated a great capacity to learn in a complex and novel environment. The reintroduction programs with the great apes, however, specifically orangutans, have been somewhat of a challenge because orangutans
tend to imprint very heavily on their human caretakers. Considering they tend to have extensive relationships with their mothers lasting seven to eight years in the wild, this is often difficult to negotiate when releasing orphaned orangutans, even after a period of rehabilitation, because they have been deprived of this vital relationship with their mothers (Grundman, 2006). Orphaned orangutans, and chimpanzees, will often return to the rescue center in search of food, not show any fear of humans, and do not always engage in the appropriate social behavior with conspecifics. Released orangutans have been observed remaining in small groups, approaching wild orangutans and entering their sleeping nests at night, and even attacking humans (Grundman, 2006; Yeager, 1997). This is problematic for the reintroduction program because these individuals are not adapting to a life free of human dependency and will most likely not contribute to the preservation of the wild population(s) of orangutans in anyway (i.e., not successfully reproduce in the wild).

In June 2009, the first ever group of rehabilitated bonobos (*Pan paniscus*) from Lola Ya Bonobo were released into a 20,000 hectares area of swampy forest in Equateur Province, Democratic Republic of Congo (Les Amis des Bonobos du Congo Newsletter, 2009). There were nine individuals released, including one pregnant female. Upon release the group remained cohesive and began to explore their new forest environment. The bonobos were continuously monitored by staff from the local community and minimally provisioned with food and water. The bonobos were observed making more sophisticated nests than they previously had in captivity, they were successful at locating and procuring food sources, and engaged in appropriate social behaviors with one another. However, some of the individuals, specifically one of the adult males, were displaying aggressive behavior (approaches, physical displays) towards humans. After an intruding villager was bitten by one of the bonobos, the three individuals who were showing the most aggressive behavior towards humans were transported back to Lola Ya Bonobo. The remaining individuals still frequent the release location for nesting and feeding, thus providing the researchers with an opportunity to directly observe the bonobos. The bonobos can easily be observed from the nearby river allowing the local villagers a chance to observe them from a closer distance. This has helped increase public awareness regarding conservation efforts for the bonobos, and has had a very positive effect on the local communities. None of the villagers had actually ever seen a live bonobo before, and willingly admitted that if they had ever eaten
bonobo meat before, they vowed never to do so again after realizing their close resemblance to humans (Les Amis des Bonobos du Congo Newsletter, 2009).

Compared to the great apes there has been very little attention given to reintroduction programs for gibbons. However, the issues of what is involved in successfully rehabilitating a gibbon remain the same as for the great apes. Gibbons who have been kept as pets develop a very different behavioral repertoire than that of wild gibbons (Mootnick & Nadler, 1997). Different skills are needed for survival in the wild, and gibbons would normally acquire these valuable skills, such as how to locate and identify food, avoid predators, navigate in a complex environment, locate sleeping/singing trees, and socialize with conspecifics from their parents. Wild gibbons may remain in their natal group for up to twelve years, sometimes longer, so when infants are removed from the wild, it can be extremely detrimental to their social and psychological well being (Mootnick & Nadler, 1997). Former pet gibbons (i.e., human raised) have been deprived of this crucial learning period and must depend on humans to assist them in acquiring these skills (i.e., placing individuals into appropriate social environments, incorporating wild foods into the gibbons’ diet, and providing an enclosure that will help facilitate proper forms of locomotion) (Cheyne et al., 2008; Grundman, 2006). Another potential issue with former pet gibbons is the prevalence of stereotypic or human-directed behaviors that arise from a life in captivity within an unnatural environment with human contact/interaction. These behaviors should be severely minimized or eradicated before the gibbons are released into the wild. If rehabilitated gibbons solicit attention from humans, whether in an affiliative or an aggressive manner, it could potentially be harmful to them, or humans, and hinder their chance for survival. It is imperative that we have a better understanding of the gibbons’ behavior throughout the entire rehabilitation process, so that we can help facilitate the reintroduction phase of the project and ensure the gibbons are able to survive without human intervention once they are released into the wild (Cheyne, 2004).

Some of the early attempts to reintroduce gibbons were unsuccessful primarily due to poor planning and management practices. For example, in Sarawak, Malaysia on the island of Borneo, the reintroduction effort of Mueller’s gibbons suffered a 90 percent mortality rate in released individuals. Several factors may have been the cause of failure: hunting in the area, starvation, disease, and conspecific aggression (Cowlishaw & Dunbar, 2000).
release of lar gibbons as reported by Tingpalapong, Watson, Whitmire, Chapple, and Marshall (1981) saw far better rates of success. Thirty-one former laboratory gibbons were released into closed forest in Thailand. The released individuals consisted of 26 wild caught individuals and five offspring that were captive born. This reintroduction program was more cautious in the pre-release planning by selecting forest that already had resident gibbons, although not many so there were vacant territories for the released gibbons, and the area was protected from hunting. Researchers monitored the gibbons post-release and provided the gibbons with food and shelter. The gibbons were released in family groups, pairs, or individuals. Unfortunately, two of the gibbons died at the release site, one was recaptured, 24 disappeared over time, and four of the gibbons joined wild groups. It is assumed that the most successful individuals were those in the first group to be released, because they were able to establish their own territories within the present population of gibbons (Cowlishaw & Dunbar, 2000).

**GIBBON RESCUE AND REHABILITATION CENTERS**

As of present, there are only three rescue and rehabilitation centers in Asia devoted strictly to gibbons; the Gibbon Rehabilitation Project in Phuket, Thailand; Kalaweit gibbon center in Kalimantan, Indonesia; and the Javan Gibbon Rescue and Rehabilitation Center in West Java, Indonesia.

**GIBBON REHABILITATION PROJECT (GRP)**

The Gibbon Rehabilitation Project (GRP) is run by the Wild Animal Rescue Foundation of Thailand and was established in 1992 by Mr. Noppadol Preuksawan, the chief of the Royal Forest Department in Phuket at that time, Mr. Thavrn SriOon, Bang Pae Sub-Station chief, the Asian Wildlife Fund and an American zoologist, Terrance Dillon Morin (The Wild Animal Rescue Foundation of Thailand, 2010). The objectives of the reintroduction program are to: develop a method to rehabilitate lar gibbons back into their natural habitat; end the demand for the illegal use of gibbons as tourist attractions and as pets; create awareness to the importance of conservation of the environment; and provide the opportunity for volunteers to study the gibbons. According to the website, the reintroduction program has been quite successful in terms of overall survivability of the released gibbons. The center does not provide any scientific data to support this claim, only brief summaries on
the website and the center does not conduct long term post-release monitoring of the gibbons. Cheyne (2004) states that the center is in a serious need of a complete overhaul of its infrastructure and its approach to the rehabilitation/reintroduction process. The GRP advertises that it is seeking volunteers to assist in the reintroduction program, but has never provided the scientific community the opportunity to monitor the released gibbons (Cheyne, 2004). Critics of the GRP (Cheyne, 2004; de Veer & van den Bos, 2000; Schoene & Brend, 2002) state that the center has created more welfare problems for the gibbons by exceeding its carrying capacity and engaging in poor management practices. The rehabilitated gibbons were not always released in established pairs. The island itself was of poor habitat quality (not contiguous forest) and not capable of supporting the gibbons long term, resulting in long term provisioning. Ultimately, the gibbons are dependent on humans, living in poor habitat, and not contributing to the wild population (Cheyne, 2004).

**KALWEIT GIBBON CENTER (KP)**

The Kalaweit gibbon center (KP) was established in 1999 and has centers on both Borneo (Kalimantan) and Sumatra. It is currently the largest rescue and rehabilitation center for gibbons (white-bearded and Mueller’s gibbons) and siamangs (*Symphalangus syndactylus*) in the world, housing approximately 300 gibbons and siamangs between the two locations (Kalaweit Gibbon Center [KP], 2010). Although the center is not open to the public, volunteers are permitted to go to the center and work as primate keepers and help with the reintroduction efforts for the gibbons. Kalaweit includes local people in all aspects of the reintroduction program by only hiring people from the surrounding villages to work at the center. In addition to the reintroduction program, the center also promotes habitat protection and provides public education on local conservation initiatives by managing a radio station, visiting local communities, and has established a local school that can accommodate up to 30 children. When gibbons arrive at Kalaweit they receive a full health evaluation and spend one month in quarantine. They are tested for Hepatitis A, B, and C, as well as Tuberculosis, and Herpes Simplex Virus 1 and 2. The enclosures at Kalaweit are built into the surrounding vegetation, using trees as the main supports as much as possible. The dimensions of the enclosures are approximately three by three by five meters. There are two types of socialization enclosures in which gibbons are housed in, one for immature
gibbons and one for adult pairs. The socialization enclosures for immature gibbons may contain several individuals at any one time. This is done in an attempt to facilitate the socialization process among conspecifics. Rehabilitated gibbons are released based on reintroduction guidelines established by the IUCN. The only published scientific data of rehabilitated and reintroduced gibbons from Kalaweit are provided by Cheyne (2004) and used for comparative analysis in this study. Presently, the released gibbons from Kalaweit are alive and doing well on Mintin Island (S. Cheyne, personal communication, July 22, 2010).

**THE JAVAN GIBBON RESCUE AND REHABILITATION CENTER (JGC)**

The Javan Gibbon Rescue and Rehabilitation Center, the site of this thesis research, is the only center on Java that focuses solely on the rescue, rehabilitation, and reintroduction of former pet Javan gibbons (Figure 2). When a gibbon first arrives at JGC they receive a full health evaluation (they are tested for Hepatitis A, B, C, as well as Tuberculosis, and Herpes Simplex Virus 1 and 2) and spend one month in quarantine. This is done in order to determine the gibbon’s health status and ensure they can be properly treated if they do suffer from any disease. In addition, this process provides the keepers with an opportunity to gain a better understanding of the gibbon’s temperament. Once the gibbon is removed from quarantine it is then moved into a socialization enclosure, ideally next to another gibbon of the opposite sex. The socialization enclosure consists of two sections that are connected by a small corridor. The keepers will then periodically open the corridor allowing the gibbons the opportunity to interact with one another. After a period of observation (one month minimum) the keepers will determine whether the gibbons will make a suitable pair based on the level of affiliative interaction between the two gibbons. If this step in the socialization process is successful and the keepers determine the gibbons will make a good pair, they are then moved into larger, more naturalistic enclosures.

This thesis research represents the first systematic study conducted at JGC documenting the pre- and post-release behavior of Javan gibbons during the rehabilitation and reintroduction process.
CHAPTER 3

RESEARCH QUESTION AND METHODS

This chapter comprises the research question and methods pertaining to my research.

RESEARCH QUESTION

Can wild-born, former pet Javan gibbons acquire the appropriate behavioral repertoire necessary to survive in the wild after a period of rehabilitation?

To answer this question, I conducted behavioral observations (“pre-release”) on three pairs of Javan gibbons that were deemed potential candidates for release by the staff of JGC (staff based their decisions on preliminary, informal observations). I compare these results to Cheyne et al.’s (2008) recommended behavioral criteria for rehabilitated gibbons. I also conducted behavioral observations (“post-release”) on the first pair of Javan gibbons released in October 2009, in order to determine whether the set of criteria is in fact a suitable measure of the behavioral preparedness of gibbons in a rehabilitation program.

METHODS

This section provides details pertaining to the study site, study group, data collection techniques and methods by which I analyzed the data.

Study Site

The pre-release observations were conducted at the Javan Gibbon Rescue and Rehabilitation Center (106°50' - 107°02' E; 6°41' - 6°51' S) in Gunung Gede-Pangrango National Park, West Java, Indonesia (Figure 2, p. 26). The park is one of the first five National Parks established in Indonesia that were designated as UNESCO World Biosphere Reserves and is comprised of two volcanoes, Mt. Gede and Mt. Pangrango. The park covers a total area of 21,975 hectares, with only 15,196 hectares being less than 1,600 meters above sea level, therefore, suitable habitat for Javan gibbons. It is located in one of the wettest parts of West Java, with an average annual rainfall of 3,000 - 4,200 millimeters. Gunung Gede-Pangrango National Park represents a unique diversity of ecosystems ranging
from lower montane/sub-montane, montane, sub-alpine forest, savanna, and marshland (Supriatna, 2006). The park is home to an array of unique flora and fauna, several species of which are considered endangered. Among those endangered include four primates: the Javan gibbon, the grizzled leaf monkey (Surili) (*Presbytis comate comate*), the ebony leaf monkey (Lutung) (*Trachypithecus auratus auratus*), and the Javan slow loris (*Nycticebus javanicus*). There are also long-tailed macaques (*Macaca fascicularis*) living in the park, but they are categorized as Least Concern (IUCN, 2010). Other endangered species living in the park include the Javan leopard (*Panthera pardus melas*), dhole (*Cuon alpinus javanicus*), the Javan Hawk-eagle (*Spizaetus bartelsi*) and the Javan Scops Owl (*Otus angelinae*) (IUCN, 2010; Supriatna, 2006).

All three of the pairs of gibbons included in this study were housed in naturalistic enclosures. The naturalistic enclosures are built into the surrounding forest with trees being used as the primary support (Figure 3). They range from six to eight meters high and vary in their overall shape and width due to the natural landscape. Once the gibbons are moved into these enclosures, there is very minimal human/gibbon interaction. The enclosures are placed among trees so the gibbons have limited view of the neighboring enclosures. The gibbons are fed a diverse diet that consists of fruit and vegetables from the local market, as well as wild fruit and leaves collected from the forest in the park. In addition, they are also given a variety of greens, tofu, tempe, peanuts, and sweet potatoes.

Post-release observations on one pair of Javan gibbons were conducted in an isolated patch of forest (5 ha) located in Gunung Gede-Pangrango National Park, approximately two kilometers away from JGC. The forest patch, Patiwel, is primary forest and is surrounded by cropland (Figure 4). A pre-release survey was conducted to assess the quality of habitat at the release site (Kurniyawati; in press). It was determined that there was adequate food sources (i.e., a sufficient amount of fruit, leaves, flowers, and insects) to sustain a pair of gibbons and potential offspring until a forest corridor has grown to a sufficient height which will allow the gibbons to move into the larger forested area of the park.

**Study Group**

JGC is currently home to 31 Javan gibbons, 18 of which are housed in pairs. At the time of this research, three pairs were deemed appropriate for release based on preliminary,
Figure 3. Naturalistic enclosure at Javan Gibbon Rescue and Rehabilitation Center.
informal observations conducted by the staff of JGC. Each pair consisted of an adult female and an adult male and were chosen based on certain behavioral criteria, namely observed copulations and a cohesive pair-bond. If a pair of gibbons is observed grooming, playing, copulating, or regularly maintaining close proximity to one another, they are considered to have a cohesive pair-bond. All of the gibbons at JGC came from the illegal pet trade. They were wild-born, human-raised and most likely had little to no previous contact with other gibbons. All six of the gibbons included in this study are free of Tuberculosis and other diseases (a necessary health criteria for release). The pairs observed in this study are: Septa and Echi, Nancy and Jeffry, Kiki and Sadewa (Table 1).

**DATA COLLECTION**

This section provides details as to how I collected data for both the pre- and post-release phases of the research.
Table 1. Description and Pair Names of the Study Gibbons

<table>
<thead>
<tr>
<th>Gibbon Pair</th>
<th>Estimated DOB</th>
<th>Sex</th>
<th>Origin</th>
<th>Number of years paired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeffry</td>
<td>1998</td>
<td>M</td>
<td>Jakarta</td>
<td>5 years</td>
</tr>
<tr>
<td>Nancy</td>
<td>1998</td>
<td>F</td>
<td>Depok, West Java</td>
<td></td>
</tr>
<tr>
<td>Sadewa</td>
<td>2000</td>
<td>M</td>
<td>Sukabumi, West Java</td>
<td>2 years</td>
</tr>
<tr>
<td>Kiki</td>
<td>2000</td>
<td>F</td>
<td>Sukabumi, West Java</td>
<td></td>
</tr>
<tr>
<td>Septa</td>
<td>1999</td>
<td>M</td>
<td>Cianjur, West Java</td>
<td>2 years</td>
</tr>
<tr>
<td>Echi</td>
<td>1999</td>
<td>F</td>
<td>Sukabumi, West Java</td>
<td></td>
</tr>
</tbody>
</table>

Pre-Release

I observed each individual gibbon utilizing focal animal time-interval sampling and ad libitum as necessary (Altmann, 1974). In order to generate an activity budget for each pair of gibbons, I recorded the observed behavioral states at one-minute intervals for the duration of the observation period (2-3 hrs) (Table 2). In addition to recording the behavioral states at one-minute intervals, I recorded the gibbons’ proximity to one another, and their location in the enclosure (see Data Analysis section for operational definitions). I collected a total of 287 hours over 43 days (Jeffry and Nancy, 94hrs; Sadewa and Kiki, 93hrs; Septa and Echi, 100hrs). Data were collected between the hours 0600h and 1700h. In an effort to collect equivalent amounts of data for each pair of gibbons throughout the hours of the day, I rotated the order of the pairs with which I began each day. Following the recommendations of Cheyne et al. (2008), I recorded positive association behaviors including: grooming, playing, and copulating. Other major activities included in the activity budget are: feed/foraging, locomoting, vocalizing, and other. Human-directed behavior and stereotypic behavior (see Ethogram, Table 2), were recorded as either events or states depending on the duration of occurrence.

Post-Release

On Friday, October 16th, 2009, the staff of JGC, Conservation International-Indonesia, Gunung- Gede Pangrango National Park, and members of the Indonesian Department of Forestry, released Septa and Echi back into the wild (Figures 5 and 6). They are the first pair of wild-born, former pet Javan gibbons to be reintroduced into the wild. They were released into a small, isolated patch of forest, Patiwel, located within Gunung Gede-Pangrango National Park.
Table 2. Ethogram for Javan Gibbon

<table>
<thead>
<tr>
<th>Behavioral State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Locomote</strong></td>
<td></td>
</tr>
<tr>
<td><em>Brachiate</em></td>
<td>Moving in a swinging motion by using one arm and then the other to grab a substrate and move self in a forward direction.</td>
</tr>
<tr>
<td><em>Climb</em></td>
<td>Using arms to reach and pull body in an upward movement-can occur in a sideways or downward direction when on the fence</td>
</tr>
<tr>
<td><em>Bipedal</em></td>
<td>Individual is walking/running on two legs in an upright position</td>
</tr>
<tr>
<td><strong>Rest</strong></td>
<td>Sitting or lying down while either asleep or awake</td>
</tr>
<tr>
<td><strong>Feed</strong></td>
<td>The act in which an individual physically consumes an edible item, also includes drinking.</td>
</tr>
<tr>
<td><strong>Social Behavior</strong></td>
<td></td>
</tr>
<tr>
<td><em>Groom</em></td>
<td>Process of cleaning or picking through partner’s hair using hands or mouth.</td>
</tr>
<tr>
<td><em>Copulate</em></td>
<td>The pair is engaged in sexual intercourse.</td>
</tr>
<tr>
<td><em>Play</em></td>
<td>Individual is engaged in activity with another individual-usually consists of wrestling or chasing each other.</td>
</tr>
<tr>
<td><em>Agonistic</em></td>
<td>Includes biting, slapping, pushing, or threatening another individual, includes open-mouth threats.</td>
</tr>
<tr>
<td><strong>Vocalize</strong></td>
<td>Individual creates loud vocalization consisting of varying notes/pitches.</td>
</tr>
<tr>
<td><strong>Human-Directed Behavior</strong></td>
<td>Any behavior directed at humans and is a result of human (keeper/observer) presence.</td>
</tr>
<tr>
<td><strong>Stereotypic Behavior</strong></td>
<td>Abnormal behavior resulting from captivity (i.e., rocking, twitching, repetitive swinging).</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Self-groom, urinate, or defecate.</td>
</tr>
</tbody>
</table>

Figure 5. Septa and Echi being released from their enclosure at (Photo by Duhe Anfield).
Since I was provided with the opportunity to conduct post-release behavioral observations on the pair, my intended method for data collection consisted of conducting full day focal follows utilizing time-interval sampling (Altmann, 1974). Unfortunately, due to the unexpected aggression the gibbons exhibited towards human observers, I was unable to systematically collect data. The gibbons made it very difficult to follow them and prevented observers from monitoring them at a close distance. Therefore, I utilized ad-libitum (Altmann, 1974) and opportunistically recorded any behavioral data I was able to collect, whenever I could observe the gibbons from a safe distance. I collected 50 hours of ad-libitum data over a total of 15 days. Data were collected between the hours of 0530 h and 1600h.

**DATA ANALYSIS**

In order to determine whether the gibbons were behaviorally ready for release, I compared the average percent of observation records observed in major activities of the Javan gibbons at JGC to the guidelines recommended by Cheyne et al. (2008) (Table 3). The
### Table 3. Proposed Criteria for Assessing the Suitability of Gibbons for Release

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gibbons spend 20–75% of travel time brachiating.</td>
<td>The gibbon should be able to move around the enclosure well, and most of this movement should be by brachiation.</td>
</tr>
<tr>
<td>Gibbons spend 50–65% of their time in the upper and emergent canopy and have never been observed sleeping on the ground.</td>
<td>No more than 5% of time to be spent on the ground for any purpose. Gibbons should be at the top of the cage for at least 40% of the time and should not be sleeping on the ground at all.</td>
</tr>
<tr>
<td>The cohesion of the pair is important for territorial defense and successful raising of offspring.</td>
<td>The pair should be spending at least 7% of total activity time in positive pair association. At least 3% of total activity time should be spent allogrooming.</td>
</tr>
<tr>
<td>Proof that the gibbons are sexually mature and active.</td>
<td>They should be copulating successfully and each member of the pair should be able to initiate successful copulation with the other.</td>
</tr>
<tr>
<td>To allow gibbons to survive once reintroduced their behavior should mimic that of wild gibbons.</td>
<td>Activity budgets should approximate those of wild conspecifics in all major categories i.e., feeding, resting and travelling.</td>
</tr>
<tr>
<td>Stereotypic behaviors are a product of captivity.</td>
<td>No more than 3% of total activity time engaged in a severe stereotypic behavior e.g., rocking or self-harm.</td>
</tr>
</tbody>
</table>


The table highlights the important aspects of wild gibbon behavior that a rehabilitated pair *should* master before they are reintroduced. It is also crucial that the gibbons solicit little to no human interaction (i.e., soliciting grooming from keepers, begging, aggressive behavior) because once they are released this behavior could potentially be harmful to the gibbons or to humans, and hinder their chance for survival in the wild.

I calculated the average percent of observation records each of the pairs of gibbons spent in major activities (rest, feed/forage, social, locomotion, and vocalization) during the observation period. These data were then compared to the activity budgets from the gibbons in the rehabilitation program at Kalawiet gibbon center in Central Kalimantan, Indonesia (Cheyne et al., 2008). Cheyne (2004) conducted behavioral observations utilizing ten-minute scan sampling on each individual gibbon. In addition, in order to determine how the gibbons’ behavior at JGC compares to wild conspecifics, I compare my results to the activity budgets of wild Javan gibbons living in Cagar Alam Leuweung Sancang (CALS) West, Java.
obtained by Malone (2007). Malone (2007) utilized two-minute scan sampling in order to
determine the behavioral state for each individual gibbon in a focal group.

Based on the criteria established by Cheyne et al. (2008) (Table 3, p. 35),
rehabilitated gibbons should be spending at least seven percent of total activity time engaged
in social behavior, particularly positive association. Positive association behavior includes
any behavior where the two gibbons are interacting with one another in an affiliative manner,
such as grooming, copulating, and playing. Cheyne (2004) also suggests that the gibbons
should be spending at least three percent of total social time engaged in allo-grooming.
Therefore, I determined the percent of observation records each pair of gibbons spent
engaged in positive association. There was an observable change in Septa and Echi’s social
behavior once they were relocated to the acclimation enclosure at Patiwel. In order to test
this, I transformed the percentage of observation records for social behavior to obtain the
arcsine values. I then used a paired-sample t-test to determine whether there was a
significant difference in mean time spent in social behavior at JGC and Patiwel. Finally, I
report any instances of agonistic behavior as the number of occurrences out of total observed
behaviors.

Stereotypic behavior is considered to be abnormal behavior and is typically repetitive
and unchanging with no obvious goal or function. It has long been recognized that captivity
can result in behavioral and psychological problems in animals (Cheyne, 2004; Mason,
1991). Stereotypic behavior can arise from a failure to replicate essential environmental
requirements in the captive setting. There is much evidence of the detrimental effect of
removing young primates (and humans) from their mothers; the infants fail to develop social
skills and suffer psychologically from the separation (Harlow & Suomi, 1971; Mootnick &
Nadler, 1997). This abnormal behavior often arises because animals in captivity are not
given the opportunity to engage in natural behaviors and it can manifest itself in several
ways. According to Cheyne (2004), stereotypic behavior in gibbons is most commonly
expressed in one (or all) of the following forms: rocking (this may be in a loose body posture
or where the body is locked into a rigid position, often where the gibbon wraps its arms
around its upper torso); twitching (the gibbon does not perform smooth body movements,
instead it jerks its limbs and head when it wishes to move them); repetitive swinging on a
fixed substrate (the gibbon was not traveling around the cage); repetitive brachiation along
the same route (the gibbon was traveling and not making play-face); self harm (biting the skin, hitting limbs against the enclosure); and teeth scraping (scraping of canines along a substrate). According to Cheyne et al. (2008) rehabilitated gibbons should not exceed three percent of their total activity time engaged in severe stereotypic behavior (i.e., rocking or self harm). If the gibbon was engaged in a form of stereotypic behavior that occurred for a duration of longer than one-minute (i.e., individual is repetively brachiating along the same route or repetitively swinging on a substrate), it was recorded and included in the activity budget. However, if the behavior occurred instantaneously (i.e., teeth scraping), I report it as an event.

In addition to stereotypic behavior, I included another category: human-directed behavior. This category consists of behavior that is directed at humans and/or a result of human (keeper/observer) presence. Gibbons which were separated from their mothers at a very young age and who have lived a significant portion of their lives with humans may potentially develop an abnormal behavioral repertoire (Mootnick & Nadler, 1997). When the gibbons are then placed into a more appropriate social environment (i.e., with conspecifics) in a rescue/rehabilitation center, the abnormal behavior may persist causing the gibbon to act aggressively towards humans or their mate, or conversely, remain tame and seek affection from human caretakers (personal observation). Former pet gibbons will most likely never have had the opportunity to interact with other gibbons once they were removed from the wild (Cheyne, 2004). Upon reaching sexual maturity, former pet gibbons may exhibit aggressive behavior or engage in other forms of abnormal behavior directed at humans (Cheyne, 2004; Mootnick & Nadler, 1997). The most commonly observed behavior is “posterior display” (Cheyne, 2004) or referred to as “hostile presenting” (Mootnick et al., 2006). This behavior resembles a sexual presentation by the female when she presents her rump to a male, but is also observed in male gibbons (Cheyne, 2004; Mootnick, Baker, Nadler, & Merker, 2006). This behavior has been observed in captive gibbons at the Javan Gibbon Center, Kalaweit gibbon center, and the Gibbon Conservation Center in Santa Clarita, California (Cheyne, 2004; Mootnick et al., 2006). Other human directed behavior includes solicitation for attention or grooming from humans, begging for food, or other unusual behavior that does not fit into the category of stereotypy. For example, one of the female gibbons included in this study, Echi, would often lock herself in the shift cage while I
was observing the pair. This behavior would consist of her sitting in the shift cage, attempting to unattatch the rope that held up the shift gate, and if she was successful, the gate would slam closed separating her from Septa (the male) and the larger part of the enclosure. I would then have to stop conducting observations and go open the shift gate. I would typically have to use a long stick to retrieve the rope and grab the string so I could attach it back to the nail holding it in place. Echi would then take that opportunity to aggressively grab at me and the substrate I was using to assist me. None of the keepers at JGC had ever observed her do this before. Sometimes this behavior would go on for longer than a few minutes, therefore, I included it in my time-interval sampling of behavioral states. All other forms of human-directed behavior typically occurred instantaneously and I report them as events.

The enclosures at JGC are all built into the surrounding forest with trees as the primary support. As a result, they vary in their overall shape and size, averaging eight to ten meters in width. They also range between six to eight meters high. It was not entirely possible for the gibbons to be too far from one another within the enclosure. However, it was still necessary to record the estimated distance between the two gibbons. Close-proximity (within one meter), or “sitting together”, without allogrooming or copulating, is considered to be one of the primary social interactions of adult gibbons (Palombit, 1994). This information can potentially be used as a good indicator to the cohesiveness of the pair bond and possibly provide insight as to whether the pair will survive the transition from captivity to living in the wild (Cheyne et al., 2008). For purposes of recording the maintenance of proximity between the pair of gibbons, I developed codes representing the estimated distance in meters and recorded the distance at the one-minute interval. The codes are as follows: contact (0); within one meter (1); one to three meters (2); three to five meters (3); and greater than five meters (which would indicate the gibbons were on complete opposite sides of their enclosure) (4). I report the percent of observation records the gibbons spent at different measures of proximity.

Gibbons that have spent the majority of their life in captivity as pets may have had very little opportunity to climb or spend time high off the ground (some owners may tie their pet gibbon to a tree). Wild gibbons will rarely come down to the forest floor due to higher risk of predation from leopards, pythons, and humans. Instead they typically spend the
majority of their time at 25 meters or higher in the forest canopy (Bartlett, 2007; Cheyne, 2004). Former pet gibbons are very comfortable spending time at the ground level of their enclosures due to the fact they most likely lived in a small cage on the ground and did not have the opportunity to climb or establish the coordination necessary for a life in the canopy (Cheyne, 2004). In addition, captive gibbons will often come to the ground level of their enclosure to retrieve fallen food or to forage, tending not to spend more than a few minutes there. If the gibbons are to survive successfully in the wild, it is crucial that they remain at the upper level of the canopy. This criterion can be used as another measure of the gibbons’ suitability for release into the wild (Cheyne, 2004). The canopy level measurements were used to determine at what level within the enclosure the gibbons are spending most of their time. The canopy level measurements were estimated and recorded using the following codes: ground (0); one to three meters (1); three to five meters (2); and upper level of enclosure (3). Cheyne (2004) recommends that rehabilitated gibbons should not be spending more than five percent of their time on the ground and should remain in the upper level of the enclosure at least 40 percent of the time. I report the percent of observation records that each gibbon spent in the location of their enclosure.

Gibbons that have been kept as pets most likely never learned how to locomote appropriately, such as brachiate, leap or climb, because they probably were kept in cages that did not allow them to practice and develop proper forms of locomotion. In addition, they may also have poorly-developed muscles and will lack the coordination necessary for a life in the forest canopy (Cheyne, 2004). According to Cheyne (2004), rehabilitated gibbons should be able to traverse around their enclosure efficiently and should utilize brachiation as the primary mode of travel. The gibbons at JGC are able to brachiate efficiently around their enclosures by either holding onto the bamboo supports at the top of the enclosure, the chainlength fence, or there are several substrates placed throughout the upper level which they can also hold onto. In order to determine which form of locomotion the gibbons prefer to use for traveling around their enclosure, I calculated the percent of total observation records that the gibbons spent engaged in each form of locomotion (i.e., climbing, brachiating, walking bipedally).
CHAPTER 4

RESULTS

This section details the results including a between-site comparison, within-site comparisons, a comparison of Cheyne et al.’s (2008) criteria, and the post-release behavioral results.

BETWEEN-SITE COMPARISON

The comparison between-sites include activity budget data from: Javan Gibbon Center, Kalaweit, and Cagar Alam Leuweung Sancang. The results from the three different sites may represent a crude comparison due to slightly different sampling methods utilized in each study (i.e., duration of time-interval sampling). However, considering the difference is minimal, I am fairly confident the results can still be meaningfully compared. When the results of the levels of activity are compared across the three groups of gibbons at different sites, the gibbons at JGC spent more time resting than either of the two other groups at CALS and Kalaweit gibbon center (KP) (71% vs. 15.2% & 50% respectively) (Figure 7). The wild Javan gibbons in CALS spent the majority of their time feeding (foraging is included in the feed category for all three groups) at 50.6 percent compared to the 18 percent of time the gibbons at KP spent feeding, and the gibbons at JGC spent the least amount of time feeding and foraging at 15.8 percent. The gibbons at KP had the highest percentage of vocalizing, followed by the gibbons at CALS, with the gibbons at JGC spending the least amount of time vocalizing. The three groups of gibbons followed a similar pattern with regards to social behavior and locomotion, with the KP gibbons having the highest percentages (8% and 19% respectively), followed by CALS(6.7% and 13.3% ) and JGC (2.2% and 6.7%). However, the percent of observation records that all three pairs spent in social behavior is relatively low when compared with the other two groups of gibbons at KP and CALS.
Figure 7. Average percent of observation records gibbons spent in activity at JGC, KP, and CALS. Data represent combined percentage of male and female gibbons in each activity. JGC-6 individuals (3 adult males; 3 adult females); CALS-5 individuals (3 adult males; 2 adult females); and KP-41 individuals (number of each sex is unknown).

**WITHIN-SITE COMPARISONS**

The within-site comparisons involve all analyses from the Javan gibbons included in this study and an evaluation of how their behavior compares to the guidelines established by Cheyne et al. (2008).

**Activity Budget**

Figure 8 illustrates the average percent of observation records that each pair of gibbons from JGC spent engaged in particular activities. When the results are compared across the three pairs of gibbons included in this study, the results show similar activity patterns. Septa and Echi had the highest percentage of resting at 74.5 percent, whereas Jeffry and Nancy had the lowest (66.3 %). Jeffry and Nancy had the highest percent of feeding/foraging at 21.1 percent and Sadewa and Kiki and Septa and Echi spent less time feeding and foraging (12.5 % and 13.7% respectively). Sadewa and Kiki engaged in the most social behavior at 2.85 percent and the other two pairs, Septa and Echi and Jeffry and Nancy spent roughly the same percent of observation records as each other engaged in social behavior (1.89% and 1.85%). For activity budget purposes, any *stereotypic* and *human-
directed behavior that occurred for duration of longer than one-minute was included in the other category; therefore, Sadewa and Kiki had the highest percentage at 7.1 percent because they often displayed stereotypic behavior (repetitive brachiation and swinging on substrates), followed by Jeffry and Nancy (5.06%), and Septa and Echi (2.6%).

Social Behavior

Jeffry and Nancy spent 1.36 percent of their total percent of observation records engaged in grooming and 0.46 percent of total percent of observation records playing. There were no observed instances of copulation during the sample period (94 hrs). There were only four instances of agnostic behavior observed out of a total of 5,652 observed behaviors. The agonistic behavior typically involved a “swat” or quick grab.
Sadewa and Kiki spent a very small percent of observation records engaged in positive pair association (2.85%). The pair only spent 0.35 percent of total observation records engaged in allo-grooming. However, they engaged in play behavior for 2.5 percent of the time. Although Kiki has been pregnant in the past (JGC staff, personal communication, June 2008) indicating the pair are sexually active, I did not observe any instances of copulation during the entire observation period (93 hrs). There were no observed instances of agonistic behavior between Sadewa and Kiki.

Septa and Echi spent a total of 1.9 percent, also very small, of observation records engaged in positive pair association behavior. They were observed grooming 1.24 percent of total time. Echi has also been pregnant in the past (JGC staff, personal communication, June 2008) and they were observed copulating four times during the observation period (100 hrs). There was a significant increase in the pair’s social behavior once they were moved over to the acclimation enclosure at Patiwel (paired samples t-test; t= 2.185 df=16, p= 0.012). All of the play behavior observed and all four instances of copulation occurred at Patiwel. There was one instance of agonistic behavior observed out of 5,982 total observed behaviors (at JGC). The incident occurred after the keepers let Echi out of the shift cage (after she had locked herself in) and as soon as she made her way to the top of the enclosure, Septa physically attacked her causing her to fall to the bottom of the enclosure.

**Stereotypic Behavior**

Jeffry and Nancy spent a total of 4.8 percent of observation records engaged in stereotypic behavior. The nature of their stereotypic behavior consisted of repetitive swinging on a substrate followed by bouncing up and down on top of the substrate (Jeffry, 3.5%), and repetitive brachiation around the enclosure (Nancy, 1.3%). Nancy would also occasionally bounce up and down on top of a substrate, albeit far less than Jeffry. The onset of behavior typically occurred before feeding times. However, Jeffry would regularly swing repetitively on one particular substrate at times other than before feeding.

Sadewa and Kiki spent a considerable amount of total observation records engaged in stereotypic behavior at 7.1 percent. Both gibbons would repetitively brachiate around the enclosure and swing repetitively on substrates. This behavior was observed most frequently before feeding, but would also occur before play bouts. If the gibbons were engaged in play
behavior and noticeably chasing one another while brachiating around their enclosure, this was not considered stereotypic behavior.

Septa and Echi had the lowest percentage of stereotypic behavior of all three of the pairs at 0.71 percent. The most observed stereotypic behavior exhibited by Septa was teeth scraping (two occurrences out of 5,962 total observation records). He would typically display this behavior upon my arrival at the enclosure for observation and would usually only do it one time. Both gibbons would occasionally brachiate around the enclosure before feeding time.

**Human-Directed Behavior**

Jeffry, who is considered a relatively tame gibbon by JGC staff, did not exhibit any human-directed behavior, affiliative or aggressive. Nancy had one instance of human-directed behavior out of a total of 5,652 total observed behaviors and it was an open-mouth threat directed at me.

Sadewa and Kiki only had three instances (one and two respectively) out of a total of 5,576 total observation records. Sadewa attempted to grab a keeper while he was placing food in the feed basket and Kiki would present her backside to the keepers (or me if I approached the enclosure).

Septa and Echi were quite aggressive and would regularly attempt to grab the keepers while they were feeding them. There were only 12 observed instances of human-directed behavior out of a total of 5,962 total observation records for Septa. In addition to the unusual behavior of Echi locking herself in the shift cage while I was observing them, she would also present her backside to both the keepers and myself, if we got too close to the enclosure. Out of a total of 5,962 observation records for Echi, 58 were directed at humans. Compared to the other five gibbons Echi displayed the most human-directed behavior.

**Maintenance of Proximity**

Figure 9 illustrates the percent observation records that each of the pairs of gibbons spent at different estimated measures of proximity. Jeffry and Nancy spent the majority of the observation records (82.2%) at a distance of at least one meter apart, but rarely spent time more than five meters away from one another. However, the percent of observation records they spent in actual contact was relatively low (6.1%).
Sadewa and Kiki spent the majority of the observation records (86.9%) at a distance of at least one meter apart. They also rarely were more than five meters away from one another. The amount of observation records they spent in actual contact was low at 3.5 percent.

Septa and Echi spent the majority of the observation records (76.7%) within relatively close proximity, usually maintaining a distance of within three meters of one another. Unlike the other two pairs, Septa and Echi spent a considerable amount of observation records (15.7%) in direct contact with each other; they would often sit right next to one another on top of their sleeping box.

**Location in Enclosure**

Figure 10 illustrates the percent of observation records that each of the pairs of gibbons spent in different levels of their enclosures.

Jeffry and Nancy would occasionally forage for food at the lower level (1-3 m) of the enclosure (27.1% and 22.7% respectively), as well as coming down to the floor of the
Figure 10. Percent of observation records spent in location of enclosure.

Sadewa would often come down to the lower level of the enclosure (12.2%), not only to forage, but also just to sit on the floor of the enclosure. He still remained in the mid to upper level (> 3 m) of the enclosure for the majority of the observation records (87.9%). In comparison, Kiki rarely ever came down to the lower levels of the enclosure and spent 91 percent of her time in the upper level. The only instances where she came down to the ground (.07%) were to play with Sadewa while he was sitting on the floor of the enclosure.

Septa and Echi spent most of their time at the upper level of their enclosure at 67.9 percent and 68.5 percent respectively. Both gibbons spent a minimal amount of time at the lower level of the enclosure (Septa 11.03% and Echi 12.1%). Echi was never observed to come down to the floor of the enclosure, and Septa would only come down to retrieve fallen food or occasionally to forage.
**Locomotion**

Figure 11 illustrates the percent of observation records that Jeffry and Nancy spent in different modes of locomotion. Jeffry preferred to climb around the enclosure more than brachiate (67% vs. 25%). Nancy utilized brachiation as her main form of travel around the enclosure (63%). She also had a very peculiar way of walking bipedally; she would bop up and down as she walked across a substrate. However, this did not impede upon her ability to walk bipedally.

![Figure 11. Percent of observation records gibbons spent in different modes of locomotion.](image)

Figure 12 illustrates the percent of observation records that Sadewa and Kiki spent in different modes of locomotion. Both gibbons utilized brachiation as their primary mode of travel around the enclosure (Sadewa, 94% and Kiki, 87%). Kiki had a slightly higher percentage of climbing than Sadewa (13% vs. 5%).

Figure 13 illustrates the percent of observation records that Septa and Echi spent in different modes of locomotion. Septa and Echi both utilized brachiation as their primary mode of travel around the enclosure (93% and 80% respectively). Echi also had a higher
Figure 12. Percent of observation records gibbons spent in different modes of locomotion.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Sadewa</th>
<th>Kiki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brachiate</td>
<td>94</td>
<td>87</td>
</tr>
<tr>
<td>Climb</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Bipedal</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 13. Percent of observation records gibbons spent in different modes of locomotion.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Septa</th>
<th>Echi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brachiate</td>
<td>93</td>
<td>80</td>
</tr>
<tr>
<td>Climb</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Bipedal</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>
percentage of climb than Septa (15% vs. 6%). Out of all six gibbons, Echi had the highest percentage of walking bipedally at five percent.

**Evaluation of Recommended Behavioral Criteria**

Table 4 presents a summary of all the necessary behavioral criteria established by Cheyne et al. (2008), in which rehabilitated gibbons should meet prior to their release, and whether the Javan gibbons included in this study satisfied the criteria or not.

**Table 4. Summary of Behavioral Criteria for Pre-Release Observations**

<table>
<thead>
<tr>
<th>Proposed criteria for assessing suitability of gibbons for release*</th>
<th>Jeffry/Nancy</th>
<th>Sadewa/Kiki</th>
<th>Septa/Echi</th>
</tr>
</thead>
<tbody>
<tr>
<td>The gibbon should be able to move around the enclosure well, and most of this movement should be by brachiation.</td>
<td>Jeffry ✗</td>
<td>Sadewa ✓</td>
<td>Septa ✓</td>
</tr>
<tr>
<td></td>
<td>Nancy ✓</td>
<td>Kiki ✓</td>
<td>Echi ✓</td>
</tr>
<tr>
<td>No more than 5% of time to be spent on the ground for any purpose. Gibbons should be at the top of the cage for at least 40% of the time and should not be sleeping on the ground at all.</td>
<td>Jeffry ✓</td>
<td>Sadewa ✓</td>
<td>Septa ✓</td>
</tr>
<tr>
<td></td>
<td>Nancy ✓</td>
<td>Kiki ✓</td>
<td>Echi ✓</td>
</tr>
<tr>
<td>The pair should be spending at least 7% of total activity time in positive pair association. At least 3% of total activity time should be spent allogrooming.</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>They should be copulating successfully and each member of the pair should be able to initiate successful copulation with the other.</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Activity budgets should approximate those of wild conspecifics in all major categories i.e., feeding, resting and travelling.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No more than 3% of total activity time engaged in a severe stereotypic behavior e.g., rocking or self-harm.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

✗ = did not satisfy criteria ✓ = satisfied criteria


**RELEASE OF JAVAN GIBBON PAIR**

Septa and Echi (Figure 14) demonstrated a high level of territoriality directed both at us and the monkeys who also inhabit Patiwel. There are approximately seven ebony langurs
Figure 14. Septa and Echi post-release (Photo by Anton Ario/CI-Indonesia).
that have been observed living in the small forest, and groups of long-tailed macaques frequently come into Patiwel from the larger area of the park to forage and feed. When the gibbons encountered either one of the groups of monkeys, they would engage in territorial behavior that is typical of wild Javan gibbons. In the wild, both male and female gibbons will actively defend their territory by approaching the intruder (usually the male initiates the approach), performing visual displays (branch shaking, brachiating) (Malone, 2007), and males may produce solo calls while the female sings. Territorial disputes rarely involve physical aggression in the wild. Wild gibbons regularly tolerate food competitors, such as macaques and other primates (MacKinnon, 1977), but unlike captive gibbons, wild gibbons have been exposed to the various other species in the forest from a very young age and know which species are potential threats and which are not (Cheyne, 2004). There were only two observed interactions between the gibbons and the monkeys and consisted of the gibbons displaying, chasing the monkeys, and vocalizing. On one occasion the gibbons were displaced by the long-tailed macaques and moved further west into the forest, and the other encounter resulted in the long-tailed macaques being displaced and moving to the west side of Patiwel.

Both Septa and Echi exhibited a very high level of aggression towards myself and observers from JGC as we attempted to monitor them in the forest. They directed their territorial/aggressive behavior towards us, similarly to how they responded to the monkeys in Patiwel. A typical observational occurrence consisted of us attempting to locate them in the forest and once they became aware of us, they approached us, coming very low (< 5 m) in the canopy to threaten us. One incident resulted in one of the observers being physically attacked and bitten by the pair of gibbons. On our first day of observations when we located the gibbons in Patiwel, they were feeding on the fruit of a fallen tree just off the trail. After approximately 2 hours and 20 minutes into our observation, Septa moved into a tree that branched out above the trail about 25 meters up from where myself and the other observer were standing. After a few minutes, Septa dropped down onto the trail and began to approach us, walking bipedally down the trail. Igud and I quickly retreated out of the forest and returned to our post located just outside of Patiwel. We decided to continue our observations of the pair at 13:00 and returned to the forest. When we located the gibbons we found them in the same general area as earlier that morning. Once again, Septa dropped
down onto the forest trail and began to approach me (I was standing directly on the trail and Igud was standing to the far right of the trail in the forest). This time I moved toward Septa in an attempt to frighten him away and he turned and went the other direction, again walking bipedally up the forest trail. I was not aware of Echi’s location at the time. After a few minutes, Igud and I continued up the forest trail. When we reached the top of the trail where the gibbons’ old enclosure is located, we found both Septa and Echi foraging around the vicinity. Once they became aware of us, Septa moved down onto the ground at the top of the trail and Echi began moving towards us through the trees. Igud and I were approximately 25-30 meters down the forest trail from the enclosure. Echi began to move closer to us, brachiating through the lower level of the canopy, while Septa ran bipedally down the forest trail and they proceeded to chase us. Unfortunately, both Igud and I tripped and fell down the trail. Igud fell first and then I, so at that moment both of the gibbons came upon Igud first and physically attacked and bit him. We were able to get up and continue running out of the forest. Septa and Echi followed us all of the way out and moved into the upper level of the canopy. Echi then began to vocalize and display at the forest edge. Fortunately, there were no other incidents resulting in aggressive physical contact, but Septa and Echi continued to chase us out of the forest each and every time we attempted to observe them. They displayed similar behavior to the first incident. Once they became aware of us, they approached us coming very low into the canopy, sometimes within five meters of the ground, and threatened us. We would use small (~3 meters) bamboo sticks to bang against the trees in an attempt to frighten the gibbons back up into the canopy of the forest. This was always unsuccessful. The guys would also use a sling-shot and fire small pieces of fruit in the gibbons’ direction (never actually hitting Septa or Echi), also attempting to frighten them away from us. This was also unsuccessful. Septa and Echi were completely fearless of human observers. Fortunately, we were able to observe the pair from the outer edge of the forest, the surrounding fields, and the research station located just outside of the forests’ edge.

Aside from their aggressive behavior towards humans, they responded well to their new forest environment from an ecological perspective. In addition to jointly defending their territory, Septa and Echi often maintained a close proximity (typically within 5 meters) to one another while foraging and feeding and were observed grooming each other as well as
copulating (by staff of JGC). We did not provide food supplementation for the gibbons. Only on one occasion did we observe Septa and Echi foraging around their old enclosure (the day of the attack) and not once did they seek us out for food or appear to be waiting around their enclosure for food. While in captivity both gibbons showed a preference for wild fruit/foliage that the keepers incorporated into their diet. From the first day they were released, Septa and Echi were successful at locating the appropriate food sources (fruit, leaves, flowers, and insects) in Patiwel and were observed drinking water from a hollow in a tree.

Unfortunately, we were never able to locate them in the later part of the afternoon when they would normally move into their sleeping tree, thus it is uncertain if they were sleeping in the same tree. However, when we were able to locate them during Echi’s morning call, both gibbons would be in the same tree, typically a Rasamala tree (*Altingia excelsa*). Rasamala trees typically reach heights of 40-60 meters and with their crown extending above the canopy, this provided Echi with the ideal setting for producing her morning call. Both Septa and Echi utilized brachiation as their primary mode of locomotion in Patiwel, in addition to leaping through the canopy. I would regularly observe them leaping distances of greater than ten meters, which was spectacular. They would also climb up vines or the bough of a tree to gain access to fruit patches within a tree and were also observed foraging and feeding on smaller branches.

During the month of June 2010, I returned to Patiwel to assess the behavior of Septa and Echi eight months post-release. Due to time constraints, I was only able to visit the release site for one afternoon. Considering my experience with Septa and Echi while attempting to conduct behavioral observations on them in the past, I did not enter the forest. Instead, I walked around the edge of Patiwel until I could locate and see the gibbons from the surrounding cropland. They were observed foraging and feeding in the trees at the edge of the forest, and I was able to observe the pair grooming one another. Interestingly, once they became aware of my presence, they exhibited the same aggressive behavior as before. Both gibbons came to the edge of the forest and Echi began to vocalize and display in the upper canopy. The staff of JGC, who continues to monitor Septa and Echi at Patiwel, have also reported the gibbons are still acting territorial and aggressive towards them.
CHAPTER 5

DISCUSSION

In this study, I examined whether select pairs of Javan gibbons housed at the Javan Gibbon Rescue and Rehabilitation Center have developed the appropriate behavioral repertoire necessary to be reintroduced and survive in the wild. I interpret my results based on other comparative studies of behavioral and ecological characteristics of the Hylobatidae. I first discuss the general behavioral patterns observed for the Javan gibbons at JGC, as well as comparing and contrasting the results to the activity budgets of white-bearded gibbons and Mueller’s gibbons at Kalaweit gibbon center in Central Kalimantan, and wild Javan gibbons at CALS in West Java. In addition, I further discuss and interpret my observations with particular regards to social behavior, stereotypic and human-directed behavior, maintenance of proximity, location in enclosure, and locomotion in more detail. I then provide a discussion as to how the gibbons’ behavior at JGC compare to the criteria recommended by Cheyne et al. (2008) and lastly, I discuss the conservation implications that are relevant to this study.

BEHAVIORAL PATTERNS

All three pairs of gibbons included in this study at JGC spent the majority of the observation records resting (average 71.1%). A relatively high percentage of time spent resting is likely unavoidable considering the gibbons are confined to their enclosures and have food provided for them. The gibbons at Kalaweit gibbon center spent approximately 50 percent of their observed time resting (Cheyne, 2004) and wild Javan gibbons at CALS spent only an average of 15.2 percent observed time resting, both of which are considerably lower than the Javan gibbons at JGC. I cannot account for the difference in time resting for the two groups of gibbons in rehabilitation programs (JGC and Kalaweit), but the low percentage of time resting for wild Javan gibbons seems more appropriate considering they spend more time foraging and feeding. In fact, the majority of time observed for the wild Javan gibbons at CALS was foraging and feeding at 50.6 percent. When gibbons are not traveling through
the forest, they tend to spend the majority of their time resting and feeding (Bartlett, 2003; Srikosamatara & Brockelman, 1987). Similar to the Kalaweit gibbon center, the enclosures at JGC are built into the surrounding forest. This environment allows the gibbons the opportunity to engage in forms of enrichment and stimulation from the natural environment by foraging for leaves and insects (Cheyne, 2004). The gibbons at Kalaweit spent 18 percent of the time feeding and foraging and the gibbons at JGC spent only 15.8 percent of their observed time feeding and foraging. Again, this is most likely due to the fact that their food is provisioned for them and they do not have to search for it. However, it should be noted that the gibbons at Kalaweit spent 19 percent of their observed time traveling, or engaged in particular modes of locomotion. This is higher than both of the groups of Javan gibbons at JGC and CALS (6.7% and 13.3% respectively). The issue of being confined to an enclosure would not explain the difference in percentages for the two groups of gibbons at JGC and Kalaweit.

Javan gibbons are one of only two species of gibbons that do not produce duet vocalizations (Kloss’s gibbon being the other). While female Javan gibbons are considered the vocal representative of the family, however, males will sometimes contribute to the female’s great call and vocalize during territorial disputes (Geissmann, 2002). The average percent of observation records that the Javan gibbons spent vocalizing was only .71 percent. This is considerably lower than both of the other gibbon pairs at CALS and Kalaweit. The wild Javan gibbons spent approximately 3.3 percent of the observed time vocalizing, whereas the gibbons at Kalaweit spent an average of 6 percent observed time vocalizing. Both of the species at Kalaweit, white-bearded gibbons and Mueller’s gibbons, do engage in duet vocalizations, so this could explain why the gibbons at Kalaweit have a higher rate of vocalizing than either of the groups of Javan gibbons. The wild Javan gibbons at CALS consist of two neighboring groups and both male and female gibbons will attempt to defend their territories by engaging in physical displays and vocalizing (Nijman, 2004, 2006; Supriatna, 2006). Therefore, the wild Javan gibbons’ higher rate of vocalizing could be due to the gibbons’ engaging in vocal territorial disputes on a regular basis. While the gibbons at JGC are in enclosures that are hidden amongst trees and not entirely visible to one another, they are still relatively close to each other. It is possible that not all of the gibbons at JGC are vocalizing in the same social context as wild gibbons (i.e., not needing to physically defend
their territories from each other). The gibbons at JGC would often begin vocalizing upon hearing wild Javan gibbons in the park vocalizing. Also, the gibbons at JGC typically vocalize in the early morning hours (~0700-0900), so not all vocalizations were included in my observation sample times. This issue could also potentially explain why the wild Javan gibbons have a higher percentage of vocalizing than the Javan gibbons at JGC.

**SOCIAL BEHAVIOR**

Not one of the pairs of Javan gibbons at JGC satisfied the recommendation of at least 7 percent of total activity time in positive pair association. Gibbons have traditionally been believed to engage in very little affiliative social behavior in comparison to other primates (Bartlett, 2003; Leighton, 1987). After an extensive review of field studies on gibbon behavior and ecology, Leighton (1987) concluded that: “gibbons spend surprisingly little time socializing with one another. Singing takes up about 4 percent of the activity period, grooming and social play usually less. The lack of social partners may contribute to such low levels of interaction” (p. 137). The rates of social behavior observed in gibbons are dependent on the number of available social partners, and since gibbons live in smaller family units, this could explain why there are lower rates of social behavior observed in the wild (Bartlett, 2003). It should be noted that Cheyne (2004) included juveniles and subadults in her study, which is potentially the reason why the gibbons at Kalaweit had a relatively higher average of time spent in social behavior (8%). Juvenile and subadult gibbons are primarily responsible for the majority of social behavior observed in wild gibbons, and for initiating social behavior with the adult gibbons (Bartlett, 2003). The wild Javan gibbons at CALS had an average of 6.7 percent observed time spent in social behavior. This is relatively higher than the Javan gibbon groups at JGC and could also be due to the younger gibbons in the groups at CALS. There was a subadult female in one of the groups of wild Javan gibbons at CALS, and both adult females in the groups had infants.

Studies of three species of gibbons; agile gibbons (*Hylobates agilis*) (Gittins & Raemaekers, 1980), Kloss’s gibbons (Whitten, 1984), and Mueller’s gibbons (Leighton, 1987) determined that social activity was virtually absent all together (Bartlett, 2003). Whereas other field studies with lar gibbons have yielded different results. One study at Tanjong Triang in Malaysia (Ellefson, 1974), lar gibbons spent ~2-3 percent of the time
engaged in social activity and Gittins and Raemaekers (1980) reported that lar gibbons at Kuala Lompat spent an average of 3 percent of their time engaged in social activity. Javan gibbons at JGC show similar results, yielding an average of 2.2 percent of total time observed in social behavior. Regardless, the display of grooming, playing, and copulation suggest a well bonded pair (Brockelman, 1984; Cheyne, 2004). Playing and grooming were the two most commonly observed behaviors. Septa and Echi was the only pair I observed copulating during my study. This has significance considering the breeding pair of Javan gibbons at the Perth Zoo in Australia has only been observed copulating two times (H. Thompson, personal communication, October 7, 2009). It was interesting to observe how Septa and Echi engaged in more social behavior (play, grooming, and copulation) once they were moved over to Patiwel. I had never observed them play while they were living at JGC. They also spent more time in close proximity and all four instances of copulation were observed at Patiwel. Close-proximity (within one meter), or “sitting together”, without allogrooming or copulating, is considered to be one of the primary social interactions of adult gibbons (Palombit, 1994). The increase in social behavior may have been due to the fact that there were not any other gibbons in the area and there was far less of a human presence at Patiwel. Their overall behavioral profile would seem to indicate a cohesive pair-bond, which will be beneficial for their survival in the wild. Wild gibbons will not necessarily feed, forage, or even sleep in the same tree, but for this study measuring how much time the gibbons spend in close proximity was useful for learning more about the nature of the pair-bond in captivity (Nijman, 2004). For example, there was one pair of Javan gibbons at JGC (not included in this study) that would not even sit on the same side of the enclosure as one another. The male would sit inside their sleeping box or swing underneath it. The female would move around the enclosure more, but anytime she came within close proximity to the male, he would move. Both of the gibbons would then engage in a physical display, consisting of vigorously brachiating around the enclosure and shaking substrates or the fence. The nature of this behavior is not indicative of a cohesive pair-bond.

Considering the gibbons at JGC did not meet the recommended 7 percent of total activity time engaged in social behavior, but do show slightly similar results to other wild gibbons (~2-3%) in terms of social behavior (Bartlett, 2003; Ellefson, 1974), I do not think
the recommended criteria of positive pair association as proposed necessarily corresponds to pair-bond cohesiveness for the gibbons at JGC.

**Stereotypic Behavior**

The observed pairs of gibbons at JGC did exhibit *mild* forms of stereotypic behavior. Most commonly observed was repetitive swinging on a fixed substrate, repetitive brachiation, and less frequently, teeth scraping. The gibbons would most often engage in repetitive swinging or brachiation around feeding times and only one of the male gibbons (Septa) exhibited a mild form of teeth scraping, usually upon my arrival for observations. Cheyne (2004) observed gibbons at Kalaweit gibbon center actually scraping their canine teeth against a substrate. This was never observed at JGC. Septa would bite at the fence and it was typically one or two quick bites. The stereotypic behaviors displayed by the Javan gibbons at JGC (as well as gibbons at Kalaweit) have never been reported in the wild. This would seem to suggest that stereotypic behavior could be caused by captivity, or at least exacerbated by captivity (Cheyne, 2004). Some researchers believe that stereotypic behavior is a means of coping with a present or past aversive situation (Mason, 1991; Mason & Berkson, 1975). Stereotypic behaviors become ingrained in the behavioral repertoire of the animal and are probably the result of poor rearing conditions from when they were kept as pets, or can develop in any captive animal as the result of a stressful environment (Mason, 1991). Considering each gibbon included in this study exhibited a relatively low level of harmless stereotypic behavior, it is unlikely these behaviors would persist once they are released or hinder their survival in any way and should not prevent a pair of gibbons from being reintroduced.

**Human-Directed Behavior**

Human-directed behavior was relatively uncommon in the adult gibbons included in my study. It was more common for the female gibbons in my study to exhibit human-directed behavior than the male gibbons. Jeffry had no instances of human-directed behavior and Sadewa had only one. Both Nancy and Kiki rarely exhibited any human-directed behavior as well. As part of the criteria for deeming a pair suitable for release, I expected to observe very little human-directed behavior from the gibbons. It could prove detrimental to the survivability of the gibbon if it was still tame and sought human attention once released.
into the forest. None of the gibbons in my study exhibited affiliative behavior towards humans. Some of the gibbons were less aggressive than others (i.e., not attempting to grab the keeper), but they did not solicit grooming or petting. Septa and Echi, on the other hand, had a comparatively high rate of human-directed behavior (Septa: 12 instances/5,962 behavioral records; Echi: 58 instances/5,962 behavioral records). Both gibbons were extremely aggressive towards the keepers and would attempt to grab them at almost every feed. In addition, if someone approached their enclosure Echi would typically present a posterior display or behave in a display like manner by brachiating around the top of the enclosure and shaking the fence or substrates.

Gibbons that were former pets (i.e., human-raised) can sometimes be aggressive towards humans upon reaching sexual maturity and tend to direct this aggression at the same sex individual (Mootnick et al., 2006; Mootnick & Nadler, 1997). The posterior displays were most commonly displayed by the females in my study, although Septa was observed displaying this behavior as well. This behavior in gibbons has not been extensively documented in the literature, except in the case of Mootnick and Nadler (1997). It is suggested that the posterior display is a signal to conspecifics and could be a result of misplaced sexual attention, submission followed by fear, or anger followed by aggression (Cheyne, 2004). The “anger followed by aggression” behavior was the most common observed response from Echi. If one of the keepers or myself approached her enclosure, she almost always displayed her posterior, but then would also engage in a physical display (i.e., brachiating around the enclosure, shaking substrates or fence). While it was clear that humans were the focus of this behavior, I never had the opportunity to observe if the gibbons would also display this behavior to conspecifics. Kiki would present her posterior if humans approached the enclosure, but she never displayed after presenting. I never observed Nancy displaying this behavior. One explanation for the aggressive behavior is that the gibbons are treating humans as potential threats, specifically when the behavior is directed at the same sex human. Mitani (1984) states that aggressive or territorial behavior in wild gibbons is almost always intrasexual; males displace males and females displace females. The posterior display, in addition to other forms of human-directed behavior, is most likely a construct of captive rearing and of being in continuous close proximity to humans. The levels at which gibbons in captivity, who are also candidates for release, engage in forms of aggressive
human-directed behavior should be monitored more closely and can potentially provide some insight into how the gibbons will respond to humans once they are released (see discussion on post-release behavioral observation with regards to human-directed behavior).

**LOCATION IN ENCLOSURE**

Gibbons are canopy dwellers and specialists at feeding from the terminal branches of the tallest trees (Cheyne, 2004). They make use of their home range three-dimensionally in space, as they exploit the canopy upwards and downwards to about ten meters above the ground (Cheyne, 2004; Kappeler, 1981). Wild gibbons rarely come to the ground due to higher risk of predation, though captive-raised gibbons are very comfortable spending time on the ground and will walk on the ground bipedally. Gibbons from the illegal pet trade were removed from the wild as infants and most likely never had the opportunity to learn valuable predator avoidance behaviors from their parents. Furthermore, they probably were kept in small cages relatively low to the ground, if not actually on the ground, hence never being able to spend time at a higher level (Cheyne, 2004).

The gibbons at JGC came down to the floor of their enclosures to retrieve fallen food or forage, but rarely will spend more than a few minutes there; typically grabbing the food and then quickly climbing back up to the higher level of the enclosure. This behavior would seem to indicate an innate desire for the gibbons to remain within a higher level of space. However, one of the male gibbons, Sadewa, would often sit on the floor of the enclosure while resting. Jeffry also appeared to be quite comfortable spending time in the lower levels of the enclosure. In some of the enclosures at JGC, including Jeffry and Nancy’s, there are climbing/swinging substrates placed at lower levels. Perhaps it would prove beneficial to remove all of the substrates from the lower levels of the enclosures in an attempt to discourage the gibbons from spending time there. The food and water baskets are also placed at the mid-level of the enclosures (~2-3 m above the ground), but this is primarily because the keepers need to be able to place food in the baskets and provide fresh water for the gibbons. If captive gibbons are to avoid predators and parasites once they are released, they must be encouraged to spend time at the higher levels of their enclosures and must demonstrate a preferred use of the top of the enclosure. All of the gibbons included in this study met the recommended 40 percent of time spent at the upper level of their enclosure.
LOCOMOTION

Fleagle (1976) reported that wild lar gibbons and siamangs cover approximately 60-75 percent of their territory by brachiation. Gittins (1983) calculated that ten percent of the total observed active time for agile gibbons was spent traveling and brachiation was used 75 percent of the time, therefore Cheyne et al. (2008) determined that gibbons in a rehabilitation program should be utilizing brachiation as their main mode of locomotion. Gibbons in captivity often do not have the space in their enclosures to brachiate for long distances, which may also explain why some individuals engage in stereotypic forms of repetitive brachiation. However, in order for rehabilitated gibbons to be suitable for release, they must demonstrate they are capable of effectively traveling around their enclosure while utilizing natural locomotive movements as are observed in wild gibbons.

The gibbons at JGC are slightly limited with the size constraints of their enclosures, but are still capable of acquiring the appropriate forms of locomotion and utilizing them within their enclosure. All three pairs of gibbons in this study demonstrated their ability to effectively locomote, and with the exception of Jeffry, utilized brachiation as their primary mode of locomotion. With regards to stereotypic brachiation, Sadewa and Kiki did utilize brachiation as their primary form of travel (94% and 87% respectively), though at times it was difficult to ascertain between simply traveling around the enclosure and when it became “stereotypic.” Therefore, there could be a discrepancy in the data between the levels of stereotypic behavior and brachiation displayed by Sadewa and Kiki. However, what is important is that they are capable of effectively brachiating and if they are going to be released into the wild, they would be able to successfully traverse through the canopy.

CONSERVATION IMPLICATIONS

The purpose of this thesis was to implement a more systematic and scientific approach to the reintroduction program at the Javan Gibbon Rescue and Rehabilitation Center. Cheyne (2004) states that, many reintroduction programs have released animals based on subjective impression rather than objective scientific data. Until this issue is addressed and the rehabilitation is carried out under scientifically proven guidelines, many reintroduced animals will continue to disappear, having contributed nothing to the overall survival potential of the species. It is my hope that the results from my research will help to
inform conservation policies aiming to preserve the Javan gibbon and determine if the reintroduction of former pet Javan gibbons will serve as a useful conservation tool for helping prevent their extinction in the wild.

Rehabilitation and reintroduction of endangered species has been heavily criticized because some argue there is little justification for the continuation of these projects because they are expensive, have limited success, and tend to focus too narrowly on one species (Kleiman, 1989). Much of the failure of rehabilitation and reintroduction stems from the lack of knowledge about the specific requirements of the focal species in terms of their social, behavioral, and nutritional needs (Cheyne et. al., 2008), which is precisely why having thorough knowledge of species’ behavior and ecology in the wild is crucial to the reintroduction process. The conservation value of rehabilitation has historically been questionable; therefore, it is the goal of this research to become the first step in developing a more systematic approach to the rehabilitation process at JGC, which will then hopefully ensure a more successful reintroduction program for Javan gibbons in West Java.

A major challenge for the reintroduction program is locating an appropriate release site for Javan gibbons on an island where deforestation is one of the primary causes of their decline. Habitat where gibbons have previously been known to exist, but that are currently not inhabited by the species, would be the ideal location to release a pair of gibbons. However, caution must be taken to ensure that the reasons for the local declines in that area have been addressed. If poaching and/or deforestation were the primary causes of the species becoming extinct in the area, then evidence must be presented to show that the problem has been eliminated or drastically reduced (Cheyne et al., 2008; Kleiman, 1989). Extensive habitat surveys should be conducted in order to determine if the release site will be able to sustain a pair of gibbons and any future offspring. There has been some criticism regarding the size of the release site (five hectares) in which Septa and Echi were released and that the small forest patch will not be able to sustain the pair of gibbons for the long-term. The release site was chosen specifically because it is small and isolated, and would be easier to monitor the gibbons post-release. The site is not intended to be the gibbons’ permanent home range within the national park. A forest corridor has been planted and the trees will eventually reach heights that the gibbons will then be able to traverse across the corridor and move out into the larger part of the park. Furthermore, Malone (2007) observed one group of
Javan gibbons (five individuals) that occupied a home range of approximately 6.25 hectares in CALS. The gibbons are essentially restricted to this home range because it is bordered by the coast to the south, a river to the west, a forest clearing to the east, and another group of gibbons to the north (Malone, 2007), yet the gibbons are able to sustain themselves in this smaller-than-average home range.

In regards to future release sites for Javan gibbons, the staff of JGC and CI-Indonesia have identified three potential sites in Gunung Gede-Pangrango National Park for the next reintroduction: Nagrak (Sukabumi), Cimande (Bogor), and Mandalawangi (Cianjur). The potential sites are not isolated like Patiwel and are all primary forest. Considering that the behavioral and ecological data on Javan gibbons are lacking, we must engage in long-term field studies on the local habitat requirements, dietary needs, and population dynamics of the species’ in order to best implement a conservation action plan for preserving the species in the wild. The knowledge obtained from such studies will help to inform conservation policies regarding demographic data, habitat carrying capacity of potential release sites, and both inter and intra-species relationships that will be necessary for a successful reintroduction program (Southwick & Blood, 1979).

**EVALUATION OF BEHAVIORAL CRITERIA**

Based on Cheyne’s (2004) research conducted at the Kalaweit gibbon center in Central Kalimantan, where she documented pre-and post-release behavior of rehabilitated gibbons, she developed a “Behavior Checklist” for gibbons in rehabilitation programs. The criteria (Cheyne et al., 2008) highlight important aspects of wild gibbon behavior that a rehabilitated pair of gibbons should master before they are released.

The first recommendation is that the gibbons should be able to move around their enclosure efficiently and should be utilizing brachiation as their primary mode of travel. All of the gibbons in this study, except one, satisfied this requirement. Considering it is crucial that gibbons in the wild are able to effectively traverse through the forest using brachiation as their main form of travel, I would say this is a necessary criterion that gibbons in the rehabilitation program should meet if they are to be considered for release.

It is suggested that gibbons should spend no more than five percent of their time on the ground level of their enclosure, and they should be at the upper level of their enclosure at
least 40 percent of the time. All of the Javan gibbons in this study met this requirement.
Once released, if the gibbons are to avoid risk of predation and survive in the wild, they must
remain in the upper level of the canopy. Former pet gibbons may be very comfortable
spending time on the ground and if this behavior is present in gibbons in the rehabilitation
program, it must be eliminated prior to release. This requirement is a necessary part of the
rehabilitation procedure.

Cheyne et al. (2008) recommends that a pair of gibbons should be spending at least
seven percent of their time engaged in positive pair association (i.e., groom, play,
copulation), with at least three percent of total activity time spent allogrooming. None of the
pairs of gibbons in this study satisfied these criteria. However, the criteria as proposed do
not acknowledge that one of the primary forms of social interaction for adult gibbons is
“sitting together” within close proximity (within one meter) (Palombit, 1994), thus it is not
included in positive association behavior. If the maintenance of close proximity were to be
included in positive association behavior, all three of the pairs of gibbons in this study would
have met the suggested requirement of at least seven percent. Jeffry and Nancy spent 17.6
percent of observation records in close proximity, Sadewa and Kiki spent 12.6 percent of
observation records in close proximity, and Septa and Echi had the highest percent of
observation records spent in close proximity at 45.7 percent. I would suggest including the
maintenance of close proximity in the positive association behavior category as part of the
necessary criteria for rehabilitated gibbons.

The guidelines also state that the pair of gibbons should be copulating successfully
and each individual should be able to initiate copulation with the other. Only one pair
included in this study was observed copulating (Septa and Echi), however, that does not
mean the other two pairs are not copulating. The breeding pair of Javan gibbons at the Perth
Zoo has only been observed copulating two times (H. Thompson, personal communication,
October 7, 2009). Therefore, it is possible that copulation between a pair of gibbons is
simply not being observed. If a pair of gibbons is not observed copulating by human
observers, it may prove beneficial to set up a video camera system to attempt to observe the
gibbons copulating. If a pair of gibbons are housed together for several years and do not
produce any offspring, it may prove beneficial for conservation efforts to re-pair the gibbons
with other individuals so that they may have the opportunity to successfully reproduce. It is
necessary that gibbons in a rehabilitation program are observed copulating, via human observation or video camera, prior to their release, so that they do contribute to the wild population.

In general, the gibbons in this study showed similar patterns of behavior with regards to the activity budgets of wild Javan gibbons. The ways in which they differ were most likely due to the captive environment. For example, the gibbons in this study spent more time resting and less time feeding/foraging than their wild counterparts. This is likely because gibbons in the wild do have to spend more time traveling to locate food sources. I would expect to see a higher percent of resting in captive gibbons because they do not have the space to travel farther distances and they have their food provisioned. Ideally, gibbons in a rehabilitation program should exhibit similar behavioral patterns to their wild conspecifics, while at the same time we must acknowledge the limitations placed on them as a result of a captive environment. Therefore, I do not include this criteria in the amended behavioral checklist.

The guidelines state that gibbons in a rehabilitation program should not be exhibiting severe stereotypic behavior (i.e., rocking or self harm) more than three percent of total activity time. Considering the nature of the stereotypic behavior displayed by the gibbons in this study was not severe, I considered all three of the pairs to have satisfied this criterion. The primary stereotypic behavior observed was repetitive brachiation or swinging on a substrate, and it is unlikely that when the gibbons are released these behaviors will persist; these behaviors are the result of a captive environment. However, stereotypic behavior should be monitored during the rehabilitation program and depending on the nature of the behavior, the decision to deem a gibbon suitable for release can be assessed based on the severity of the behavior. I recommend that if a gibbon exhibits severe stereotypic behavior, that it not be released into the wild. Perhaps the individual would be more beneficial remaining at JGC and used for a captive breeding program, and then any future offspring may be released into the wild.

I would also recommend adding a diet category to the behavioral criteria. The Javan gibbons at JGC have fruit and foliage that is collected from the forest in Gunung Gede-Pangrango incorporated in to their diet. This is done so that the gibbons will be accustomed to eating a more natural diet. It is important that any gibbon who is a candidate for
reintroduction must show a preference for wild fruit and foliage before they are released. They must enjoy eating these sources of food and become familiar with them visually, so that when they are living in the wild, they are able to identify them in the canopy.

Overall, the behavioral checklist is an effective tool for determining the preparedness of a pair of gibbons prior to reintroduction, but based on my data could be amended. The rehabilitation and reintroduction of gibbons is a relatively new conservation strategy and there are very little data published on the successful reintroduction of gibbons back into the wild. With 15 of the 17 gibbon species currently listed as Endangered or Critically Endangered (IUCN, 2010; Van Ngoc et al., 2010), the future of all gibbons remains uncertain (Cheyne et al., 2008). The reintroduction of former pet gibbons may play a significant role in the preservation of many of these threatened species of gibbons. However, it is crucial that the rehabilitation procedure is fully documented. This is the only way to establish a well-rounded rehabilitation/reintroduction program that adheres to scientific guidelines and principles.

Table 5 discusses the revisions/additions I have made to Cheyne et al.’s (2008) behavioral checklist based on the results from this study.

**LESSONS LEARNED FROM THE RELEASE**

When I arrived at JGC to conduct my field work in July 2009, I was informed that the first pair of Javan gibbons (Figure 15) was going to be released during the month of October 2009. As a result, I was presented with the opportunity to conduct behavioral observations on the pair before and after they were released. The pair was moved to an acclimation enclosure at the release site, Patiwel, a month and a half before they were released into the forest. Therefore, I was able to compare their behavior at JGC and at Patiwel pre-release, and also their behavioral response to the forest once they were released.

Due to a relatively high number of Javan gibbons that are currently held illegally in Indonesia as pets, rescue and reintroduction may be an effective conservation strategy for reestablishing populations of Javan gibbons in the wild. However, based on Septa and Echi’s response to human observers after they were released, precaution will need to be taken for future releases when monitoring reintroduced gibbons. I expected to observe very little human-directed behavior, either affiliative (i.e., soliciting grooming, petting) or aggressive
Table 5. Revised Behavioral Checklist

<table>
<thead>
<tr>
<th>Proposed criteria for assessing suitability of gibbons for release.*</th>
<th>Behavioral recommendations based on the results obtained from this thesis.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The gibbon should be able to move around the enclosure well, and most of this movement should be by brachiation</td>
<td>Gibbons should be able to effectively locomote and should utilize brachiation as their primary mode of travel around the enclosure.</td>
</tr>
<tr>
<td>No more than 5% of time to be spent on the ground for any purpose. Gibbons should be at the top of the cage for at least 40% of the time and should not be sleeping on the ground at all.</td>
<td>Gibbons should be spending the majority of their time at the upper level of their enclosure, with no more than 5% of time spent on the ground.</td>
</tr>
<tr>
<td>The pair should be spending at least 7% of total activity time in positive pair association. At least 3% of total activity time should be spent allogrooming.</td>
<td>Gibbons should be fed a diet that includes wild fruits and foliage, and they must demonstrate a significant interest in these foods.</td>
</tr>
<tr>
<td>They should be copulating successfully and each member of the pair should be able to initiate successful copulation with the other.</td>
<td>The pair should be spending at least 15% of total observation records in positive association behavior (i.e., groom, play, copulation, and within close proximity).</td>
</tr>
<tr>
<td>Activity budgets should approximate those of wild conspecifics in all major categories i.e., feeding, resting and travelling.</td>
<td>They should be copulating successfully and each member of the pair should be able to initiate successful copulation with the other.</td>
</tr>
<tr>
<td>No more than 3% of total activity time engaged in a severe stereotypic behavior e.g., rocking or self-harm.</td>
<td>Gibbons should not exhibit any form of severe stereotypic behavior and very infrequent occurrences of human-directed behavior.</td>
</tr>
</tbody>
</table>

behavior, once the gibbons were released. This expectation is based on the finding that wild gibbons tend to shy away from humans and flee when they encounter them in the forest, but will sometimes perform threat displays or alarm calls (I. Supian, personal communication, October 24, 2009; Malone, 2007).

Captive gibbons, on the other hand, may have very little fear of humans. There has never been a published report of a wild gibbon physically attacking a human. Although Septa and Echi were highly aggressive towards humans while in captivity, I did not expect the aggressive behavior would persist once they were released. There is always a potential risk in releasing animals into the wild that have lived in captivity with humans for most of their life, because they will either have developed a psychological attachment or resentment towards humans, or will have no fear of them. There are reports of reintroduced orangutans, bonobos, and gibbons attacking humans (Les Amis des Bonobo du Congo Newsletter, 2009;
The Wild Animal Rescue Foundation of Thailand, 2010; Yeager, 1997). For example, one adolescent male orangutan attacked and bit humans over 25 times in a 15 month period in Tanjung Puting National Park in Indonesia (Yeager, 1997). In Phuket, Thailand at the Gibbon Rehabilitation Project (GRP), aggression directed at humans was displayed by two adult lar gibbons immediately after they were released from their enclosure. When the staff would attempt to observe the gibbons in the forest, the male would approach observers jumping from tree to tree at a low height in the canopy or running bipedally on the ground. Some of the observers, including both volunteers and staff, were actually scratched or bitten by the male gibbon. The female (and the juvenile) would sometimes urinate or defecate on humans or their belongings. She also scratched some observers and seemed to specifically dislike female observers (The Wild Animal Rescue Foundation of Thailand, 2010). At JGC, Echi showed a similar dislike for me while she was in captivity. Once she was released, she directed aggressive behavior at all human observers (I was the only female observer). The staff of GRP would use sling shots to attempt to scare the gibbons and the gibbons eventually learned to back off when they became aware of the sling shots. We also used sling shots in an attempt to frighten Septa and Echi back up into the canopy, however, this method did not work for us. GRP reports that the aggressive behavior of the adult male towards observers eventually decreased during the study period, while the adult female still exhibited aggressive behavior to every new female observer. The gibbons at Kalaweit were released onto an island (Mintin) and most of the post-release monitoring was conducted from a boat off shore. However, observers would occasionally go onto the island and attempt to locate the gibbons, but there were never any aggressive encounters between the gibbons and human observers.

Considering Septa and Echi were removed from the illegal pet trade and have spent the majority of their life in captivity with human interaction prior to being released, it is very likely that they may maintain some degree of abnormal behavior. However, even though the aggressive behavior they displayed towards humans is not typical for wild gibbons, this does not mean they cannot survive in the wild. It may actually be advantageous for them when they are able to move into the larger part of the park and have to establish a new territory near wild gibbons. They have demonstrated that they are capable of effectively defending their territory and so they will hopefully be able to sustain themselves in the larger
population of wild gibbons in Gunung Gede-Pangrango National Park. Septa and Echi maintained normal species typical behavior with one another and their bond remained intact. After the gibbons at Kalaweit were released onto Mintin Island, the association between the pair broke down and there was no longer any social interaction or singing. The pair of gibbons did come back together after four weeks (Cheyne, 2004). In addition to engaging in normal social behavior with one another, Septa and Echi made use of all substrates available to them in the forest, despite never having any experience prior to being released that would have prepared them for the complexities of the forest. Ultimately, it would appear that Septa and Echi have developed appropriate survival skills and demonstrate that some gibbons are capable of some level of rehabilitation after having spent the majority of their life in captivity. For future releases, it will be critical to ensure the release site has very little human activity in the area in order to minimize the encounter rate between gibbons and humans. Each gibbon has a different life history and the outcome of future release efforts will likely vary on a case by case basis.

**LOCAL INITIATIVES AND SUPPORT**

Support from local governments and communities is crucial and one way to ensure a successful reintroduction program for Javan gibbons in West Java. Based on a comprehensive review of previous research and an assessment of continued threats to the Javan gibbon and its habitat, Supriatna (2006) concluded that educational outreach and public support, as well as participation, will be invaluable components in the elimination of existing pressures and the implementation of conservation initiatives (Malone, 2007). Conservation programs should devote sufficient time and energy into the development of education programs that will suit all audiences and focus on all aspects of conservation (Nijman, 2004). In order to increase community awareness and knowledge on biodiversity conservation in Gunung Gede-Pangrango National Park, CI-Indonesia has enlisted the use of a mobile conservation education unit that travels to local communities teaching conservation education. The primary goal of the conservation education program is to encourage local people to incorporate conservation concepts into their daily activities and provide them with more knowledge regarding the local flora and fauna. For children, the unit uses “Moli” the Javan gibbon and “Telsi” the Javan hawk-eagle as characters to deliver the program’s
conservation message. In addition, the Mobile Conservation Education Unit has a small library that is accessible to local communities.

Furthermore, regarding the primary issues of habitat loss and the illegal trade in gibbons, local people will have to be involved in the long-term effective management of forest resources and they must demonstrate the will to reject, report, and prosecute individuals who are involved in the illegal pet trade (Malone, 2007). The local people are not provided with adequate information regarding the importance of conservation and the long term benefits they can derive from the forests (i.e., watershed protection) (Supriatna, 2006). It is crucial for the Indonesian government, NGOs, scientists, and other concerned stakeholders to merge their efforts regarding the best conservation policies that will benefit the indigenous people of Java and its wildlife (Orlove & Brush, 1996). Conservation is about changing the way in which people perceive the planet, including the wildlife with which they share it with. It is imperative to establish a well-rounded conservation education program that emphasizes the value of all wildlife and its role in maintaining forest biodiversity.

The purpose of any reintroduction program should be thoughtfully weighed against the costs and benefits of alternative conservation strategies, including protection of the wild population. Rehabilitation and reintroduction of former pet gibbons can potentially serve to make a considerable contribution to the reestablishment of viable wild populations, as well as reduce significant welfare issues for gibbons already living in rescue centers (Nijman, 2006). It has been suggested that conservation efforts should focus on preserving the remaining habitat and populations of wild primates and that the bulk of the available funding should be redirected to these causes (Sarrazin & Barbault, 1996). However, if rehabilitation and reintroduction programs adhere to scientific principles and guidelines, coupled with careful planning and documentation of the pre- and post-release behavior of the animals, the programs can positively contribute to species’ conservation and habitat protection (Cheyne, 2009). Ultimately, a reintroduction program cannot succeed without the researchers interacting with local and national governments, government and non-government professionals, and the local people in the communities. Education about the reintroduction program is crucial to secure continuity and the long-term support, protection, and management of the Javan gibbon and its habitat and ensure that this fascinating ape does not go extinct on the island of Java (Kleiman, 1989).
REFERENCES


