

## **Conservation Programs for the Endangered Javan Gibbon (*Hylobates moloch*)**

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# Conservation Programs for the Endangered Javan Gibbon (*Hylobates moloch*)

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**Abstract:** The Javan gibbon (*Hylobates moloch*), found in Western Java, is one of the rarest and most endangered of the hylobatids. Two workshops, which brought together Indonesian primate biologists, international scientists, zoos, local and international nongovernmental organizations, and government organizations, have been carried out for the conservation of this species. In 1994, a Population and Habitat Viability Analysis (PHVA) workshop was held focusing on the distribution, status, and threats of wild populations of Javan gibbon, and in 1997, a second was held to discuss strategies for rescue and rehabilitation. The results have been used to develop guidelines to save the Javan gibbon in the wild, and to trace further directions for research on, and the monitoring of, the remaining populations. To date, major accomplishments are as follows; headway has been made on protecting their stronghold habitats through the creation of the Gunung Ciremai National Park and the development of a conservation corridor, incorporating Gunung Salak into Gunung Halimun National Park and enlarging the Gunung Gede Pangrango National Park, which increased the size of the two parks to 135,000 ha in total and more than doubled the amount of protected habitat for the Javan gibbon; programs have been set up for monitoring the pet market as well as populations in the wild; a rescue and rehabilitation center has been established, as has an education program and a conservation awareness campaign using the Javan gibbon as a mascot species.

**Key Words:** Javan gibbon, *Hylobates moloch*, Java, conservation

## Introduction

The island of Java marks the most southeasterly limits of the ranges of a number of primates of mainland Asia. Some in Sumatra and Kalimantan are already extinct, including the pig-tail macaque, orangutan, and tarsiers. These local extinctions are believed to be quite ancient, but others are very recent, dating back only a few decades, such as the loss of the Javan tiger, *Panthera tigris javanicus* (see Seidentsticker 1987). Of the five primates living in Java today, the Javan gibbon, *Hylobates moloch* (Audebert, 1797) (Fig. 1) and the grizzled leaf monkey or surili, *Presbytis comata* (Desmarest, 1822), are now categorized on the *IUCN Red List of Threatened Species* as Critically Endangered and Endangered, respectively (IUCN 2006). The Javan leaf monkey, *Trachypitecus auratus* (É. Geoffroy, 1812) and Javan slow loris, *Nycticebus coucang javanicus* É. Geoffroy, 1812 are ranked as Vulnerable, and the only primate still relatively abundant on the island is the long-tailed macaque, *Macaca fascicularis* (Raffles, 1821) (Supriatna and Hendras 2000; Supriatna *et al.* 2001).

There are about 14 species of gibbon; all restricted to Asia (Marshall and Sugardjito 1986; Groves, 2005). Six are found in Indonesia, in Sumatra, Java, and Kalimantan, but only the Javan gibbon has been listed as Critically Endangered, facing as it does the highest risk of extinction due to habitat loss and hunting for pets (Supriatna *et al.* 2001). The Javan gibbon is now found only in forest remnants of western (*H. moloch moloch*) and central Java (*H. moloch pongolsoni* Sody, 1949). Two workshops have been carried out to examine the conservation status and discuss conservation measures for the species. A Population and Habitat Viability Analysis (PHVA) workshop was held in 1994, run by the IUCN/SSC Conservation Breeding Specialist Group (CBSG) (Supriatna *et al.* 1994), and a second workshop, organized by Conservation International Indonesia in collaboration with the University of Indonesia and the Nagao Environment Fund Japan in 1997, examined particularly the rescue and rehabilitation programs for the species (Supriatna and Manullang 1999). The workshops, especially the second, resulted in intensified efforts on



**Figure 1.** An adult male Javan gibbon, *Hylobates moloch*, at the Javan Gibbon Center, Bogor, Indonesia.

the part of experts, governments and conservation organizations to save the Javan gibbon.

During the last two decades, much attention has been given to obtaining population estimates of the gibbons surviving in the small patchy forests in west and central Java (Asquith 1995; Asquith *et al.* 1995; Nijmen and van Balen 1998, Supriatna *et al.* 1998; Djanubudiman *et al.* 2004; Nijman 2004). A number of students and scientists have carried out surveys in specific sites such as the Gunung Slamet Protected Forest (Supriatna *et al.* 1992), Ujung Kulon National Park (Gurmaya 1992; Wibisono 1995), Gunung Halimun National Park (Sugardjito *et al.* 1997, Sugardjito and Sinaga 1999), Gunung Gede Pangrango National Park (Purwanto 1996; Rahardjo 2003), Gunung Simpang Protected Area (Subekti 2003), and Gunung Tilu Protected Area (Al Rasyid 2003).

There have been numerous initiatives and campaigns to save the Javan gibbon. Notable was the media campaign and education program at the Badogol Conservation Education Center in the Gunung Gede Pangrango National Park, set up and supported by the Gunung Gede National Park Management, Conservation International, the Alami Foundation, and the University of Indonesia. Every year more than 5,000 people visit the site. The aim is to report and detail the plight of the Javan gibbon and promote an understanding of the link between conserving wildlife and the benefits to the people in securing their natural forests.

### Threats to the Javan Gibbon

An island of about 130,000 km<sup>2</sup> (slightly larger than New York State), Java has been overcrowded for the last 200 years. Before independence in 1945, the Dutch government tried to relocate some of its human population to other islands in order to reduce the pressures on the environment. The rate of population increase accelerated in the 19th century, and by the 20th, and in the 40 years from 1961 to 2000, the population of Java almost doubled, from 63 million to more than 115

million (Whitten *et al.* 1996; Biro Pusat Statistik 2006). This burgeoning human population and the island's long history of farming, back to at least 1,000 years ago, has significantly reduced Java's forest cover. Whitten *et al.* (1996) estimated that more than 1.5 million ha had already been lost to farmland and teak plantations by 1000 A.D. Prior to World War II, Java's forests had been reduced to 23% of their original extent (Seidensticker 1987). By 1973, this had dropped to 11%, and by 1990, to an estimated 7%—only 0.96 million ha of forest remnants (FAO 1990). Most of the natural forests remaining today are in national parks or other, variously effective, forms of protected areas, including those for watershed conservation. Large areas of “forest” cover on the island are tree plantations (teak, pine, and others), mixed community forests, or forest research areas (silviculture).

Java continues to lose its forests—significantly so following the Indonesian government's decentralization of forest management to the regencies. In 2001, the central government adopted new laws on responsibilities for natural resource management and the allocation of the pertinent budgets. Forest management, except for conservation areas, has been given over to local governments, some of which focus on short-term economic gain from activities such as logging, rather than the sustainable, long-term management of natural resources. One aspect that results in the persistence of these threats is that local people, including decision-makers, do not have adequate information concerning the importance of conservation, and the long-term benefits that local people can derive from these forests, such as watershed services. The major cause of natural forest loss today is not, however, industrial-scale logging, but encroachment and depredation by smallholders—tree cutting for subsistence plots, collection of firewood, forest fires, and charcoal production.

The balance of five years of decentralization in the responsibilities for forest management is one of further forest loss in Java. Satellite images spanning 10 years, from 1985 to 1997, show a reduction in forest cover not only in the watershed protection forests but also in the protected areas (Holmes 2000). The forest of the Gunung Simpang Protected Area lost almost 15% (from 15,000 ha) during this time, Ujung Kulon National Park lost 4% of its 76,100 ha, and Gunung Halimun National Park lost 2.5% of 42,000 ha (director, Conservation Area of the Ministry of Forestry pers. comm. 2001).

The pet trade is another major problem for the Javan gibbon. It is believed that an entire second population (nearly 300 individuals) is illegally held in captivity in Indonesia; most frequently as pets (Supriatna *et al.* 1994). The north coast of the island of Java is a major route for the trafficking of Indonesian nonhuman primates, including lesser apes from Java (Malone *et al.* 2004). As such, Javan gibbon hunters throughout the island are likely to be involved in the supply and sourcing of the illegal trade in primates and other wildlife. One of the biggest challenges in enforcing the regulations is the willingness of the authorities to become engaged in and carry through the required judicial procedures. Illegal logging, felling for firewood and local construction industries, encroachment of pro-

tected areas, and illegal trading in wildlife are widespread and yet unpunished.

### Distribution and Key Populations

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

Many of the forest patches maintaining gibbons are minute and have less than 10 individuals—a number well below the demographic and genetic thresholds for their mid-to long-term persistence (Lande 1988). They are evidently at high risk of extinction unless subjected to intensive conservation efforts. Although conservation programs might best be focused primarily on core populations such as those in the national parks of Gunung Halimun, Gunung Gede Pangrango, and Ujung

Kulon (Supriatna *et al.* 1994), consideration must be given to smaller populations functioning as critical stepping-stone populations allowing for the maintenance of genetic diversity, genetic exchange, dispersal and colonization—processes vital for the long-term survival of this species.

The majority of the surviving Javan gibbons are now confined to small populations in isolated forest patches. With burgeoning human populations and the uncertain future of the already scarce and fragmented forests, there is a need to establish a wildlife sanctuary to allow for the rescue and translocation of the scattered and isolated gibbons groups before their forests are destroyed. Although the translocation of wild animals is still fraught with difficulties, this strategy may be the only conservation option in this case, particularly when so much of the forest on Java is scheduled for imminent destruction. The translocation of rescued groups proved to be a highly successful component of the overall strategy for the conservation of the golden lion tamarin (*Leontopithecus rosalia*) in the Atlantic forest of Brazil. In the early 1990s, 42 lion tamarins in six groups, each isolated in tiny forest remnants, were captured and introduced to a secure forest. They thrived, and in May 2006, numbered more than 250 in about 25 groups, comprising about 18% of the entire population (1,400) in the wild (Kierulff *et al.* 2002; M. C. M. Kierulff pers. comm, 24 May 2006). Prolonged monitoring and in-depth studies of their demography, ecology, and behavior need to accompany a program of this sort. Analyses are in progress to determine the extent and nature of genetic variability in the remnant populations and the degree of divergence among them. Such information will contribute to a decision as to whether such a strategy is necessary and justifiable and, if the answers are positive, will allow for the determination of which populations should be given highest conservation priority (Awise 1994).

Although estimates of remaining gibbon numbers may vary, there can be no doubts as to the significant threats that all current populations are facing: principally from continuing habitat degradation and fragmentation. Today almost all the remaining Javan gibbon habitats are submontane and

**Table 1.** Javan gibbon habitat areas and populations of importance for effective conservation measures.

Protected area / area	Habitat (km <sup>2</sup> )	Forest size (km <sup>2</sup> )	Forest type	Estimated population	Source
Ujung Kulon NP G. - Payung G. - Honje	30 85	761	Lowland	300–560	Kappeler (1984) Gurmaya (1992), Wibisono (1995), Asquith <i>et al.</i> (1995), Rinaldi (2000), Nijman (2004), Djanubudiman <i>et al.</i> 2004
Gunung Halimun NP Gunung Salak	235 76	400	Lowland, submontane, montane	900–1221	Nijman (1995); Supriatna <i>et al.</i> (1998), Sugardjito and Sinaga (1999), Djanubudiman <i>et al.</i> (2004)
Gunung Gede Pangrango NP	50	140	Lowland, submontane, montane	447	Djanubudiman <i>et al.</i> (2004), Suryanti (2006)
Gunung Papandayan PF	130		Submontane and montane	527	Djanubudiman <i>et al.</i> (2004)
Telaga Warna PA		50	Submontane	476	Djanubudiman <i>et al.</i> (2004)
Gunung Simpang PA	110	150	Submontane		Asquith <i>et al.</i> (1995), Djanubudiman <i>et al.</i> (2004)
Gunung Tilu PA	30	80	Submontane	196	Djanubudiman <i>et al.</i> (2004)
Gunung Kendeng PF, Dieng Plateau	90		Submontane	492	Djanubudiman <i>et al.</i> (2004)
Gunung Slamet PF	38.6		Lowland, submontane, montane	96	Seitre and Seitre (1990); Supriatna <i>et al.</i> (1992), Nijman (1995); Djanubudiman <i>et al.</i> (2004)

NP = national park, PF = protection forest. PA = protected area.

montane forests (Gunung means mountain). The major exception is Ujung Kulon National Park, but there are also small portions of lowland forest in Gunung Halimun and Gunung Gede national parks. Only the three national parks in West Java, Gunung Gede Pangrango, Gunung Halimun, and Ujung Kulon, have the potential to maintain populations of more than 100 individuals, but some protected areas (Gunung Simping, Gunung Tilu dan Telaga Warna) and protected forests for watersheds (Gunung Kendeng, Gunung Papandayan) also have significant numbers of gibbons (Table 1).

The most recent survey (supported by the U.S. Fish and Wildlife Service) documented the disappearance of a number of forests over the last decade, notably Bojong picung and Pasir susuru, besides the imminent loss of gibbon habitat in Leuweung Sancang, Gunung Jayanti, Gunung Tangkuban Perahu, and Telaga Warna, where only part of the remaining forests are in legally protected areas (Djanubudiman *et al.* 2004). Knowing the actual numbers of gibbons is important, but paramount now is, where possible, the protection of these forests, avoiding their destruction and controlling hunting and where gibbons and their forests are doomed, some means to have them translocated or taken into captive breeding programs for later reintroduction.

### Conservation Measures for the Javan Gibbon

#### *Population and Habitat Viability Analysis workshop*

In May 1994, more than 50 people participated in a PHVA workshop for the Javan gibbon (Supriatna *et al.* 1994). The workshop established guidelines for a captive management program, not just as a hedge against extinction, but also to rationalize and facilitate the placing of confiscated animals. Also highly recommended was a public awareness campaign that focused on the threats to the Javan gibbon and its habitat. Follow-up workshops developed the criteria for site selection,

guidelines for quarantine procedures and veterinary policy, and recommendations regarding enclosure design, nutrition, population sources, rehabilitation, and education and research programs, besides a plan to establish a Javan gibbon rescue and rehabilitation center.

On the last day of the conference, a working group was established to lay out the guidelines for establishing a captive management program. Immediate recommendations included a survey of pets, the establishment of a Javan gibbon studbook, the preparation of a gibbon husbandry manual, and training in gibbon health and husbandry techniques for Indonesian Zoo Association (PKBSI) staff. Not all of these recommendations have been acted on, but nevertheless remain a priority. A survey of pets and gibbons held in Indonesian zoos was carried out in 1996 (Supriatna *et al.* 1998). Information was gathered from the Offices for Conservation and Natural Resources (BKSDA) of West Java, Central Java, and Jakarta, and subsequently verified, checking with the zoos and pet owners. The numbers of pets registered in West Java, Central Java, and Jakarta were 54, 41, and 36, respectively. Most pets were found to be in very poor health, and some were traded or had died of parasitosis or infectious diseases (Supriatna *et al.* 1998). The studbook is run from Perth Zoo, Australia, while other recommendations, such as training in gibbon health and developing a manual for gibbon husbandry, were carried out after the rescue and rehabilitation workshop in 1999.

#### *Rescue and Rehabilitation Program*

Following the 1994 PHVA workshop, Conservation International, the University of Indonesia, and the Nagao Environment Fund (NEF) of Japan hosted an international workshop on Javan Gibbon Rescue and Rehabilitation in August 1997 (Supriatna and Manullang 1999). Eight papers were presented on such topics as the population status in the wild (Gunung Halimun National Park) and population genetics; *ex situ* conservation and cryo-preservation (Abinawanto and Supriatna 1999); government policy on rehabilitation, management, nutrition, and cage design; and protocols for caging. A significant element of the workshop was the presentation of techniques, methods, and lessons learned by experts on the rehabilitation gibbons in Thailand. Other aspects considered were the existing government policy on rehabilitation, the IUCN protocols, and the experiences of zoos in gibbon caging and husbandry. Supriatna *et al.* (1998) also informed that the reported numbers of gibbons kept as pets were not entirely accurate because many were misidentified.

The phylogenetic tree for hylobatids clearly shows the Javan gibbon to be a monophyletic group separate from other gibbons (see, for example, Takacs *et al.* 2005). DNA sequence data suggest strongly, however, the existence of two lineages, a western lineage and an eastern lineage extending into Central Java (Supriatna *et al.* 1999; Andayani *et al.* 2001). Morphological differences between these two gibbons are subtle, and the release of confiscated animals to the wild must, therefore, occur with extreme caution. It is also essential that zoos identify their gibbons for their correct husbandry within a breeding



**Figure 2.** A comparison of forest cover on the island of Java in 1985 (above) and 1997 (below). Sources: RePPProt (1985); Indonesia, Ministry of Forestry and World Bank (2000).

program, not only so as to maintain the identity of the subspecies but also because out-breeding may have deleterious effects on reproductive performance. The conclusion of this workshop resulted in a recommendation to the Government of Indonesia to establish a Rescue and Rehabilitation Center (Supriatna and Manullang 1999).

Recommended also was a breeding program to preserve the genetic diversity of the species in captivity. It was argued that a captive breeding program had a vital role to play in the survival of the Javan gibbon. There are a small number held in zoos outside Indonesia, but the first step would be to improve our understanding of the reproductive behavior and physiology of the species. Two graduate students from University of Indonesia and Bogor Agriculture University are currently carrying out research with respect to this (Sjahfirdi *et al* 2006a, 2006b) and have already made significant inroads to understanding the menstrual cycle and the behavioral and physiological determination of the periovulatory phase. Studies such as these will, we hope, contribute to an understanding as to why the Javan gibbon shows such low reproductive rates in captivity

#### *Javan Gibbon Center*

During the XVIII Congress of the International Primatological Society (IPS), held in Adelaide, Australia, in 2001, the international nongovernmental organization (NGO) Conservation International (CI) and the Silvery Gibbon Project (SGP, Australia) agreed to collaborate to establish a Javan Gibbon Center (JGC) for the maintenance and rehabilitation of rescued and confiscated gibbons. The JGC receives donated or confiscated gibbons (usually pets) with the short-term goal of assessing their medical and behavioral status, and restoring them to full health. Because there are so few Javan gibbons remaining, the genetic material of these illegally held (and likely unreleasable) animals is too important to be lost. The JGC is working, therefore, to: (1) retrieve pet Javan gibbons; (2) manage an *ex situ* population; (3) conduct noninvasive research, including genome resource banking; and (4) provide for public awareness and education programs focusing on the Javan gibbon and its imperiled status in the wild. This work is carried out in collaboration with the Indonesian Ministry of Forestry (Department of Forest Conservation and National Parks, the Provincial Natural Resources Agency, and the Forestry Research and Development Center), the Javan Gibbon Foundation, and the University of Indonesia.

The JGC formally opened in mid-2003 on land donated by a local ecotourism hotel. It is currently (June 2006) home to six rescued gibbons. A number of facilities have been constructed, including a guard station; an office; a medical and quarantine facility; and individual, bonding, and socialization enclosures. The infrastructure and staffing of the JGC are, however, still far from complete. More gibbon enclosures are needed to accommodate animals that are currently turned away because of space and staff constraints.

In parallel with the work in the JGC, there is an urgent need for education outreach to local communities living in

and around the Javan gibbon's remaining forests. Some efforts have been made but they are as yet incipient. Outreach is critical so that when animals are successfully rehabilitated and can be released, there will be ample support and understanding, and protection provided by the local communities involved.

#### **Securing More Habitat Via Corridor Development**

As mentioned above, the molecular genetics study by Andayani *et al* (2001) suggested the presence of two lineages of Javan gibbons. A western lineage is represented by the large population of Gunung Halimun, while the eastern lineage includes isolates around Cianjur-Sukabumi complex (possibly covers Gunung Masigit, Gunung Tilu, Gunung Ciremai, and Gunung Sawal) and Gunung Slamet in central Java. These may relate to the named subspecies of western (*H. moloch moloch*) and central Java (*H. moloch pongoalsoni*) (see Brandon-Jones *et al.* 2004; Groves 2005). This finding has consequences for conservation policy: (1) gibbons in the Gunung Halimun complex should be managed as a separate and distinct conservation unit—they should not be considered as stock to reinforce the threatened isolates of the eastern lineage; (2) the Cianjur-Sukabumi complex presents a second distinct unit—gibbons from there can be moved among the different localities within this complex; (3) although the gibbons in Gunung Slamet are not evolutionarily distinct from populations in the west, they merit special attention because they might represent a case of peripheral isolation.

The forests and the gibbon population of Gunung Halimun are almost linked to the Gunung Salak Protected Forest and the Gunung Gede-Pangrango National Park. With approximately 1,800 to 2,000 individuals—almost half of the entire wild population—these three mountain ranges are the major stronghold for Javan gibbon populations today. These protected areas comprise an integrated conservation management system that protects the last remaining tropical forest remnants on Java, and also guarantees water supplies for 35 million people in Jakarta, Indonesia's capital, and neighboring cities, besides numerous industries along the rivers that run north-south in western Java. In 2003, the government agreed to create a corridor of these protected areas by incorporating Gunung Salak into Gunung Halimun National Park and enlarging the Gunung Gede Pangrango National Park. This decision, which increased the size of the two parks to 135,000 ha in total, more than doubled the amount of protected habitat for the Javan gibbon. The management of the Gunung Gede Pangrango National Park has created a buffer of vegetation to secure the new boundaries of this recent park expansion by developing a small community agroforestry and reforestation program (Conservation International Indonesia 2005).

#### **Educating People to Save the Javan Gibbon**

For more than five years (2000–2006), Conservation International Indonesia has led the GEDEPAHALA Consortium (Gede-Pangrango-Halimun-Salak), comprised of

17 NGOs, eight government institutions and research centers, four universities, and two private companies. The objective of the consortium is to raise the awareness of all stakeholders (including government, business enterprises, and local communities) concerning the advantages of maintaining, protecting, and expanding the two parks for human welfare, notably in the maintenance of a reliable long-term water supply, the generation of carbon sequestration benefits, and the protection of wildlife.

About an hour's drive from Jakarta, this montane region is of major importance for tourism. There are hundreds of hotels, restaurants, and recreation areas, and for obvious reasons the tourism industry there must be a major target for awareness campaigns concerning the value of the forests, their wildlife, and the plight of Java's endemic ape. In 2001, the Alami Foundation, Conservation International Indonesia, and the park authority created the Badogol Conservation Education Center to secure local support for the parks through an understanding of the behavior of wildlife and by generating direct and indirect benefits to the local communities. A Mobile Conservation Education Unit is used to take the conservation education program beyond the park's gates, visiting communities surrounding the Gunung Gede-Pangrango National Park to encourage local residents to incorporate conservation concepts in their daily activities. The Mobile Conservation Education Unit uses the characters of Moli the Javan gibbon, and Telsi the Javan hawk-eagle, to deliver a conservation message, besides showing wildlife films, stimulating discussions, and playing interactive games, and making a small library accessible to local groups (Conservation International Indonesia 2005).

### Other Conservation Measure Needs and Recommendations

There has been a dramatic loss of natural habitats throughout Indonesia, and the massive destruction of its forests and the loss of the Javan tiger signal a clear extinction crisis in Java, as in so many other regions of the country. The last and richest habitats across Java are now under the greatest pressure. Unprotected lowland forests are likely to be completely cleared unless aggressive measures are taken by government officers and NGOs. The range of the Javan gibbon has been dramatically reduced by habitat loss and human encroachment. Of 37 forests previously inhabited by this species and registered by Kappeler (1984), many were found to severely degraded and no longer suitable or able to sustain viable populations just 10 years later (Asquith *et al.* 1995). Djanubudiman *et al.* (2004) further emphasized that illegal poaching is another serious threat to the species. Specific recommendations for the conservation of the Javan gibbon include the need to encourage government officers to take action in curbing illegal trade in gibbons, to double their efforts to patrol the existing parks, to create programs to monitor populations both in and outside protected areas, and to discourage the trade by confiscating pets and placing them in a rehabilitation program.

Indonesian forestry reform is moving rapidly, with a growing interest among stakeholders to seize this opportunity

to promote greater sustainability in the forestry sectors, as well as to increase local community involvement in the management of their forest resources. There is a growing concern regarding the provision of effective long-term management for Indonesia's extraordinary system of conservation areas—in Java comprising almost 90% of the island's remnants forests. There is, consequently, an urgent need to implement a demonstrative program to earn public support for the potential direct and indirect benefits of the parks. The charm of the endangered Javan gibbon can be used to develop ecotourism programs, and generate income for all stakeholders in and around the protected areas where it occurs.

Legislation providing for regional autonomy, which went into effect in January 2001, is fundamentally reshaping the relationship between Jakarta and local authorities for all sectors, including forestry policy, legislation, and administration. Local governments are anxious to increase their revenues from natural resources, including efforts to levy taxes on private and state-controlled operations. District and provincial officers are now allowed to pass local regulations. These may have negative or positive implications for forest conservation and indigenous livelihoods. One positive implication is the increased facility and capacity for NGOs to lobby for local regulations that recognize indigenous rights to natural resources and promote the sustainable use of forests and their resources. A potential negative implication is that district administrators can now issue large numbers of permits for local companies to exploit their forests. This movement has to be anticipated by conservationists and government conservation officers, promote greater local participation in resource allocation decisions, and demand a greater accountability on the part of regional governments.

The principal recommendation regarding the application of scientifically grounded conservation management of the Javan gibbon is the need for research on their population genetics. There is genetic evidence that the Javan gibbon split, around 100,000 years ago, into two distinct lineages, western and central (Supriatna *et al.* 1999; Andayani *et al.* 2001). This finding must be considered when planning the relocation of groups from doomed habitats—a vital tactic for conservation of the genetic variability of the species. Genetic research on this species has to date been based on a limited number of samples, and any plan for translocation should first be based on a more complete understanding of the demography and population genetics of the species in the various parts of its range. If we can still conserve the forests remaining today, and eliminate hunting pressure, there is still hope for the survival of the Javan gibbon.

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