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THE TINJIL ISLAND NATURAL HABITAT BREEDING FACILITY: A DECADE OF OPERATION

Sepuluh Tahun Pengelolaan : Fasiltas Penangkaran Habitat Alami Pulau Tinjil

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ABSTRACT

In response to the conflicting demands of primate supply and conservation, a unique primate resource conservation program was established in 1987 on Tinjil Island, Indonesia. Designated as a natural habitat breeding facility (NHBF), Tinjil Island has emerged as a succesful primate resource operation and has demonstrated the value of natural habitat breeding as a conservationally sound approach resource. Beginning with an introduced breeding population of 520 simian retrovirus (SRV)-free longtailed macaques, 680 progeny have now been harvested, 400 of which have been sent to the University of Washington for use in AIDS related research. In addition to its role as a primate resource operation, the Tinjil facility has become an active research and training field station. More than 150 students from Indonesia, Japan and the United States have conducted research projects on Tinjil Island covering topics relating to primate biology and behavior, ecology, management and conservation. A field course in primate behavior and ecology has been conducted annually since 1991. Training activities such as these play an inportant role in promoting a greater understanding of primatology, an appreciation of biodiversity, and an awareness of the need for effective conservation and management practices. The Tinjil Island NHBF is a multifaceted operation that should serve as a model for future primate resource and conservation programs.

Key Words: *Macaca fascicularis*, AIDS, reproduction, conservation

ABSTRAK

Sebagai jawaban terhadap adanya benturan kepentingan antara permintaan terhadap primata dan konservasi, pada tahun 1987 dibentuk suatu program unik tentang konservasi sumberdaya primata di Pulau Tinjil, Indonesia. Sesuai dengan peruntukkannya sebagai tempat penangkaran alami monyet Ekor Panjang, Pulau Tinjil telah berhasil berperan sebagai sarana pengembangan sumberdaya primata dan menunjukkan arti penangkaran sebagai pendekatan dari aspek konservasi bagi sumberdaya yang berkelanjutan. Berawal dengan mengintroduksi 520 ekor induk monyet Ekor Panjang yang bebas dari retrovirus (SRV), kini telah berhasil memanen 680 ekor anakan, 400 ekor diantaranya telah dikirim ke University of Washington untuk digunakan sebagai hewan model penelitian AIDS. Selain sebagai sarana panangkaran monyet Ekor Panjang, Pulau Tinjil secara aktif digunakan sebagai tempat penelitian dan pelatihan. Lebih dari 150 orang mahasiswa yang berasal dari Indonesia, Jepang dan Amerika telah melakukan penelitian di Pulau Tinjil dalam bidang biologi dan perilaku primata, ekologi, manajemen dan konservasi. Pelatihan perilaku dan ekologi primata secara berkesinambungan dilakukan sejak tahun 1991. Aktivitas pelatihan ini memegang peranan penting dalam memberikan pemahaman terhadap primatologi, penghargaan terhadap biodiversitas dan kepedulian terhadap pentingnya konservasi secara efektif maupun praktek manajemen penangkaran. Penangkaran alami di Pulau Tinjil merupakan suatu bentuk operasional multi fungsi yang dapat dijadikan model bagi pengembangan program konservasi primata di masa yang akan datang.

Kata Kunci : *Macaca fascicularis*, AIDS, reproduksi, konservasi

INTRODUCTION

When the first reports on the discovery of a retrovirus linked to acquired immunodeficiency syndrome (AIDS) began to appear in the early 1980s (Barre-Sinoussi *et al.*, 1983; Gallo *et al.*, 1984; and Levy *et al.*, 1984), the search for an appropriate nonhuman primate model became a critical concern. If primate-based research on the pathogenesis of AIDS and vaccine development was to continue in an unimpeded fashion, a reliable source of monkeys free from AIDS-related retroviruses had to be secured. In response to the conflicting demands of primate supply and conservation (i.e., ensuring the availability of monkeys while minimizing pressure on natural populations), we embarked in 1986 upon a unique collaborative project to provide a reliable supply of longtailed macaques (*Macaca fascicularis*) that are free of simian retrovirsus (SRV). The goal was to establish, in a habitat country, a primate resource operation that would not deplete the country's natural primate population but rather serve as a model for self-sustaining production. It was agreed that the best mechanism for providing SRV-free animals in an economical and conservationally sound manner would be to establish a free-ranging, virus-free breeding colony and use only the progeny from such a colony for AIDS-related research.

The concept of natural habitat breeding originated, in part, at a meeting of the World Health Organization (WHO), convened in 1981 to address the feasibility of establishing national programs in habitat countries to manage primate populations as sustainable or "renewable" resources. Such programs would ensure the permanent conservation of the various species and maintain the supply of primates for essential biomedical research (MacKinnon, 1983). That same year, the Ecosystems Conservation Group (of the International Union for the Conservation of Nature) and WHO submitted a joint recommendation: Only primates known to be "common" should be used for biomedical research and wild-caught primates should be used primarily for the establishment of self-sustaining breeding colonies, with the eventual goal of breeding in captivity most or all of the primates used in research (MacKinnon, 1983). The following year, WHO-sponsored consultants (inculding O. A. Smith from the Washington Regional Primate Research Center at the University of Washington, WaRPRC) met with the Indonesian government to explore the feasibility of establishing a national primate breeding program in Indonesia (Hiddleston and Smith, 1982). Their recommendation focused on natural habitat breeding facilities (NHBF) as the most feasible approach to a sustainable resource capable of satisfying the needs of primate supply and conservation.

In 1986, the WaRPRC, joined by Bowman Gray School of Medicine and the Oregon RPRC, as part of an informal consortium, joined with the Institut Pertanian Bogor (IPB) to establish a collaborative program of research and training in primatology (including virology, pathology, behavioral biology, and ecology) as well as the establishment of the first Primate Research Center in Indonesia. Foremost among the projects was the establishment of a NHBF on Tinjil Island, West Java[1]. This breeding facility was intended to provide SRV-free longtailed macaques for use in AIDS-related research at the WaRPRC and in biomedical research directed at specific health concerns of Indonesians, conducted at IPB.

Initial construction and operation of the Tinjil facility began in 1987, and the first group of monkeys was released onto the island in 1988. In 1990, IPB's Primate Program received official status and was fully recognized by the Indonesian government as the first Primate Research Center in Indonesia, Pusat Studi Satwa Primata (PSSP) IPB. The Tinjil NHBF represents one of the first sizeable attempts to establish, in a habitat country, a primate resource and conservation program in accordance with the 1981 joint recommendation of the Ecosystems Conservation Group and WHO.

During the past 10 years, the Tinjil Island NHBF has emerged as a successful primate

resource program and has demonstrated the value of natural habitat breeding as a conservationally sound approach to a sustainable resource (Bowden and Smith, 1992; Kyes *et al.*, 1995). The purpose of this paper is to provide a brief history of the NHBF on Tinjil Island, focusing on the resource operation, research, and training. A number of papers about the Tinjil NHBF provide greater detail and technical descriptions of the topics discussed in this article (Bowden and Smith, 1992; Crockett *et al.*, 1996; Iskandar *et al.*, 1996; Kyes, 1993; Kyes *et al.*, 1995; Kyes *et al.*, 1997; Morton *et al.*, 1995; Pamungkas *et al.*, 1994).

PRIMATE RESOURCE OPERATION

Background

Tinjil Island is located about 16 km off the south coast of West Java at 6° 56' 97" S, 105° 48' 70" E (GPS position fix: island base camp; see Fig. 1). The island is about 600 ha in size (6 km long and 1 km wide) and consists primarily of lowland, secondary tropical rain forest and coastal/beach vegetation. Before the longtailed macaques were introduced in 1988, the island was uninhabited by human beings or nonhuman primates.

The base of operation is located near the eastern end of the island. It consists of several permanent buildings and huts that provide storage facilities, living accommodations and office space for resident staff (5-8 individuals), visiting scientists, and students.

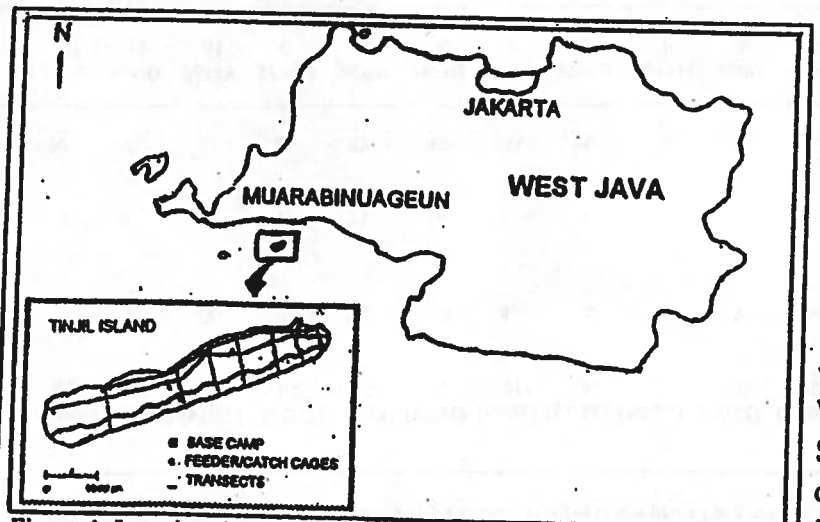

Figure 1. Location of the Tinjil Island Natural Habitat Building Facility

Several feeder/catch cages (12x6x2.5 m) distributed around the island (Fig. 1) serve as supplemental provisioning sites. They also function as trapping facilities for the periodic capture of monkeys for health assessment and harvest. A network of 10 transects (Fig. 1) provides access to most of the island. The trails are numbered at 25 m intervals to aid in identifying the locations of groups encountered during population census/surveys. The trails also provide convenient access to the feeder cages for food provisioning with the use of an all-terrain vehicle.

Logistical support for the Tinjil facility originates at the PSSP-IPB transit base camp located in Muarabinuangeun, a fishing village on the south coast of West Java, about 18 km from Tinjil (see Fig. 1). The Tinjil NHBF was established and managed during the first four years of operation by Chuck L. Darsono, D.Sc. (Hon.), a private entrepreneur who has been active in primate breeding and export for a number of years. Since January 1992, management of the NHBF has been the responsibility of PSSP-IPB.

Founder Stock

Between February 1988 and December 1994, a total of 520 adult long-tailed macaques (58 males and 462 females) were released onto Tinjil Island to establish a permanent breeding population. The monkeys were captured in West Java and in the Sumatran provinces of Lampung and South Sumatra. Before being released onto Tinjil, each monkey underwent a thorough quarantine and screening process including physical examination, age determination

(via dental eruption), tuberculin skin test (animals with a positive reaction were removed from the candidate population) and SRV screening protocol (described by Pamungkas *et al.* 1994 and Morton *et al.* 1995). The animals were also treated for intestinal parasites as required and each animal received a chest tattoo for identification purposes.

Population Management and Offspring Harvest

Beginning in 1991, the first group of progeny was removed from the Tinjil facility for use in AIDS-related research at the WaRPRC. Removal marked an important step in the facility's development as a primate resource operation. Offspring harvesting also has become an essential component of the population management program designed to ensure a stable, self-sustaining population.

Managing a natural habitat breeding colony requires a thorough knowledge of the population's demographics. Regular monitoring of demographic variables provides the best means of assessing the status of a population and the effectiveness of the management strategy. An annual census (see below) combined with computerized population modeling (Crockett *et al.*, 1996) has proven to be an effective approach in guiding management decisions such as establishing suitable harvest quotas that will ensure a self-sustaining population. More details on the current management practices and capture techniques are discussed elsewhere (Kyes *et al.*, 1997).

Twelve offspring harvests have taken place on Tinjil Island since June 1991. A total of 680 juveniles (416 males and 264 females), 1 to 3 years of age, have been removed from the island to date (see Table 1). Of this number, 400 have been sent to the WaRPRC. These animals have had a significant impact on the scientific advances in the Center's AIDS research program. This is perhaps best illustrated by the recent *Science* article by Tsai *et al.* (1995) who found that the experimental antiviral compound (*R*)-9-(2-Phosphonylmethoxy-

Table 1. Summary of Offspring Captures on Tinjil Island

	Number of Monkeys (Male/Female) by capture period												
Category	1 Jun91	2 Dec91	3 Jul92	4 May93	5 Dec93	6 Jun94	7 Dec94	8 Jun95	9 Nov95	10 Apr96	11 Dec96	12 Sept97	TOTAL
Captured	56	56	65	59	64	130	63	62	55	56	57	106	829
Died during Holding	0	0	2	3	1	1	4	11	0	0	0	0	22*
Released back to Island	6	6	18	5	9	9	6	34	5	20	3	6	127
Removed from Island	50 (28/22)	50 (24/26)	45 (22/23)	51 (27/24)	54 (29/25)	120 (76/44)	53 (28/25)	17 (13/4)	50 (21/29)	36 (22/14)	54 (29/25)	100 (60/40)	680 (416/264)

*Deaths that resulted from pythons that gained access to the temporary holding cage or apparent exposure (while in the holding cage) during unusually severe and extended periods of stormy weather. No deaths have occurred during actual capture.
* Harvest in progress number are not complete **) Total to date. harvest # 12 is still in progress

propyl) adenine (PMBA) safely blocked all traces of SIV infection in monkeys recently exposed to the virus. All the animals used in that study were from the Tinjil facility. In fact, Tinjil offspring have been used almost exclusively in the AIDS Therapies Projects at the WaRPRC.

The harvest of offspring also facilitates the routine health assessment of the animals captured (including adults). Once captured, all offspring and randomly selected adults are held in the temporary holding cage at the island base camp. Each animal is sedated and then given a physical exam, (re)tattooed, and tested for tuberculosis. A blood sample is collected for SRV screening. The information is then entered into a population-monitoring data base. Adults and offspring judged to be too young for removal from the island are returned to their respective social groups following assessment. Throughout the period of capture and holding, veterinary staff remain on the island to treat any health problems that might arise. All animals screened thus far have tested negative for tuberculosis and SRV, thus assuring the integrity of the SRV-free natural habitat breeding colony on Tinjil.

RESEARCH ACTIVITIES

Over the last several years, the Tinjil facility has developed into an active research station providing a range of research opportunities for both students and scientists. More than 150 students from Indonesia, as well as from Japan and the United States, have conducted research projects on Tinjil Island covering topics relating to primate biology and behavior, ecology, management and conservation. Some of these students have completed their senior honors and masters theses at the facility (Iskandar and Yanto, 1992).

Annual Census

Among the most ambitious research projects on Tinjil Island is an ongoing survey/census of the macaque population that has been conducted annually since 1990 (Kyes, 1993). Census data on demographic parameters such as birth rate and survivorship play a critical role in guiding the management of this breeding colony and monitoring its success.

Recent census data (Kyes, 1996) indicate that the monkeys are distributed throughout the island, with a disproportionate concentration in the eastern and central thirds of the island, near the original release site. Approximately 18-20 groups have formed on the island, 12 of which can be reliably identified by tattoos and/or physical features of group members.

Group size, composition, and reproduction estimates have been obtained from four of the 12 identified groups. These "sample" groups frequent the feeder cages, permitting the most complete counts of group members. Mean group size (1994-1996) for the sample groups has varied around 51 members, with an average of five adult males and 25 adult females per group. The number of young (juveniles and infants) in these groups fluctuates considerably as a result of the offspring harvests, the mean group size may be somewhat underestimated.

Estimates of reproduction (1990-1996) suggest an annual birth rate of 56-68%. Births occur during all 12 months of the year, a finding that is consistent with other studies of *M. fascicularis* (Kavanagh and Laursen, 1984; Lindburg, 1987; van Schaik and van Noordwijk, 1985). On the basis of our demographic data and population modeling, the population on Tinjil Island at the end of 1996 was estimated to be about 1450 monkeys (assuming an average birth rate of 60% and intermediate survivorship values; (Crockett *et al.*, 1996).

TRAINING ACTIVITIES

The Tinjil Island NHBF is ideally suited as a training facility for students who wish to obtain experience in field study methods and techniques. One of the major educational and training activities at the facility is the Field Course in Primate

Behavior and Ecology (conducted by R.C. Kyes), which has been offered annually since 1991. This 3-week field course involves daily lectures, demonstrations/exercises, individual projects, and apprenticeship training. To date, 57 participants, including university students, staff, faculty, and governmental staff (Forestry Department, PHPA) from around Indonesia, have completed the course.

In 1995, the Indonesian Field Study Program was established to facilitate training and research opportunities for American students at PSSP-IPB affiliated field and laboratory facilities in Indonesia. This international study program, directed by R.C. Kyes and based in the Department of Psychology at the University of Washington, has been conducted at the Tinjil facility for the past 3 years. To date, a total of 12 students (including both undergraduate and graduate) have participated in the 4-week program. Students receive training in basic primatology and field study methods and complete an independent research project of their choice. This program is conducted concurrently with the Field Course (noted above), thus allowing the opportunity of cultural exchange and research collaboration among participants (Novak *et al.*, 1996).

Training activities such as these play an important role in promoting a greater understanding of primatology, an appreciation of biodiversity, and an awareness of the need for effective conservation and management practices. The success of the Tinjil training program has prompted other Indonesian universities to request similar course offerings for their students and staff. Plans are currently underway to provide a Field Course in Primate Behavior, Management and Conservation for participants from the Univeristy of Sam Ratulangi in Manado, North Sulawesi. The course is scheduled for May 1998 and will be conducted at the Tangkoko-Duasudara Nature Reserve, home to a population of crested black macaques (*Macaca nigra*) and spectral tarsiers (*Tarsius spectrum*).

DISCUSSION

The Tinjil Island NHBF possesses a unique combination of features making it, to the best of our knowledge, the first of its kind among primate resource operations around the world. (1) The Tinjil facility was established in a habitat country for the purpose of breeding an indigenous species. (2) The animals were introduced into an uninhabitated area with a native forest and natural boundary, thereby facilitating the management of a free-ranging breeding population. (3) The colony was established as an SRV-free population to ensure a major source of virus-free animals for specific biomedical research.

The facility's strength lies not only in its function as a resource operation but also in its role as a conservation program (Kyes *et al.*, 1995; 1997) and through its success as a field station for primate research and field training. These achievements have prompted the Indonesian government and state forestry company (Perum Perhutani) to consider designating other islands as sites for the natural habitat breeding of primates.

NHBFs will undoubtedly become one of the primary resource options for maintaining the availability of high-quality, bred-for-purpose primates for use in important biomedical research around the world. The Tinjil Island NHBF is a multifaceted operation that should serve as a model for future primate resource and conservation programs.

FOOTNOTES

1 Bowman Gray School of Medicine and the Oregon RPRC are no longer active participants in the NHBF project described here. Bowman Gray has since established collaborative projects with PSSP-IPB related to their own research interests.

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