Monyet Yang Dihargai, Monyet Yang Dibenci: The Human–Macaque Interface in Indonesia

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Chapter 10
Monyet Yang Dihargai, Monyet Yang Dibenci: The Human-Macaque Interface in Indonesia*

Jeffrey V. Peterson and Erin P. Riley

10.1 Introduction

The worlds of human and nonhuman primates are increasingly overlapping. The term "interface" aptly encapsulates all aspects of the relationships linking together human and nonhuman primates, that is, their dynamic interaction in their shared environment. It is now well understood that there is a long history of sympatry between populations of human and nonhuman primates, one that has experienced many types of changes but most notably in the degree of negative influence from humans. With this knowledge, we can no longer assume that any given nonhuman primate population is absolutely free from human influence. This influence may be most visible in the form of bushmeat markets or anthropogenic habitat conversion but can also be more subtle such as with long-term effects on individual or group level nonhuman primate fitness. Additionally, researchers have become increasingly interested in the epidemiological significance of this interface. Zoonoses co-affecting human and nonhuman primates are continually being researched, providing more detailed information on diseases already familiar to us and occasionally even leading to new zoonoses being discovered (Engel et al. 2006).

While there is considerable variability in the nature of the human-nonhuman primate interface in different areas of the world, a common thread is the concept of space. The overlapping lives of human and nonhuman primates often result from limitations of space and the increasing necessity to share. Much of the human-nonhuman primate interface can be understood by examining how both groups react to sharing space with each other, historically as well as in more recent contexts. Methods in behavioral observation are useful for exploring the reactions of our

*The Revered Monkey, the Despised Monkey

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nonhuman primate cousins, while ethnographic techniques focusing on perceptions of local nonhuman primates are proving to be strong indicators of our own attitudes (Lee and Priston 2005).

The purpose of this chapter is to discuss the diverse ecological and cultural facets of the human-macaque interface in Indonesia and explore how these facets intersect to result in a constantly shifting relationship between commensalism and conflict, tolerance and intolerance, and reverence and disdain throughout the country. We begin by describing the high level of macaque species diversity in Indonesia, the ecological contexts in which they are found, and the concomitant cultural diversity of the archipelago. We then explore the ecological (anthropogenic habitat disturbance, crop raiding, hunting, and disease transmission) and cultural (mythology, folklore, and religion) facets of the human-macaque interface. To provide depth to this discussion, we present preliminary findings from a case study of Balinese transmigrant communities in South Sulawesi that aims to understand how Balinese perceptions of macaque sacredness (or reverence) may be impacted by their migration to a new environmental context outside of Bali. We conclude by discussing potential future directions of the human-macaque interface and its relevance for future research and conservation efforts.

10.2 Macaque Species Diversity and Ecological Context

10.2.1 Indonesian Macaques

Macaca is the most geographically widespread nonhuman primate genus and one of the most speciose (Abegg and Thierry 2002). Indonesia is home to ten different macaque species, making it the greatest number of macaque species within a single habitat country (Table 10.1). Of these ten species, *M. fascicularis* is of least concern (IUCN 2010), six are listed as vulnerable (*M. brunnescens, M. hecki, M. nemestrina, M. nigrescens, M. ochreata*, and *M. tonkeana*) (IUCN 2010), one is endangered (*M. maura*) (IUCN 2010), and two are critically endangered (*M. nigra, M. pagensis*) (IUCN 2010).

10.2.2 Macaque Habitat Ecology

There are over 17,000 islands in the Indonesian archipelago that together comprise a wide range of ecological systems. Macaques occur primarily in the western half of Indonesia and extend as far east as the island of Sulawesi. Within this area, the ecological contexts in which macaques are located fall into three main categories: urban/temple environments, protected forest areas, and forest-farm matrix. These three environments, however, are not closed ecological systems. There are many

Table 10.1 Indonesian macaque species

Macaca species	Common name	Geographic location	Habitat[a, b]
1. *M. fascicularis*	Long-tailed	Sumatra, Java, Bali, Kalimantan	UT/PA/FFM
2. *M. pagensis*	Mentawai	Mentawai Islands	FFM
3. *M. nemestrina*	Pig-tailed	Sumatra, Kalimantan	FFM
4. *M. tonkeana*	Tonkean	Central Sulawesi	PA/FFM
5. *M. nigra*	Black crested	Northeastern Sulawesi	PA/FFM
6. *M. nigrescens*	Gorontalo	North Sulawesi	PA/FFM
7. *M. hecki*	Heck's	Northwestern Sulawesi	PA/FFM
8. *M. maura*	Moor	Southwestern Sulawesi	PA/FFM
9. *M. ochreata*	Booted	Southeastern Sulawesi	PA/FFM
10. *M. brunnescens*	Buton	Buton and Muna islands	PA/FFM

[a]*UT* urban/temple environments, *PA* protected areas, *FFM* forest-farm matrix
[b]Source: IUCN (2010)

instances of these ecological contexts neighboring each other or even overlapping. As a result, a single macaque population may find each of these three contexts within its home range.

The urban/temple environmental context is an almost exclusively Balinese phenomenon. The continuous presence of large macaque populations at Hindu temple sites has been well documented (Wheatley 1999; Loudon et al. 2006; Fuentes et al. 2007). These locations constitute urban environments in which Indonesian macaques are able to thrive, though this is not always the case. It has been recently suggested that the long-term close relationship between humans and macaques at the Balinese temple sites may have negative health effects for the macaques such as low-quality diet and bidirectional disease transmission (Lane et al. 2010).

Many of the Indonesian macaques exist in forested habitats that have been designated as protected areas. Given the high levels of biodiversity across the archipelago, protected area conservation is the dominant model of conservation. There are a total of 965 protected areas in Indonesia, representing 12.5% of the total land cover (WRI 2006). Outside of Bali, the existence of protected area habitat may be critical for those species living in areas with high human population densities. For example, the endangered crested black macaque, which occurs in the northeast corner of Sulawesi where human population density is the highest (132 individuals/km^2) (BPS 2000), has been found to maintain stable populations only in areas protected by government mandates, although still in close contact with humans through ecotourism (Melfi 2010).

The forest-farm matrix is the predominant setting for the human-macaque interface in Indonesia (Riley and Priston 2010). The primary issue is that agricultural crops (both subsistence and cash) are planted and cultivated where forest once stood. As a result, these crop gardens typically share a border with macaque forest habitats, thereby simultaneously facilitating foraging access for the macaques and hampering farmers' ability to defend their crops. Crop raiding often causes local farmers to have negative perceptions of nonhuman primates (Lee and Priston 2005). Therefore, the prevalence of the forest-farm matrix may indicate that a large part of the human-macaque interface in Indonesia is characterized by conflict.

10.3 Ethnic and Religious Identity in Indonesia

Within the Indonesian archipelago, there are 6,000 inhabited islands that together hold a population of over 245 million people (CIA 2011). As one of the world's largest populations, Indonesia is also one of the most culturally diverse. The number of distinct ethnic groups has been counted as over 300 (Hoey 2003). Each of these cultures has their own language, cultural traditions, and customary practices, which creates a wide range of ethnicities that comprise Indonesian society. To linguistically unite this diverse archipelago, *Bahasa Indonesia* was made the national language and is taught throughout Indonesia from elementary school onward, along with English. This prioritization of *Bahasa Indonesia* is becoming more and more useful as intercultural contact is increasing in frequency through the ease of intra- and interisland travel and communication.

The Indonesian transmigration program has played a large role in facilitating intercultural contact. This government-sponsored program was funded largely by the World Bank and was intended to alleviate increasing population pressure on the islands of Java, Bali, Lombok, and Madura (Whitten et al. 1987; World Bank 1988). Approximately 334,581 people were relocated between the years 1956 and 1974, well below the goal of roughly three million (Davis 1976). While this program technically ended after the 1980s, unsponsored transmigrants still migrate out of Bali or between transmigrant sites already located on the other islands (World Bank 1988).

Indonesia's cultural diversity is also manifested in people's religious identity. While most Indonesians identify with one of the five officially recognized religions (Islam, Protestant Christianity, Roman Catholicism, Hinduism, and Buddhism (Schiller 1996)), many still adhere to pagan beliefs and traditions (Atkinson 1983). The vast majority of citizens (86.1%) are Islamic, followed by Protestant (5.7%) and Roman Catholic (3%) (CIA 2011). These broad religious categories serve to unite many otherwise very different ethnic groups throughout Indonesia.

10.4 The Human-Macaque Interface: Ecological Facets

10.4.1 Anthropogenic Habitat Alteration

Anthropogenic habitat alteration via such activities as selective logging and forest fragmentation can have a negative impact on nonhuman primate livelihoods, especially when key food species are eliminated within the nonhuman primate group's range. Researchers interested in the potential effect of anthropogenic habitat disturbance on nonhuman primate populations' habitat quality often focus on changes in population size and density (e.g., Bishop et al. 1981; Marshall et al. 2006; Paciulli 2010). Some argue the need for measuring direct effects (Marshall 2010), while others suggest that habitat quality can be indirectly affected through the accumulation of multiple factors whose effects are not immediately visible. Ways of measuring this gradual impact are through increased energy costs (Riley 2008), higher instances of

inbreeding (Melfi 2010), and even changes in the trophic level at which a population feeds (Gibson 2011).

Although anthropogenic habitat alteration typically results in lower quality food availability for nonhuman primates (Johns 1986; Felton et al. 2003), the behavioral and dietary adaptability of many macaque species allows them to persist in areas of disturbance (Riley 2007a). Such adaptability, however, may result in higher energetic costs that may not be adaptive in the long term. A group of Tonkean macaques in a heavily altered forest site was found to have daily path lengths similar to a second larger group inhabiting a relatively undamaged forest (Riley 2008). These relatively long daily paths for the small group were also confined to a smaller overall range, forcing the macaques to exploit the same parts of their home range more intensively than the other group (Riley 2008). Furthermore, home range adjustments become more difficult as high-quality habitats become smaller and spaced further apart (Melfi 2010). Small macaque populations are particularly vulnerable to habitat fragmentation because isolation from other groups decreases opportunities for gene flow and increases potential for the negative genetic effect of inbreeding (Melfi 2010). Disturbed or fragmented forest areas, however, should not be ignored by conservationists because incorporating mildly degraded forest areas into conservation strategies may be beneficial in terms of the future habitat carrying capacity, as has been suggested specifically for *Pongo pygmaeus morio* in Borneo (Marshall et al. 2006), but may be suitable for the highly adaptable macaque species' habitats as well (Paciulli 2010).

10.4.2 Crop Raiding

Anthropogenic habitat disturbance in the form of forest conversion for agricultural plots has a twofold effect on the habitat: it decreases the amount of forest habitat for the macaques and replaces it with a new and potentially appealing food source. As these forest-edge gardens can be located near to, or perhaps inside of, local macaque home ranges the monkeys can easily access the converted land to exploit the new resource in the area. Farmers see this as destructive behavior that is responsible for decreasing their crop yields and damaging their livelihoods. This forest-farm matrix scenario is common throughout Indonesia and represents a major source of tension. The forest-farm matrix can therefore be seen largely as both a *product* of anthropogenic habitat conversion and *source* of conflict with nonhuman primates through crop raiding.

The expansive range and large group size of macaques, along with their omnivorous, adaptable diet and high levels of intelligence are often cited as characteristics responsible for their success as crop raiders (Hill 2005; Lee and Priston 2005; Riley 2007b; Paciulli 2010). If macaque populations are frequent and successful crop raiders, this aspect of their behavior is likely to create the most powerful opinions and receive the strongest reactions from local humans. Often, farmers' tolerance of macaques is negatively correlated with high levels of *perceived* raiding: the more macaques are believed to destroy crops, the lower overall tolerance plantation owners feel for them. For example, in Lore Lindu National Park, Central Sulawesi, Riley (2007b)

investigated the relationship between perceived levels of crop raiding and farmers' attitudes towards the local macaques. At this site cacao (*Theobroma cacao*) is consumed opportunistically by nearby Tonkean macaque populations (Riley 2007b). The large-bodied Tonkean macaques are conspicuous crop raiders that are not afraid of entering gardens, even when the farmer is present, and so have been characterized as detrimental to cacao production by many farmers in the area (Riley 2007b). The farmers in this study typically believed that macaques are the most frequent crop-raiding animal species and consume nearly 75% of their cacao crop (Riley 2007b). Quantitative measurements of crop losses, however, determined that the macaques were actually causing less crop damage than forest rats (Riley 2007b). This discrepancy may help foster more positive opinions regarding the Tonkean macaques, but it has to be understood by the local farmers if their opinions are going to change.

Many factors may influence farmers' perceptions of crop raiding, but the conspicuousness of potential raiders may be primary. Sumatran farmers who experience crop raiding from wild boars, pig-tailed macaques, and several other animal species incorrectly identified the wild boars as most destructive, when in fact it was the macaques (Linkie et al. 2007). Regardless of the actual damage to crops by macaques versus other animal species, humans are going to react according to their perceptions of the circumstances (Lee and Priston 2005; Riley 2007a). Therefore, in the future, it may be prudent to think about crop-raiding prevention strategies that are not only effective in lowering crop-raiding instances but are also effective at demonstrating actual levels of crop loss. Priston and Underdown (2009) have demonstrated how individual farmers can predict their risk of future crop loss by introducing a pest- and crop-specific formula that determines potential losses based on current losses. Risk is determined through an incidence rate that farmers can calculate by dividing the total number of damaged plants by the total number of plants at risk of being damaged (the sum of the damaged and undamaged plants) for a single crop species (Priston and Underdown 2009). This formula can be used throughout the year to establish seasonal variation in crop raiding (Priston and Underdown 2009), which is known to occur by crop type and pest species (Linkie et al. 2007). This simple method can assist farmers in choosing which crops to plant or not plant based on each crop's determined vulnerability to a particular pest (Priston and Underdown 2009). Other proposed strategies to mitigate crop raiding without harming macaques or other taxa include establishing buffer zones of preferred foods (Riley and Fuentes 2011) or physical barriers (Hockings and Humle 2009), taste aversion techniques, and guarding (Hill 2005).

10.4.3 Hunting

In Indonesia, macaques are hunted for a variety of reasons such as retaliation from crop raiding (Riley and Priston 2010), for consumption in ceremonial meals (Jones-Engel et al. 2005; Melfi 2010), to be kept as pets for a variety of different ends (Jones-Engel et al. 2005), and, more rarely, for medicinal application (Alves et al. 2010;

Peterson, unpublished data). Farmers have occasionally admitted to shooting raiding macaques opportunistically (Riley and Priston 2010), but in Sulawesi, they also frequently trap macaques to keep as pets (Jones-Engel et al. 2005). These pet macaques are typically either eaten or sold in the market for profit (Jones-Engel et al. 2005). Market-based hunting practices, as opposed to subsistence-based, are especially dangerous to protected animal species because the hunters are searching for higher economic gains through larger quantities of animals captured (Lee 1999). Research has suggested that demand for bushmeat in Sulawesi is on the rise and that hunting practices are becoming more sophisticated and intensified (Lee 1999; Lee et al. 2005; Melfi 2010). The critically endangered Sulawesi black-crested macaque is exceptionally vulnerable to increased hunting activity given its shrinking population and geographical proximity to the large bushmeat markets and human population densities (Melfi 2010). Bushmeat is also being brought to North Sulawesi from other provinces, causing animal species all over the island to be affected by this high demand (Lee et al. 2005). Large-scale markets like those in North Sulawesi may not be as prevalent across the rest of Indonesia due to many Muslim populations not participating in the capture and consumption of several wild animal species, such as monkeys (Lee et al. 2005). Hunting, however, does still occur in other parts of Indonesia such as Borneo (Marshall et al. 2006; Wadley and Colfer 2004), Java (Supriatna 2006), and Sumatra (Wheatley et al. 1999).

It has also been suggested that hunting pressures may actually be more damaging to nonhuman primate populations than other anthropogenic activities, such as habitat alteration (Marshall et al. 2006). Bornean orangutans (*P. pygmaeus morio*), whose slow life history patterns makes them inherently more susceptible to hunting, were found to have lower population densities when hunting pressures from nearby villages were present (Marshall et al. 2006). These population densities were more strongly correlated to hunting pressure proximity than logging intensity (Marshall et al. 2006). The hunting pressures experienced in this study were largely for private consumption or medicinal use (Marshall et al. 2006) and would fall under the category of "subsistence hunting," as opposed to the more intense commercial hunting that characterizes the bushmeat markets of North Sulawesi (Lee 1999). Therefore, unlike low- to mid-level anthropogenic habitat alteration, even low levels of hunting may be enough to negatively affect nonhuman primate population densities (Marshall et al. 2006). It is worth noting that low-intensity logging and forest fragmentation may have indirect effects on nonhuman primate populations by easing access into high-quality habitats for local hunters (Melfi 2010).

10.4.4 Disease Transmission

Researchers are increasingly interested in the epidemiological relationship between macaques and humans, especially in Indonesia. This interest may have been intensified by the recent discovery of the simian foamy virus (SFV), a zoonotic retrovirus, in both long-tailed macaques (*Macaca fascicularis*) and

Balinese temple employees (Engel et al. 2006). Although SFV is carried by Old World and New World monkeys, Balinese monkey temples have become primary locations for research on this pathogen as they experience a constant flow of tourists and employees who come into contact with monkeys on a daily basis (Engel et al. 2006). The risk for disease exchange between macaques and humans is significantly increased any time there are sustained interactions between the two species. Along with tourism activity, the pet trade has also been cited as a primary context of zoonotic disease transmission (Jones-Engel et al. 2005). The risk of catching diseases from macaques may result in widespread disregard for macaque populations in the future (Fuentes 2006).

It is important to note that close contact between human and nonhumans primates can have epidemiological implications for the macaque populations as well. Jones-Engel et al. (2004) found that in a large sample of pet macaques taken from across Sulawesi many were infected with intestinal parasites common in humans. These results suggest that the unique environment of pet monkeys, characterized by their high levels of contact with and reliance on nonprofessional human caretakers, causes their parasite load to differ substantially from that which is expected for wild macaque populations (Jones-Engel et al. 2004). Additionally, these anthropogenic parasite loads on pet macaques can be spread to wild populations through contact between the pets and wild individuals (Jones-Engel et al. 2005). Nonendemic pathogens can be introduced to wild macaque populations if the local pets are brought from a different island and contain nonendemic parasite loads (Jones-Engel et al. 2005). This transfer of novel pathogens may have important consequences for the health of wild macaque populations. Aside from disease transmission, there are physiological consequences for the macaques that experience frequent contact with humans such as increased stress levels, which bring with them consequences for individual macaque health as well as developing antisocial behavior towards humans (Lane et al. 2010).

Overall, there are many pathogens that can be cross transmitted between macaques and humans in Indonesia. The contexts in which zoonotic transmission are most frequently studied include Balinese monkey temples (Engel et al. 2006; Lane et al. 2011), markets (Malone et al. 2002), and among pet/performance monkeys (Jones-Engel et al. 2004; Schillaci et al. 2006). Below (Table 10.2), we have listed some of the most prominent pathogens that are shared among humans and macaques in Indonesia and the typical direction of transfer.

10.5 The Human-Macaque Interface: Cultural Facets

10.5.1 Mythology and Folklore

Where spatial overlap between human and nonhuman primates has a deep historical context, nonhuman primates may often be included in aspects of cultural mythology and folklore. An important aspect of the ethnoprimatological framework is focusing

Table 10.2 Bidirectional disease transmission

Pathogen	Type	Direction	Source
Entamoeba coli	Protozoon	Human → macaque	Jones-Engel et al. (2004)
Blastocystis hominis	Protozoon	Human → macaque	Jones-Engel et al. (2004)
Iodamoeba bütschlii	Protozoon	Human → macaque	Jones-Engel et al. (2004)
Entamoeba hartmanni	Protozoon	Human → macaque	Jones-Engel et al. (2004)
Endolimax nana	Protozoon	Human → macaque	Jones-Engel et al. (2004)
Chilomastrix mesnili	Protozoon	Human → macaque	Jones-Engel et al. (2004)
Ascaris spp.	Helminth	Human → macaque	Jones-Engel et al. (2004)
Trichuris spp.	Helminth	Human → macaque	Jones-Engel et al. (2004)
Hookworm	Helminth	Human → macaque	Jones-Engel et al. (2004)
Measles	Virus, respiratory	Human → macaque	Schillaci et al. (2006)
Rubella	Virus, respiratory	Human → macaque	Schillaci et al. (2006)
Parainfluenza 2 and 3	Virus, respiratory	Human → macaque	Schillaci et al. (2006)
Simian foamy virus	Retrovirus	Human ← macaque	Engel et al. (2006)
Herpesvirus B	Virus	Human ← macaque	Engel et al. (2002)

on situations where nonhuman primates have been included in the symbolic worldviews of humans and how that symbolism affects human attitudes towards them (Riley et al. 2011). Mythology often serves the dual purpose of entertainment and philosophical speculation, demonstrating the society's understanding of the ecological processes around them (Shepard 2002). When mythical tales focus on a specific animal species, anthropomorphizing the animal aids in demonstrating the storyteller's perspective regarding particular aspects of the human condition such as illness, death, and even desirable or undesirable personality traits (Shepard 2002). Nonhuman primates are ideal characters in mythology due to their readily observable behaviors and habits which can easily be interpreted as analogues to aspects of human behavior (Mullin 1999).

One outcome of folklore and mythology can be the local conservation of a particular species due to preexisting taboos against harming them. Taboos are often associated with folklore and mythology and protect species by virtue of cultural custom (Colding and Folke 2001; Saj et al. 2006). In contrast to formally prescribed prohibitions, informal self-imposed and self-monitored cultural conventions or norms protect specific habitats by regulating adherents' interactions with the environment in terms of resource access and use (Colding and Folke 2001). Habitat taboos are often associated with religious or spiritual perceptions of sacredness that facilitate the habitat's protection (Colding and Folke 2001). Plant and animal species within the habitat are often protected under these taboos by extension, through bans on hunting, fishing, and harvesting any of the resources therein (Colding and Folke 2001).

Forest patches receiving protection under such taboos are commonly referred to as *sacred groves* (Baker et al. 2009; Colding and Folke 2001). Often located within these sacred groves are shrines possessing a religious or spiritual significance that is then applied to the entire area surrounding them (Baker et al. 2009; Colding and Folke 2001). Although these sacred forest sites are of spiritual and ritual importance

that can occasionally contribute to habitat conservation (Baker et al. 2009; Saj et al. 2006), rich wildlife diversity within them may also present hunting opportunities for local residents (Wadley and Colfer 2004). Aside from sacred grove hunting, perceptions of sacredness themselves are subject to change over time as cultural groups can outgrow the taboo which a conservation program has attempted to bind them to (Baker et al. 2009). Furthermore, recent migrants to an area will not typically share local peoples' cultural taboos and therefore freely hunt, trap, or kill a "protected" species if the opportunity arises (Colquhoun 2005; Riley 2007b). Riley's (2007b) research on macaque folklore in Central Sulawesi, Indonesia suggests that differing cultural beliefs between separate ethnic groups complicates the idea of structuring permanent conservation programs on the customs of one group when others have equal access to the same resources. For example, recent migrants to Lore Lindu National Park do not share the same level of reverence for local Tonkean macaques as some of the indigenous members of the community (Riley 2010). This difference is attributed largely to the migrants' lack of cultural associations with Tonkean macaques. Additionally, temporary migrants to an area may have a deleterious effect on local ecology because they are less inclined to pursue sustainable patterns of resource use during their short-term occupation (Hill 2005).

Mythology and folkloric knowledge can also instruct people as to which nonhuman primate species they *should* consume. Many species in Indonesia are reportedly used in traditional folk medicine (Alves et al. 2010). For instance, in parts of Indonesia, macaque liver is believed to cure asthma, while the flesh, though not having medicinal properties, is enjoyed for its uniquely "hot" flavor (Peterson, unpublished data). The existence of these cultural preferences for nonhuman primate consumption adds complexity to the human-macaque interface in Indonesia, where the diversity of cultural practices, mythology, and folklore can result in species protection as well as exploitation.

10.5.2 Religion

Much of the work regarding the religious component of the human-macaque interface in Indonesia has taken place in the Balinese monkey forests and sacred temple sites. The current interspecies relationships displayed in these locations are representative of the extensive history of sympatry between humans and long-tailed macaques (*Macaca fascicularis*) on Bali (Loudon et al. 2006; Wheatley 1999). The sacred forests around the *Pura Dalem*, or funerary temples, are colloquially known as "monkey forests" when the macaques inhabit them (Fuentes et al. 2005; Wheatley 1999). Like the forests, monkeys associated with these temple sites may be considered sacred and offered a degree of protection as a result (Fuentes et al. 2005; Loudon et al. 2006; Wheatley 1999). Many of the larger monkey forest temples provision the local macaques, keeping them in the area to serve the additional purpose of tourist attraction (Fuentes et al. 2007). Fuentes et al. (2007) believe that along with religious taboos, tourism may be advantageous to the macaques by providing them

with additional food sources from the tourists and a decreased risk of predation. These advantages for the macaques are mirrored by the increased economic incentive for the local inhabitants to keep them protected as well (Fuentes et al. 2007). A potentially negative result of increased tourism is disease transmission between macaques and humans (Engel et al. 2006; Fuentes 2006). Diseases that move from macaques to humans may end up fostering negative opinions of the sacred macaques in these tourist sites.

The integration of temple sacredness with the surrounding environment on Bali is embedded in the unique form of Hinduism practiced there. Balinese monkey forests are characterized by the philosophical concept of *Tri Hita Karana*, which states that the production of goodness and well-being is only possible through harmonious interaction between the three elements of the world: God, man, and nature (Jensen and Suyrani 1992; Wheatley 1999). The Balinese funerary temples and the associated monkey forests represent a convergence point for the aforementioned religious, ecological, and economic factors resulting in taboos on harming the macaques and their habitat. It is here, within these temple sites and sacred grounds, that interactions between the Balinese people and macaques have largely been examined (e.g., Wheatley 1999; Loudon et al. 2006; Fuentes et al. 2007).

10.6 The Paradox of Macaque Sacredness

Recently, the characterization of "ubiquitous sacredness" among Balinese macaques and their protected status has been called into question (Loudon et al. 2006; Schillaci et al. 2010). These authors suggest that sacredness may only be applied to long-tailed macaques in sacred temple spaces and that when found outside of this context, they are treated as pest animals. This may be related to their economic significance in Balinese temples where tourism has become a profitable enterprise in contrast to potential profit loss through crop raiding by these same macaques in a different spatial context (Fuentes et al. 2007; Schillaci et al. 2010). Drawing upon this important notion of spatial context are inquiries into Balinese perceptions of macaque sacredness outside of Bali as well. Previous research has suggested that Balinese transmigrants in Sulawesi do not regard the local macaques as sacred (Jones-Engel et al. 2005). These conclusions, however, have not yet been systematically investigated in a study of their own.

The Hindu population of Sulawesi is derived almost exclusively from Balinese transmigrants (Davis 1976; Whitten et al. 1987). Many Balinese people moved to Sulawesi as part of the transmigration program instituted by the Indonesian government in the 1950s which officially extended into the 1980s (Davis 1976; World Bank 1988). As a result, thousands of Balinese families have relocated to other areas in Indonesia, including the eastern Indonesian island of Sulawesi (Davis 1976; Whitten et al. 1987). The Balinese transmigrants in Sulawesi now reside in transmigrant communities where their religious and ethnic identities have remained intact (Jones-Engel et al. 2005). The transmigrant areas, however, vary geographically

and ecologically from the small mountainous island of Bali, which may influence transmigrant perceptions of their new space. The new environmental surroundings also lack Bali's long history of human occupation, especially regarding the incorporation of religiously symbolic landscapes and ancient temple sites. All Balinese Hindu temples in Sulawesi have been constructed by the transmigrants upon their arrival. Therefore, any reverence that is observed for Sulawesi macaques by the Balinese transmigrants need not be the result of their long-standing occupation of sacred grounds. Instead, this could be a feeling that was brought with them from Bali and applied to the new transmigrant space in Sulawesi.

One of us (Peterson) is currently exploring whether the relocation of Balinese transmigrants to South Sulawesi has affected their perceptions of macaque sacredness and, if so, to what degree does that alter the two species' interactions and coexistence. The major ethnic groups known to inhabit the research area (Luwu Timor district) are the Toraja Kaili, Pamona, and the coastal Bugis – Makassar Bugis (Davis 1976; Whitten et al. 1987). Through transmigration, families from Bali were relocated to the Kalaena transmigrant settlement (Roth 2009). Transmigrants from Java are also located within this region, and villages are comprised of solely Balinese or Javanese transmigrants, or are a mixed population with native residents as well (Roth 2009).

Preliminary results support the suggestion that perceptions of macaque sacredness are, indeed, more strongly tied to space than to an inherent holiness of monkeys in the eyes of Balinese Hinduism (Jones-Engel et al. 2005; Schillaci et al. 2010). After responding that the local booted macaques (*Macaca ochreata*) were not considered sacred, many of the transmigrants specified that this is because they do not live in temple sites like the macaques in Bali (Peterson, unpublished data). Therefore, the respondents in this study appear to make important distinctions between forest monkeys and temple monkeys when asked to explore their own perceptions of macaque sacredness.

One issue closely tied to this spatial factor is the level of macaque habituation. The fact that these booted macaque populations live in the forest-farm matrix neighboring transmigrant villages causes them to come into far less contact with humans than the long-tailed macaques that reside in the urban/temple environment of Bali. When discussing interactions with *M. ochreata*, respondents often lamented that these monkeys are too afraid of humans and always run away if they meet (Peterson, unpublished data). This is not surprising as the majority of these interactions occur when villagers enter the forest to search for wood, or with dogs to hunt pigs or monkeys. These interactional contexts are not conducive to habituation, and the lack of a centralized living space for the macaques like the temple complexes in Bali makes it difficult to conceive of the booted macaques becoming habituated to local villagers.

Along with the fearful behaviors of unhabituated macaques, crop raiding has been cited as one of the primary behavioral characteristics preventing the booted macaques from being considered sacred (Peterson, unpublished data). These two behavioral issues (crop raiding and unhabituated behaviors) are inevitably linked together as crop raiding can cause response hunting, which in turn reinforces the unhabituated behaviors. Included in our definition of "unhabituated behaviors" are

things listed by the respondents such as running away from humans, not "wanting" or being able to adapt to humans, and being untame or "wild" in general (Peterson, unpublished data). The relevance of macaque behavior for its effect on perceptions of macaque sacredness is supported by recent research suggesting that even the long-tailed macaques in Bali are dissuaded from crop raiding by farmers with the use of pellet guns (Schillaci et al. 2010). Additionally, *M. fascicularis* are often chased out of gardens and even hunted and eaten near temple areas less frequented by tourists where the macaques are less habituated to humans and unprotected (Loudon et al. 2006). These findings suggest that even in Bali there is no ubiquitous sacredness for temple monkeys if they begin to interfere with farmers' livelihoods in the forest-farm matrix. This same principle seems to hold true for the Balinese transmigrants and their relationship with the booted macaques of Sulawesi.

10.7 Conclusions

In this chapter, we describe the multifaceted nature of the human-macaque interface in Indonesia. We see this interface as being divided into three major environmental settings: urban/temple, protected forest area, and forest-farm matrix. As we have established, these environmental settings often overlap or appear contiguously, and therefore, a number of the Indonesian macaque species are associated with more than one of these environmental contexts. This ecological diversity presents a dynamic spatial setting for the human-macaque interface, with intricacies that should be addressed in future ethnoprimatological inquiries. Riley (2006) suggests incorporating primatological methodology to record both aspects of macaque behavioral ecology and the extent of their interaction with local humans, as well as ethnographic methodology to understand why humans believe these interactions are taking place and the cultural importance attributed to them. This mixed methodologies approach can help uncover the nuanced relationships between humans and macaques, specifically how these relationships vary throughout the different environmental contexts in which they occur.

Primatological studies that focus on the human-macaque interface are as timely now as ever and will continue to be relevant in the future. The increasing human population in Indonesia and around the world is resulting in expanded contexts for contact between human and nonhuman primates, providing indefinite opportunities for new inquiries. Knowledge gained through investigations into the human-macaque interface has both theoretical and applied significance (Riley and Fuentes 2011). Theoretically, such explorations contribute to our understanding of how human behavior shapes the socio-ecological pressures that act upon primates and other organisms across landscapes and ecosystems (Riley and Fuentes 2011). One example is the increasingly studied epidemiological landscape of the human-macaque interface. It has been demonstrated that increased contact between macaques and humans can introduce novel zoonotic pressures on wild macaque populations through direct contact with humans (Engel et al. 2006; Fuentes 2006)

or indirectly through pets (Jones-Engel et al. 2005). Studying the intricacies of this epidemiological landscape can address the situations in which both macaques and humans are most at risk of disease transmission and how these risks can best be mitigated.

Another future direction might be to explore how the predominant context of the human-macaque interface, the forest-farm matrix, and specifically access to cultivated foods is shaping macaque biology and behavior. Significant dietary changes from forest to cultivated foods that would otherwise be inaccessible in pristine forest (i.e., cacao, corn, cassava) may affect various aspects of macaque biology, health, behavior, and ultimately, fitness. Some of the behavioral changes that may accompany this dietary shift include traveling and foraging patterns. The range over which macaques traverse may be altered due to the inclusion of cultivated lands. Also, larger macaque groups may split off into smaller "foraging parties" to avoid detection from local humans when they enter the cultivated foraging grounds. Foraging for primarily cultivated foods may require other adaptations to avoid human aggression, such as foraging at times when fields are free of people or carrying food off-site to eat in safety later. Macaque cheek pouches may be especially helpful in facilitating the latter of these potential behavioral adaptations. Incorporating more cultivated food sources into macaque diets may also provide opportunities for changes to occur in their communication systems that are relevant to the new feeding context.

The applied contributions of inquiries into the human-macaque interface are largely in the area of conservation. The long-term holistic studies we suggest in this chapter can integrate conservation approaches that are known to be appropriate for a given environmental setting and tailor them to the specific cultural and ecological facets of the new area. Using informal institutions (e.g., habitat taboos) for the basis of conservation programs may be effective in this light, but it comes with caveats. One caveat, as outlined by Riley (2010), is the potentially narrow scope of taboos that may only apply to one specific animal species or a small patch of land. These taboos may not be easily extended to encompass the entire ecosystem in which the taboo is upheld (Riley 2010). Furthermore, as taboos are typically specific to a single ethnic group, the migration of a different one into the area may make the established conservation program based on local taboos difficult to enforce (Colquhoun 2005; Riley 2010). Therefore, future conservation-oriented research should describe the effective and ineffective aspects of informally protected resource and habitat taboos to add depth to our understanding of the cultural factors affecting habitat protection. As previously demonstrated, the spatial context in which macaques and the Balinese interact appears to be fundamental in guiding the cultural and ecological manifestations of their relationship. In the forest-farm matrix, cultural notions of macaque sacredness are sometimes forgotten in the interest of protecting farmers' crops, which indicates an important distinction between protected spaces for symbolically religious reasons and spaces that need to be protected for subsistence purposes. Because the potential for conflict is much higher in the forest-farm matrix than the other environmental contexts, applied conservation programs will benefit from understanding the difficulties and potential conservation roadblocks that come as a result of this forest-farm matrix conflict.

The intersection of the ecological and cultural facets that comprise the human-macaque interface can be thought of as a matrix whose constituent components fluctuate in size, frequency, and influence from place to place. The capacity for culture to change through time, adjusting to changes or perceived changes in the ecological or cultural surroundings, presents a complex situation to be understood by the primatologist. The lines between what constitutes a cultural or ecological facet also become blurred when we think about the economic goals that are behind logging and the quest for livelihood that inspires some forms of forest conversion for new agricultural land. Because these facets are so fluid and interrelated, long-term applications of the mixed methodologies approach will likely be the best way to document how relationships within the human-macaque interface shift, resulting in conflict where there was once commensalism, mutualism where there was once conflict, and the whole gamut of potential relationship manifestations.

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