Taboos, social norms and conservation in the eastern rainforests of Madagascar

Julia P G Jones[1*], Mijasoa A Andriamarovolona[2], Neal J Hockley[1]

[1]School of the Environment and Natural Resources, Thoday Building, Deniol Road, University of Wales, Bangor, LL57 2UW. +44 (0) 1248 382650
[2]Vokatry ny Ala, BP 1067, Fianarantsoa 301, Madagascar. +261 (0) 331115773
* Corresponding author: julia.jones@bangor.ac.uk

Abstract

Where enforcement capacity for externally defined rules is weak, informal institutions which regulate access to wild species are of great interest to conservationists. A system of prohibitions known as fady is central to Malagasy culture. We look at the fady that affect natural resource use in the eastern rainforests of Madagascar, discuss whether they originate in attempts to manage natural resources and whether they play an important conservation role. We found a range of prohibitions from strict taboos where a species or area was forbidden by the ancestors, to social norms concerning acceptable behaviour when harvesting wild species. We found that strict taboos offered real protection to some threatened species including the lemur *Propithecus edwardsi* and the carnivore *Cryptoprocta ferox*. Taboos also reduced pressure on some economically important endemic species such as freshwater crayfish, by preventing their sale or limiting the harvest season. Social norms, where the sanction was social disapproval rather than supernatural retribution, encouraged sustainable harvesting practices for tenrecs and pandans. We found some evidence that the imposition of external conservation rules may have led to the break-down of such social norms by taking management power away from local people. In areas where forests were under community management, a social norm dictating how pandans should be harvested to avoid waste was widely respected (>90% of harvested pandans we saw had been harvested in this way). However, in forests within Ranomafana National Park, where local people have no rights to harvest products, less than 3% of harvested pandans we observed had been harvested according to the stated best practice. Many of the people closest to Madagascar's remaining biodiversity-rich habitat live in societies where traditional beliefs and societal norms governing interactions with wild species are powerful. Conservationists should make more effort to understand such existing institutions which, especially in the absence of capacity to enforce externally defined rules, may play an important conservation role.

Introduction

In many parts of the world, conservation rules which exist to control access to areas or limit harvesting of wild species are weakly enforced due to lack of capacity (Peres and Terborogh 1995; Walsh et al 2003). Informal institutions which govern the use of natural resources are therefore of great interest to conservation (Agrawal 2001). In many traditional societies, taboos exist which influence the use of wild species (McDonald 1977, Ross 1978, Koranteng et al. 2000; Anoliefo et al. 2003; Brooke & Tschapka 2002). Colding and Folke (1997; 2001) suggest that many such resource and habitat taboos play a role similar to formal institutions for conservation in contemporary society.

Some anthropologists have suggested that taboos concerning natural resource management have developed with the purpose of conserving important natural resources (McDonald 1977; Ross 1978). In this context, conservation means resource use restraint that sacrifices short-term yield in order to realize long-term benefits from heightened sustainability or yield (Alvard 1998). Most recent work has showed that people from 'western' and 'traditional' societies respond similarly to incentives (Winterhalder and Smith 2000; Penn 2003) and it is clearly naïve to imagine traditional people as 'noble savages' living in simple harmony with nature (Buege 1996). However, human societies which fulfil certain conditions (relatively constant group membership, long term residence in an area and heavy reliance on natural resources) have developed successful resource management institutions (Feeny 1990; Ostrom 1999), among which taboos may play a role.

A system of prohibitions known as fady (the word is both singular and plural) is centrally important in Malagasy culture (van Gennep 1904; Ruud 1960; Lambek 1992). The word fady has many usages including acts which are simply breaches of good manners punished only by popular disapproval, as well as acts which are offensive to the ancestors and bring supernatural punishment (Linton 1933; Lambek 1992). There are a number of examples of traditional *fady* providing some protection to wildlife species in Madagascar e.g. Verreaux Sifaka *Propithecus verreauxi deckeni* (Durbin 1994), Golden-crowned *Sifaka Propithecus tattersalli* (Vargas *et al.* 2002) and the radiated tortoise *Geochelone radiata* (Lingard et al 2003), or forest areas (Horning 2004; Ramanamanjato et al 1999). The fady against eating the Radiated tortoise (*Geochelonia radiata*) among some groups in southern Madagascar has even been credited with preventing its extinction (Nussbaum and Raxworthy 2000).

In Madagascar, national laws exist that ban killing of lemurs (Loi 62-020) and prevent exploitation within protected areas (Loi 2001-05), while locally agreed laws govern extraction levels of exploited species in community forests (Loi 96-025). The state is ultimately responsible for monitoring and enforcing these laws and agreements, but their capacity to do so is low. The role of traditional informal institutions, such as fady, which govern interactions with wild species should therefore be of great interest to conservationists. In this paper we look in detail at fady which affect people's use of wild species in

the eastern rainforests of Madagascar. We discuss the origin of the fady, whether they play an important role in conservation and the likely stability of these informal institutions in the face of change.

Materials and methods

Study area and the human population

This work was carried out over a period of four years in the central eastern rainforests of Madagascar (Figure 1). We worked in villages in the periphery of Ranomafana National Park where villagers cannot harvest forest resources legally. We also worked in two villages further south where the villagers have rights to use and manage their forest resources under community-conservation agreements (Table 1). People throughout the study area rely on small-scale agriculture and harvesting forest products for subsistence use or sale (Ferraro 2002). They self-identify with the Betsileo or Tanala ethnic groups, apart from in Andrambovato which is made up of recent immigrants of mixed descent (Table 1).

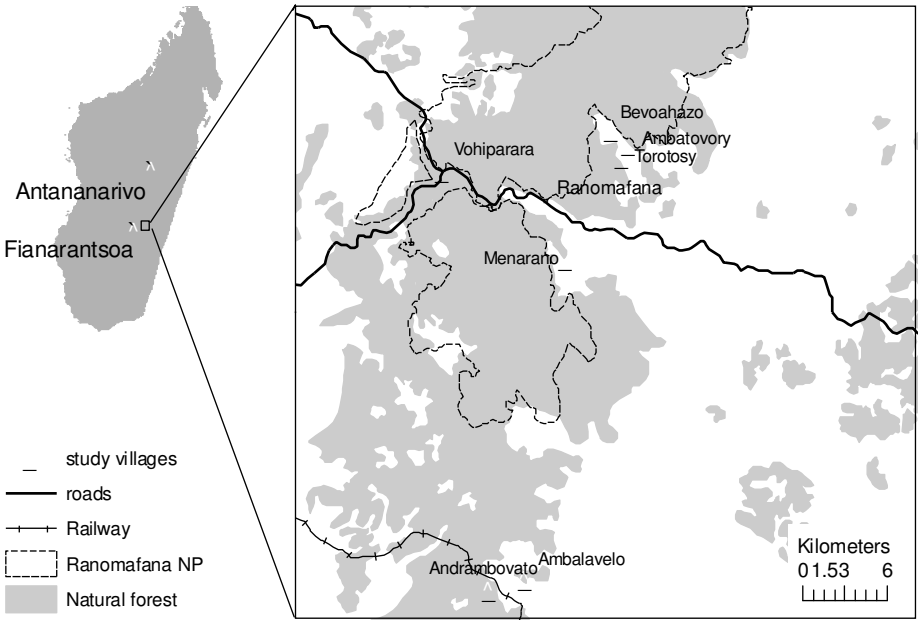

Figure 1: A map of the study area showing villages mentioned in the text

Table 1: The villages visited in this study

Village	Commune	Dominant ethnic group	Management of forest surrounding village	Approximate number of households
Vohiparara	Androy	Betsileo	RNP[1]	50
Bevoahazo	Ranomafana	Tanala	RNP	50
Ambatovory	Ranomafana	Tanala	RNP	15
Torotosy	Ranomafana	Tanala	RNP	45
Menarano	Ranomafana	Tanala	RNP	45
Ambalavero	Tolongoina	Tanala	Community-managed[2]	30
Andrambovato	Tolongoina	Mixed	Community-managed	40

[1]Ranomafana National Park, [2] Managed by the community under contract to the government under the GCF (*Gestion Contractualisée des Forêts*) law.

Identifying existing prohibitions

The information reported in this paper was gathered during field work on the sustainability of forest product harvesting in the area (see Jones et al. 2005). For two years (2001 to 2003), JPGJ and NJH lived in Bevoahazo and spent approximately one week each month in Vohiparara. We visited the other villages more sporadically. MMA lived for seven months in Menarano. All three authors then continued to work in the area for a further 18 months, staying in the villages for up to a fortnight at a time. Both non-Malagasy authors are fluent in Malagasy. Fady are personal and it is not always appropriate to ask direct questions about them. Over the study period, more than 70 villagers from the villages regularly worked as field assistants on our ecological work. The information presented here was gathered from informal interviews and discussions with field assistants and other villagers. We were familiar with the local names of species in the area. However, we always confirmed identification by asking informants to describe the species being talked about or point to it in a book. To identify Pandanaceae, a difficult to identify group, we took specimens which were identified by Martin Callmander (Missouri Botanic Gardens, Madagascar).

Estimating degree of adherence to reported prohibitions

We made great effort to collect independent information on the extent to which fady were adhered to. In some cases all that was possible was to triangulate what we were told through other conversations and interviews. It is always difficult to get accurate information on levels of illegal activity and all wild-harvesting was illegal within RNP and lemur hunting was illegal throughout the study area. However, our long residence in the villages, particularly in Bevaohazo, gave us plenty of opportunities to triangulate information from interviews.

Where possible we verified interview information with direct observations of people's activities. As residents in the villages we knew when people were going tenrec hunting and could observe women drying plant fibres and weaving. We also made observations of traps and other evidence of harvesting in the forest. We were able to collect some quantitative information on adherence to the social norm regarding the correct way to harvest Pandanaceae. We surveyed harvested Pandanus plants and noted the method used.

Results

Resource and habitat prohibitions recorded

We adapt Colding and Folke's (2001) classification system of resource and habitat taboos and consider the fady affecting forest resource exploitation under the headings segment, temporal, method, life history, specific species, and habitat fady. We also add a seventh category: use fady which control how

a species can be used (Table 2). We found that the term fady was used to describe a variety of prohibitions which we classify into three groups. *Sandrana* were extremely strict prohibitions from the ancestors which cannot be broken under any circumstance. *Fadin-drazana* (lit: fady of the ancestors) originate from the good sense of the ancestors. These fady may be more negotiable and people may ask their ancestors to free them in times of need. The final group we refer to as *fadim-piarahamonina* (lit: fady of the community), these are a class of prohibitions based on what society accepts or does not accept. Some people would not frame this last group in terms of fady but would simply say that they shouldn't be done (*tsy azo atao*). These categories are not absolutely distinct but we believe that they are helpful to describe the spectrum of prohibitions.

Segment fady

Segment taboos apply when a particular species cannot be used by people of a particular age, status or sex. For example, a fady prevents a species of pandanus known as *Vakoan'Olana* (*Pandanus longissimepedonculatus*) from being used as sleeping mats for nursing mothers with babies. *Vakoan'Olana* (as opposed to other superficially similar species of pandanus) has *hasina* (holiness) and consequentially should not be urinated on. Other segment fady apply to pregnant women and prevent them eating crayfish and crabs (there is a risk of having a dangerous multiple birth) or eels (risk of miscarriage).

Temporal fady

In Bevoahazo and Vohiparara there is a fady concerning the timing of when 'green things' (zava-maintso) can be brought into the village. In the Bevoahazo area this represents a strong and widely respected taboo against bringing weaving materials or bamboo into the village before the rice has been harvested. In Vohiparara this *fady* seems to have been attenuated; while the rice stands in the fields weaving materials and bamboo must be left under a tree outside the village for one night to wilt. To break this fady would be to invite a severe hail storm which would destroy crops.

Method fady

When harvesting pandanus, the plant should not be felled and the *vololony* (the two or three central leaf shoots, which have yet to separate) should not be cut. When asked why, people stated that this is necessary to allow the plant to recover in time for harvesting next year. People say that if the plant is felled (or even perhaps if the central leaves are cut) the plant will die. To avoid cutting the stem means to abandon some plants which are too tall to be harvested without felling. The central leaves are too soft for use in weaving, the only cost in leaving them is the extra care and attention needed when cutting the useful leaves. It is forbidden to use fishing nets in one of the largest rivers in the Bevoahazo valley. To use nets for fishing would break an ancient agreement between the village's founders and the crocodile which is said to reside in the waters under which it agreed not to eat people.

Life History fady

In Bevoahazo people said the right time to harvest striped? tenrecs (*Tenrec ecaudatus*) is April or May, just before hibernation.

Species-specific fady

Fady preventing the killing or eating certain species are common throughout the area. We classify these into four categories based on the reasons given for the fady.

a) Species which are considered to embody dead ancestors. The upright posture and human-like hands and feet of some lemurs, especially those in the family Indiridae, make it is easy to understand why these species are considered more human than animal (‘*tsy mba biby*’). Many people throughout the study area are strictly taboo for Milne-Edwards Sifaka (*Propethiecus edwardsi*) and the nocturnal Eastern Avahi (*Avahi laniger*). Some people express distaste for the idea of eating other large lemurs, such as the Red-fronted Brown Lemur (*Eulemur rufus*) and Red-bellied Lemur (*Eulemur rubriventer*), but this is seldom articulated as a strict taboo. We heard no reports that it was fady to eat other lemur species such as the Eastern Lesser Bamboo Lemur (*Haplemur griseus*), or smaller lemurs in the family Cheirogaleidae.

b) Species which scavenge on the bodies of the ancestors. Local people report that the Fossa (*Cryptoprocta ferox*) and smaller carnivores (probably *Fossa fossana*, *Eupleres goudotii* and the introduced *Viverricula indica*) scavenge on the bodies of ancestors buried in shallow graves in the forest. Eating these species is therefore strictly taboo.

c) Species which helped a clan member in the past. We have recorded similar stories to explain strict taboos for various species including the Greater hedgehog tenrec (*Setifer setosus*), Lowland streaked tenrec (*Hemicentetes semispinosus*), Crested Drongo (*Dicrurus fortificatus*), Crested Ibis (*Lophotibis cristata*) and Madagascar Tree Boa (*Sanzinia madagascariensis*). The story says that clan members were hiding from danger. A child cried, alerting the enemy to the presence of the terrified villages hiding nearby. An animal then called/came out from close to their hiding place, diverting the enemy’s attention. In thanks to the animal saving their lives, its descents were declared fady for all the clan.

d) Species which are fady for no known reason. Many people in Vohiparara have fady preventing them from using the pandanus species *Karabobo* (*Pandanus kimlangii*) to make mats, although they will make mats from very similar species in the same genus. Many people in the Bevoahazo area are fady for one of the two eel species found in the area. No reasons were given for this fady.

Habitat fady

A widespread and common fady in the region concerns activities which can be carried out in the areas surrounding tombs. These areas are called ‘tany fady’ or ‘ala fady’ (fady land or fady forest) and should not be entered by outsiders of the clan whose tomb it is. Hunting or cutting trees is strictly prohibited in the immediate vicinity of the tombs.

Table 2: The *fady* found in the study area which relate to use of wild-species or habitats

Type of *fady*	What it applies to	local name	Place	Notes (superscript indicates the level of *fady*)
Segment *fady*	A species of pandan (Pandanus longissimepedonculatus)	*Vakoan'olana*	Andrambovato, Ambalavero	It mustn't be urinated on so *fady* for sleeping mats for nursing mothers or children[2]
	Eels (*Anguilla* spp)	*Amalona*	Widespread	Pregnant women should not eat, or they will misscarry[2]
	Crayfish (*Astacoides* spp), freshwater crabs (*Hydrothelphusa* spp)	*Orana, foza*	Widespread	Pregnant women should not eat, or they will have multiple births[2]
Temporal *fady*	All species of Pandanus Other plants used for weaving Bamboo	*Vakoana* *Herana, Harefo* *Volo*	Bevoahazo, Ambatovory, Torotosy (lesser extent in Vohiparara)	Can't be brought into the village while there is still rice growing in the fields[2]
Method *fady*	Using fishing nets		Bevoahazo	Can't fish with nets in the main river (Tsaratango)[2]
	Cutting the central leaves of pandans		Widespread	When harvesting pandans, the central leaves should not be damaged[3]
Life history *fady*	Tailless tenrec (*Tenrec ecaudatus*[LC])	*Trandraka*	Bevoahazo	Shouldn't be harvested until after they have reproduced, before hibernation in April/May[3]
Specific species *fady*	Eastern Woolly Lemur (*Avahi laniger*[LC]), Milne-Edwards Sifaka (*Propithecus edwardsi*[EN]) Less commonly Red-fronted Brown lemur (*Eulemur rufus*[LC]) Red-bellied Lemur (*Eulemur rubriventer*[VU])	*Vahina* *Simpona* *Varika* *Barimaso*	Widespread	These are ancestors in animal form[1]
	Fossa, (Cryptoprocta ferox[EN]), Fanaloka (*Fossa fossana*[VU]) Falanouc (*Eupleres goudotii*[EN])	*Fosa varika, Fosa kely*	Bevoahazo, Ambatovory, Torotosy	Carnivores are known to eat bodies of ancestors[1]
	Greater Hedgehog Tenrec (*Setifer setosus*[LC]) Lowland Streaked Tenrec (*Hemicentetes semispinosus*[LC]) Crested Drongo (*Dicrurus forficatus*[LC]) Crested Ibis (Lophotibis cristata [NT]) Madagascar Tree Boa (Sanzinia madagascariensis[VU])	*Sokina* *Sora* *Railovy* *Akohon'ala* *Mandotra*	Some people in all villages	Protected a clan member from danger[1]

	A type of eel (*Anguilla* sp.)	*Amalom-bandana*	Widespread but certain people only	Unknown reason [1]
	A species of pandan (*Pandanus kimlangii*)	*Karabobo*		
	Flat-tailed geckos (*Uroplatus* sp.)	*Anga-datsaka*	Widespread	
	Dwarf chameleons (*Brookesia* sp.)	*Ravinahidatsaka*		
Habitat *fady*	Forest around tombs	*Tany fady/ ala fady*	Widespread	Respect for the ancestors [1]
Usage *fady*	Can't sell crayfish (*Astacoides* spp.), freshwater crabs (*Hydrothelphusa* spp.), all products of freshwater or all wild-harvested food	*Fady-mivarotra orana/ foza/laokandrano/ remby*	Bevoahazo, Ambatovory, Torotosy (very few people in Vohiparara)	Widespread *fady* against selling crayfish, crabs, freshwater products or (for some families) any food collected from the wild[2]
	Tree ferns (*Cyathea* spp.)	*Fahofaho*	Bevoahazo, Ambatovory, Torotosy	Some people were *fady* for using the hard stem of tree ferns (*taolana*) as supports for their houses[3]

[1] *Sandrana*: the strictest category of *fady*

[2] *Fadin-drazana*: *Fady* invoked by the ancestors but for which there is more opportunity for flexibility

[3] *Fadim-piarahamonina*: something which should not be done and is looked down upon by society but which is not strictly *fady* in terms of being prohibited by the ancestors

Superscripts on species names refer to IUCN threat categories (En: Endangered, Vu: Vulnerable, NT: Near Threatened, LC: Least Concern). For lemurs, we follow Mittermeier et al. (2006), for other species we follow IUCN (2006).

Use fady

In Bevoahazo, most households had fady which limited the commercialisation of wild-harvested foods. Approximately half the households had fady preventing them from selling any wild-harvested food including tenrecs, honey, fish or crayfish. Some were fady for selling products of freshwater only and for others this prohibition applied only to crayfish and freshwater crabs. The opposite was seen in the Betsileo village of Vohiparara where only three households (all incomers) had fady preventing commercialisation of crayfish and other wild foods. Two elders independently suggested that the fady was invoked to ensure that people concentrated on farming, providing families with enough staple food, rather than exposing themselves to the vagaries of a market economy. Some people in the Bevoahazo area were fady for using the trunk of tree ferns (*Cyathea* spp) as supports for their house, or for sleeping the night in a house which had tree fern supports. No reason was given for this fady.

Does the existence of these prohibitions change behaviour?

All sources agreed that taboos that were framed in terms of a strict fady (*sandrana*) were strongly adhered to. For example, people who told us that they were fady for the Greater hedgehog tenrec (*Setifer setosus*) would never eat this species and would even buy and release one if they saw it for sale. People expected supernatural retribution if such fady were broken and were quick to give examples of where people had broken fady and been struck down with illness or misfortune.

Our interviews suggest that carnivores were never killed for food in the area. They may be killed if they stray into a village and threaten domestic fowl but they would not be eaten. For example, a Fossa (*Cryptoprocta ferox*) was killed in Ambatovory in 2001 and we observed traps for small carnivores close to chicken runs in Vohiparara. During our time in the village, working in the forest daily, we observed only two lemur traps (both were baited live traps). Interviews suggest that this lemur hunting was targeted at *Eulemur fulvus* for which few people were fady. We would suggest that the widely taboo Milne-Edwards Sifaka (*Propithecus edwardsi*) and the Eastern Woolly Lemur (*Avahi laniger*) are never killed in Bevoahazo.

We were able to directly observe when weaving materials were collected. In Bevoahazo, the fady effectively limited the harvest season to a short season after the rice harvest. Fibres were then prepared and woven into mats in time for the following year's harvest. Similarly, fady preventing the sale of various species, most significantly crayfish, were widespread and our observations suggest they were strictly observed.

The social norm prohibiting cutting the central shoots of pandans was widely reported throughout all the villages visited in the study but the degree to which this was observed varied strongly between areas. Only one out of 40 harvested pandans in Andrambovato and Ambalavero had these central leaves cut. However, in Ranomafana National Park, in forests harvested by

villagers from Vohiparara, 30 out of 34 harvested plants visited had their central leaves cut (Chi^2=55.5, P=<0.001). People in Bevoahazo stated that the correct time for hunting the Tailless tenrec (*Tenrec ecaudatus*) was April and May. Our observations suggest that tenrec hunting as an activity (as opposed to opportunistically killing a tenrec found in the course of other activities) occurred primarily during these months.

Discussion

Is there a resource-management ethic in the origin of the fady?

Do the taboos reported in this paper demonstrate a conservation ethic among the ancestors? Of course it is difficult to know as those who made the fady are long dead. Most of the fady which prevent the use or killing of various species have their origin in well known stories, none of which displayed a conservation ethic. This is perhaps unsurprising as taboos which prevent the consumption of a species remove the need for careful stewardship of that species as a useful resource (Colding and Folke 2001). Ruud (1960) and van Gennep (1904), in their encyclopaedic review of fady from across Madagascar, collected many stories about the origin of fady. None of the stories they report have a natural resource management ethic behind them.

Other fady are concerned with economically useful species. We carried our extensive interviews as to the origin of the fady preventing selling of crayfish, crabs or all wild-foods. No one we interviewed who had this fady thought of crayfish or crabs as a limited resource and no one offered stewardship of the resource as an explanation for the origin of the fady. Our interviews suggest that the origin of this fady was in ensuring that households concentrated on producing staples so they could be self-sufficient in food, rather than selling harvested products for cash.

Some of the prohibitions we recorded were not taboos imposed by the ancestors but social norms, enforced by social pressure, of acceptable behaviour when harvesting valued wild species. These social norms, such as the correct time to hunt tenrecs and the way to harvest pandanus most sustainably, clearly had their origin in careful management of natural resources. Of course, today's social norms may be tomorrow's taboo. For example the fady preventing the use of fishing nets in Bevoahazo may have originated from the perspective of management of fish stocks, but is today framed in terms of a pact between the ancestors and a crocodile.

Do the taboos and social norms play an important conservation role?

Regardless of whether they have their origin in natural resource management, species and habitat taboos can result in conservation or improved natural resource management (Colding and Folke 2001). The species-specific taboos recorded in this study offer protection to five threatened species (one lemur, three carnivores and one snake) as well as other endemic birds, mammals and plants. Our observations suggest that these taboos provide significant protection for these species in the study area. It is difficult to get accurate information on levels of hunting of lemurs and

carnivores, especially in Bevoahazo and Vohiparara which lie on the border of Ranomafana National Park. However, our long residence in the area and the openness with which people would discuss other illegal activities, gives us confidence in our conclusions that the reported taboos do offer protection. In Bevoahazo, where we spent the most time, we believe that carnivores are never killed for food and lemurs in the family Indiridae, are never hunted by local people.

Taboos can become internalised, affecting a person's perceptions. For example, non-practicing Jews, for whom the religious reason behind dietary taboos has been removed, may be unable to overcome a visceral revulsion at the idea of eating forbidden foods (Lambek 1992). When questioned about eating fady lemurs or carnivores, people showed clear horror or disgust. This effect may even offer some protection to the larger lemur species not explicitly protected by fady. People who lacked fady against *Eulemur fulvus* or *Eulemur rubriventer*, some of whom did eat them occasionally, said that they preferred all domestic meats and the meat of wild pigs or Tenrec. The similarity to humans was often mentioned as the reason for their distaste. Food preferences are important as, ultimately, they will influence demand for a species and therefore hunting pressure (East et al 2005).

We observed that villages which have taboos preventing the commercialisation of crayfish harvest exploit these species at much lower levels (Jones et al 2005). The control of harvesting caused by this fady preventing commercialisation may play an important role in the conservation of *Astacoides caldwelli*. This is a rare endemic crayfish found only at low altitudes where it is limited to very few sites (Jones et al in press). That this species remains relatively abundant around Bevoahazo (JPG Jones unpublished data) may be due in part to this fady preventing commercial harvesting.

Cultural norms which prescribe how people should harvest other species also seem likely to have positive conservation implications. The main tenrec hunting season was in April or May, which is after the young have become independent (Nicoll 2003). Felling a pandanus is likely to kill it (M. Calamander pers com) and our observations suggest that by leaving the leaving the central leaves of pandanus when harvesting, the plant can indeed be visited in successive years (NJH unpublished data).

Because *fady* tend to be prohibitions, they are overwhelmingly conservative. We found no *fady* with obvious negative conservation impacts. Similarly, although there are many reports in the literature of *fady* which provide conservation benefits (see introduction), the only harmful *fady* we have come across is one which results in the killing of Aye-aye (*Daubentonia madagascariensis*) that stray close to villages in parts of the country (Simons and Meyers 2001).

The stability of natural resource taboos and cultural norms

A number of authors have noted that increased exposure to modern living has eroded traditional beliefs with negative impacts on habitats or

populations protected by taboos (e.g. Anoliefo et al. 2003). Certain taboos (*sandrana*) were framed in terms of a total prohibition which could never be broken. However, commentators in Madagascar have noted that increasing movements of people tends to erode adherence to *fady* (Lingard et al. 2003, Lilette et al. 2006) and as traditional beliefs change, even these strict taboos may weaken. We found evidence that *fady* can evolve and change in response to economic necessity. This flexibility was illustrated by families who had lost the taboo preventing sale of wild-harvested foods when ancestors had been forced to do these things during hard times. Similarly, some villagers attenuated the taboo limiting the season for harvesting weaving materials by leaving the green plants outside the village to wilt. This modification was widespread in Vohiparara where many women weave mats to sell, giving a strong commercial incentive to extend the harvesting season.

It is widely recognised that the maintenance of local management institutions depends on property rights (Ostrom 1999). We found some evidence that respect for socially enforced prohibitions is breaking down where local people have lost the right to manage their resources. Villagers from the periphery of Ranomafana National Park complain that they are no longer the 'topon-tany' (a Malagasy concept indicating ownership and stewardship of land) and that they can no longer exclude others from their forests. They blamed poor current management of bamboo and pandans (Vohiparara) and crayfish (Menarano) on this issue. We saw some evidence to support the idea that resource management mechanisms have broken down in villages around the park. Although the social norm concerning how pandans should be harvested was respected in Andrambovato and Ambalavero, we found that people harvested pandans without respect for this norm in Vohiparara where park rules prevent legal forest use. Although tentative, these results highlight the possibility that the imposition of external conservation rules can lead to erosion of local management mechanisms (Horning 2003; Gelcich et al. 2006). In addition, anger directed towards the park at what people feel is unnecessary imposition on their way of life has resulted in people carrying out active vandalism. Although Milne-Edwards sifaka *P. edwarsi* are usually protected by a strong *fady*, people in one village broke this *fady* and killed a radio-collared individual to express their anger towards the park authorities. This incident occurred following a clampdown by the park on villagers burning their agricultural fields in the park periphery.

Conclusions

Many of the people living around Madagascar's remaining natural forests live in societies where traditional beliefs are strong. Informal institutions, including commands from the ancestors and culturally accepted behaviour, influence people's interaction with their environment. We have shown that a number of threatened species are offered protection by strict taboos and that social norms limit the level of exploitation of other species. Of course taboos and traditional institutions alone are clearly not going to save Madagascar's biodiversity; the pressures are far too strong and numerous. The protection offered by traditional institutions also will not match exactly with the objectives and priorities of conservation biologists and many species of

conservation concern are not covered by any rules. There is also a limit to how much these institutions can be enhanced or strengthened by outsiders wanting to capture their power for the purposes of conservation. However, in remote rural areas, these informal institutions may represent the only rules with any degree of enforcement. Rules, without enforcement, are not enough to induce people to change behaviour (Rowcliffe et al 2004). Locally defined and enforced prohibitions therefore deserve much greater attention from conservationists.

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References

Agrawal, A. 2001. Common property institutions and sustainable governance of resources. World Development **29**:1649-1672.

Alvard, M. S. 1998. Evolutionary ecology and resource conservation. Evolutionary Anthropology **7**:62-74.

Anoliefo, G. O., O. S. Isikhuemhen, and N. R. Ochije. 2003. Environmental implications of the erosion of cultural taboo practices in Awka-South local government area of Anambra State, Nigeria. Journal of Agricultural & Environmental Ethics **16**:281-296.

Brooke, A. P., and M. Tschapka. 2002. Threats from overhunting to the flying fox, *Pteropus tonganus*, (Chiroptera: Pteropodidae) on Niue Island, South Pacific Ocean. Biological Conservation **103**:343-348.

Buege, D. J. 1996. The ecologically noble savage revisited. Environmental Ethics **18**:71-88.

Colding, J., and C. Foke. 1997. The relations among threatened species, their protection and taboos. Conservation Ecology (online) **1**.

Colding, J., and C. Folke. 2001. Social taboos: "invisible" systems of local resource management and biological conservation. Ecological Applications **11**:584-600.

Durbin, J. 1994. The role of local people in the maintenance of protected areas in Madagascar, PhD, Durrell Institute of Conservation and Ecology.

East, T., N. F. Kumpel, E. J. Milner-Gulland, and J. M. Rowcliffe. 2005. Determinants of urban bushmeat consumption in Rio Muni, Equatorial Guinea. Biological Conservation **126**:206-215.

Feeny, D., F. Berkes, B. J. McCay, and J. M. Acheson. 1990. The tragedy of the commons: twenty two years later. Human Ecology **18**:1-19.

Ferraro, P. J. 2002. The local costs of establishing protected areas in low-income nations: Ranomafana National Park, Madagascar. Ecological Economics **43**:261-275.

Gelcich, S., G. Edwards-Jones, M. J. Kaiser, and J. C. Castilla. 2006. Co-management policy can reduce resilience in traditionally managed marine ecosystems. Ecosystems **9**:951-966.
Horning, N. R. 2003. How rules affect conservation outcome. Pages 146-153 in S. M. Goodman, and J. P. Benstead, editors. The Natural History of Madagascar. The Chicago University Press, Chicago, USA.
IUCN. 2006. IUCN Red List of Threatened Species. <www.iucnredlist.org> Downloaded on 11 April 2007.
Jones, J. P. G., F. B. Andriahajaina, N. J. Hockley, A. Balmford, and O. R. Ravoahangimalala. 2005. A multidisciplinary approach to assessing the sustainability of freshwater crayfish harvesting in Madagascar. Conservation Biology **19**:1863-1871.
Jones, J. P. G., F. B. Andriahajaina, N. J. Hockley, K. A. Crandall, and O. R. Ravoahangimalala. in press. The ecology and conservation status of Madagascar's endemic freshwater crayfish (Parastacidae; Astacoides) Freshwater Biology.
Koranteng, K. A., P. K. Ofori-Danson, and M. Entsua-Mensah. 2000. Fish and fisheries of the Muni lagoon in Ghana, West Africa. Biodiversity and Conservation **9**:487-499.
Lambek, M. 1992. Taboo as cultural practice among Malagasy speakers. Man **27**:245-266.
Lilette, V. 2006. Mixed results: conservation of the marine turtle and the red-tailed tropicbird by Vezo semi-nomadic fishers. Conservation and Society **4**:262-286.
Lingard, M., N. Raharison, E. Rabakonandrianina, T.-A. Rakotoarisoa, and T. Elmqvist. 2003. The role of local taboos in conservation and management of species: The radiated tortoise in Southern Madagascar. Conservation and Society **1**:225-246.
McDonald, D. 1977. Food taboos: a primitive environmental protection agency. Anthropos **72**:734-748.
Mittermeier, R., W. R. Konstant, F. Hawkins, E. E. Louis, O. Langrand, J. Ratsimbazafy, R. Rasoloarison, J. U. Ganzhorn, S. Rajaobelina, I. Tattersall, and D. M. Meyers 2006. Lemurs of Madagascar. Conservation International, Washington DC.
Nicoll, M. E. 2003. *Tenrec ecaudatus*, Tenrec, Tandraka, Trandraka. Pages 1283-1287 in S. M. Goodman, and J. P. Benstead, editors. The Natural History of Madagascar. The University of Chicago Press, Chicago, USA.
Nussbaum, R. A., and C. J. Raxworthy. 2000. Commentary on conservation of "Sokatra," the radiated tortoise (Geochelone radiata) of Madagascar. Amphibian and Reptile Conservation **2**:6-14.
Ostrom, E. 1999. Coping with tragedies of the commons. Annual Review of Political Science **2**:493-535.
Penn, D. J. 2003. The evolutionary roots of our environmental problems: towards a Darwinian ecology. Quarterly Review of Biology **78**:275-301.
Peres, C. A., and J. W. Terborgh. 1995. Amazonian nature reserves: an analysis of the defensibility status of existing conservation units and design criteria foro the future. Conservation Biology **9**:34-46.
Ramanamanjato, J. B., R. A. Nussbaum, and C. J. Raxworthy. 1999. A new species of Mabuya Fitzinger (Reptilia : Squamata : Scincidae) from the

Onilahy River of south-west Madagascar. Herpetological Journal **9**:65-71.
Ross, E. B. 1978. Food taboos, diet and hunting strategy: the adaptation to animals in Amazon cultural ecology. Current Anthropology **19**:1-19.
Rowcliffe, J. M., E. de Merode, and G. Cowlishaw. 2004. Do wildlife laws work? Species protection and the application of a prey choice model to poaching decisions. Proceedings of the Royal Society of London Series B-Biological Sciences **271**:2631-2636.
Ruud, J. 1960. Taboo: A Study of Malagasy Customs and Beliefs. Allen and Unwin, London, UK.
Simons, E. L., and D. M. Meyers. 2001. Folklore and beliefs about the Aye aye (*Daubentonia madagascariensis*). Lemur News **6**:11-16.
van Gennep, A. 1904. Tabou et Totémisme à Madagascar: Etude Descriptive et Théorétique. Ernest Leroux, Paris, France.
Vargas, A., I. Jimenez, I. Palomares, and M. Palacios. 2002. Distribution, status and conservation needs of the golden-crowned sifaka *Propithecus tattersalli*. Biological Conservation **108**:325-334.
Walsh, P. D., K. A. Abernethy, M. Bermejo, R. Beyersk, P. De Wachter, M. E. Akou, B. Huljbregis, D. I. Mambounga, A. K. Toham, A. M. Kilbourn, S. A. Lahm, S. Latour, F. Maisels, C. Mbina, Y. Mihindou, S. N. Obiang, E. N. Effa, M. P. Starkey, P. Telfer, M. Thibault, C. E. G. Tutin, L. J. T. White, and D. S. Wilkie. 2003. Catastrophic ape decline in western equatorial Africa. Nature **422**:611-614.
Winterhalder, B., and E. A. Smith. 2000. Analyzing adaptive strategies: Human behavioral ecology at twenty-five. Evolutionary Anthropology **9**:51-72.