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Malagasy Swidden Agriculture: The Influence of Conservation Organizations on Indigenous Knowledge

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Abstract: This research evaluates the influence of conservation organizations on the cultural model of *tavy* (swidden agriculture) in eastern Madagascar. It compares communities in protected and unprotected areas of eastern Madagascar, whose members have been influenced to varying degrees by the introduction of non-indigenous conservation practices. The analysis makes use of schema theory and cultural models to present the various stages of *tavy* agriculture. Principal components analysis and ANOVA are used to test following hypothesis: As knowledge of non-indigenous conservation practices increases, knowledge of *tavy* decreases. The implications for the hypothesis being accepted are then discussed.

INTRODUCTION

This research evaluates the influence of conservation organizations upon indigenous people, in particular, their effect on the cultural model of *tavy* (swidden agriculture) in eastern Madagascar. By understanding the cultural significance of *tavy*, it is hoped that the planned transition from *tavy* to irrigated agriculture can be implemented in a culturally appropriate manner. Not only is it necessary to take into account the cultural role *tavy* plays in Madagascar, but also to understand how the introduction of non-indigenous

conservation practices has influenced ritual elements of *tavy*. Much of the anthropological focus on agricultural practices and conservation in Madagascar is on political ecology (e.g., Gezon 1997a; 1997b; 1999a; 1999b) and land use (e.g., Durbin & Ralambo 1994), but there has been less attention to the impact of conservation organizations on indigenous Malagasy and the rituals of *tavy* (for two exceptions see Harper 2002 and Razafiarivony 1995). These works have added to the understanding of how conservation projects impact economies and community structure, whereas this

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research addresses the impact projects have on knowledge and ritual. This research makes use of schemas and cultural models as units of ethnographic analysis to examine ritual elements of *tavy*. By using the concept of cultural models, shared cultural knowledge is the focus of this analysis.

Agricultural practices in Madagascar have received much attention by economists, biologists and agricultural scientists, but, in comparison, little has been done to understand the cultural aspects of Madagascar's swidden agriculture. The agricultural practices of the communities located in protected areas of primary and secondary mid-altitude rain forests are monitored by the Association Nationale pour la Gestion des Aires Protégées (A.N.G.A.P.) and the agricultural practices of those located in unprotected areas of severely degraded mid-altitude rain forests are monitored by the Ministre des Eaux et Forêts (M.E.F.). A.N.G.A.P. serves as a Malagasy non-governmental organization (NGO) that manages protected areas while the M.E.F. focuses on remnants of forest that are not included in protected areas. In addition to these two Malagasy agencies, several international NGOs are promoting conservation and sustainable resource use in Madagascar (e.g., USAID, WWF and the World Bank). Central to many of the programs of these NGOs is educating the local indigenous population on non-indigenous techniques, which are often designed without considering their impact on local beliefs and knowledge.

PROBLEM

There has been a recent shift within ethno-ecological research away from the focus on either beliefs or behavior (e.g.,

Alvard 1995; Alvard and Kunzar 2001; Ruttan and Borgerhoff Mulder 1999; Winterhalder and Lu 1997) to exploring the pattern of environmental knowledge and the effect of cultural models of the environment on behavior (Nazarea 1999:93-4). Where focus on environmental models of thought have occurred, they have not assessed the extent to which the model was shared (e.g., Schareika 2001). The analysis of intercultural variation allows for the assessment of the degree to which cultural knowledge is shared within a group (Boster 1985; 1987; Brewer et al. 1991; Garro 1988; 2000; Romney 1989; 1999; Romney et al. 1987; Romney et al. 1986). By both understanding the effect cultural models have on behavior and how the cultural models are shared within any one community, development agencies may be aided in their implementation of programs that impact cultural behavior and beliefs.

Indigenous communities are not always successful instituting a conservation program because "traditional conservation beliefs… are not ready-made prescriptions for today's world" (Western and Wright 1994, 2). In Madagascar, as well as other areas with indigenous populations, the hope is that the coordination of scientific research and indigenous traditional values will lead to projects fulfilling their goals (Rabetaliana and Schachenmann 1999). It is not enough to have conservation biologists and/or ecologists involved with a conservation project, but the members of a community must be aware of the consequences of their subsistence practices on the environment (Kleymeyer 1994, 323). Conservation projects have attempted to increase awareness through either reviving

traditional conservation ethics or education on contemporary conservation methods. Conservation programs in developing countries are unlikely to meet their goals without the cooperation of the community in which the program is applied, no matter how many scientific specialists are involved.

This research is the result of a collaborative effort between multiple agencies[1], including L'Association Nationale pour la Gestion des Aires Protégées (ANGAP), Toamasina and Parc National D'Andasibe, and the Ministre des Eaux et Forêts (MEF), Toamasina, to evaluate whether a transition from rice grown by swidden agricultural methods to wet terraced fields is feasible in the eastern Madagascar province of Toamasina. *Tavy* is of interest to scientists and conservation groups in Madagascar not only because of its adverse effect on the endemic flora and fauna, but also because it is both ecologically and economically unsustainable under current human population densities. Only one of the over 200 rural farmers interviewed stated that they could be self sufficient by farming alone, as their crop yields were too low due to overuse of the land. Farmers report that they may allow a field to lay fallow for only two years, instead of ten or more, because they lack enough fertile land in which to grow their crops. Several institutions and agencies are currently exploring possible methods of instituting a change of agricultural practices in the eastern regions of Madagascar. This transition is essential so that the Malagasy population not only has a stable source of food but also is able to maintain its environmental and economic integrity. These agencies and institutions also seek to protect the remnants of rainforest and to restore the degraded buffer areas around protected areas. The practice of swidden agriculture in these buffer zones prevents this restoration. The goal, then, is to end the practice of swidden agriculture by providing an alternative means of agricultural production that is ecologically and economically viable for the area. For a more detailed discussion of the stakeholders and history of agricultural development and conservation in eastern Madagascar, see Hume *in press* and 2006a.

SCHEMAS AND CULTURAL MODELS

The term, schema, was suggested by Mandler (1984) to have been in use as early as Immanuel Kant (1929 [1781]), when Kant described a canid's recognition of other creatures as schema. However, it was not until the early 1970s that schemas were applied to the human condition and became a part of cognitive anthropology's repertoire for identifying and describing human thought. Schemas are cultural constructions of human thought that are used to process information. Individuals share schemas with other's in their cultural group, which in turn allows symbolic communication about complex ideas and/or processes. Put concisely, a schema is defined here as a culturally bound cognitive representation that enables the interpretation of data by a person or group and possible reaction to that information by applying contextual data to a set pattern of thought. The contextual data enables interpretation of external stimuli through use of the schema as a way to 'think through the problem' by placing the data in empty 'slots.' Schemas are embedded within and related to other schemes. This embeddedness leads to a hierarchal

complexity where multiple schemas are subsumed within one schema and several schemas may be found at similar levels of the hierarchy (D'Andrade 1995, 124).

While cultural models are implicitly linked with schema theory, the use of the cultural model concept also predates cognitive anthropology, just as the idea of schemas. The concept of cultural models is attributed to Craik (1943), who used cultural models to describe the decision making process where past experience and knowledge are used to solve a problem. Therefore, in Craik's synthesis, cultural models are simply complex schemas that are used in problem solving. D'Andrade writes that the main difference between a cultural model and a schema is that, by definition, a schema must be simple enough to be held in short-term memory and anything more complex is a cultural model (D'Andrade 1995, 152). D'Andrade continues that cultural models consist of one or more semantic relationships (schemas) that organize the elements of cognition into interpretive frameworks used to describe internal or external phenomena (1995, 151).

Several authors (e.g., Kronenfeld 2000; Shore 1996; Strauss and Quinn 1997) take cultural models as their level of analysis and have developed a descriptive definition of cultural models. The first aspect of cultural models that is evident in the literature is that cultural models are shared representations of common knowledge. In this logic, schemas are therefore defined as individual perceptions subject to individualistic experience as opposed to shared cultural models (Strauss and Quinn 1997, 122). It is this group quality rather than individual knowledge that makes cultural models elusive, since

the level of any analysis of cultural models must incorporate individual knowledge as representative of group knowledge. Complicating this further is the fact that individuals may be participants in several groups and group membership must be ascertained to define knowledge communities. However, the amount of "sharedness" that is necessary for a determination as a cultural model and not as an individual schema is not always quantifiable, but may be determined by the researcher's "taste" (Strauss and Quinn 1997, 122). There are not inherent mechanisms within the cultural model concept to determine to what degree the model must be shared in order to be called a cultural model.

This research follows the aforementioned assertion that a cultural model is built upon two or more related schemas and must be shared among a cultural group. However, to what degree a model of knowledge needs to be shared to be considered a cultural model is more difficult to address. One solution to this dilemma was found by Garro (1988), who determined the sharedness of cultural models through the use of consensus analysis (e.g., Romney, et al. 1986). Garro (1988) examined the variation and consensus of Ojibway Indian's knowledge about high blood pressure. Through her analysis, Garro illustrates how cultural consensus analysis can quantifiably measure the degree of each informant's shared cultural knowledge about high blood pressure with the rest of her sample (1988, 104-108). The analysis presented below follows Garro's lead by using a quantifiable measure of shared knowledge, principal components analysis (a form of consensus and/or cultural variation analysis), to

demonstrate that knowledge about tavy is a cultural model.

Hypothesis

Fieldwork conducted in early 2003 identified that the rituals associated with *tavy* appeared to vary inversely in proportion to the degree that rural farmers were the beneficiaries of development programs aimed at improving crop yields by FOFIFA, MEF and MEA. Because development programs appeared to be influencing the ritual beliefs and practices of the farmers, this research attempts to test the following hypothesis: As knowledge of non-indigenous conservation practices increases, knowledge of *tavy* rituals decreases. If there has been important influence by conservation groups on local cultural practices, conservation organizations might be displacing indigenous beliefs with non-indigenous ones. This could be a sign of the success of conservation organizations in reducing agricultural practices that are no longer sustainable. If conservation groups have not influenced local cultural practices, both knowledge of non-indigenous conservation practices and *tavy* may increase. In other words, it could be that conservation organizations promote the sharing of knowledge of both non-indigenous conservation practices and *tavy* as result of educational materials comparing non-indigenous conservation practices and *tavy*. A final possibility is that there may be no correlation between shared knowledge of non-indigenous conservation practices and *tavy*.

METHODS

With the aid of a technician from FOFIFA, rural farmers in two communities along the main highway (Route National 2 (RN2) between Antananarivo and Toamasina) participated in the interviews. In both of these communities, farmers spoke about their methods of agriculture and the rituals performed while growing rice. There were approximately thirty extended structured interviews with the farmers in this area. Directly following fieldwork in Toamasina, there was an initial contact of local authorities for continued research in the Andasibe region and several additional interviews occurred. The result of this field season was an improvement in the knowledge and use of the Malagasy language for use in interviews and the construction of a cultural model of *tavy* from the qualitative data collected.

2004 Field Season

The variation in responses when questioned about the items offered during rituals appeared to coincide with the degree of information that the agencies gave the farmers regarding sustainable agriculture, which directly lead to the formation of the hypothesis of this research, that as knowledge of non-indigenous conservation practices increases, knowledge of *tavy* decreases. In the summer of 2004, the study consisted of 185 farmers in the Andasibe region (mid-level rainforest in eastern Madagascar) in three communities to test whether information given to the farmers by conservation organizations was affecting their ritual practices. The three locations for interviews were: (1) Andasibe – a city with an estimated population of 5,000, (2) Mahatsara – a village with an estimated population of 250, and (3) Ampangalatsary is approximately 4 kilometers south of Andasibe with many small-interspersed communities and an estimated

population of 1,000. Communities in Andasibe and Ampangalatsary were also split, where at least five Betsimisaraka farmers were interviewed from each community. The informants who were chosen were those that were at their homes and available for interviewing (many were either in their fields or away on business during the day). Andasibe is an ethnically diverse town that was a major logging center and now is the center for two local mines and a railroad construction agency. Mahatsara village (approximately 8 kilometers north of Andasibe) contains mostly individuals from the Mantadia National Park nearby that choose to settle in a village created by the local conservation authority, ANGAP.

The three particular sample populations were chosen because of their varying degree of connections with conservation organizations. Mahatsara village developed during the relocation of people from Parc National de Mantadia by ANGAP, continues to have strong connections with the local conservation authority (ANGAP) and MEF. Andasibe is equal distances from Mantadia national park and Analamazoatra special reserve and is the base of operations for seven national and international conservation organizations. Ampangalatsary, while near both the Reserve Speciale d'Analamazoatra and Reserve de Maromizaha[2], and is not subject to the ongoing efforts of the conservation organizations operating in

the vicinity, but does have influence from MEF. It was believed that Ampangalatsary would show high ritual knowledge and Andasibe low with Mahatsara falling somewhere in the middle, all coordinating with the amount of influence that the conservation organizations had with the sample populations.

The first step of the survey was the creation of a survey instrument designed to collect both demographic and ritual performance data. Initially translated from English into Malagasy by a research assistant, they were later corrected by collaborators at the Institut de Civilisations / Musée d'Art et d'Archéologie de l'Université d'Antananarivo. The following demographic information was collected: age, ethnicity, religion, years lived in the area, years farming, items grown, other supplementary occupations, irrigated agriculture experience, and the last time *tavy* was performed. Although there are many ethnicities in the area, the Betsimisaraka[3] were the focus of this research as the area is part of their regional home (149 of the 185 total informants identified themselves as Betsimisaraka). The cultural model of *tavy* consisted of five ritual schemas and informants reported with which spiritual being each ritual was associated and which of the possible five offerings were appropriate. The following is the survey's four-point scale:

English	Malagasy
1. Completely agree	1. Mifanaraka araky izany mihitsy
2. Somewhat agree	2. Mifanaraka eo eo ihany
3. Somewhat disagree	3. Tsy mifanaraka eo eo ihany
4. Completely disagree	4. Tsy mifanaraka araky izany mihitsy

Depending upon what the informant's answers were to these questions, follow up questions were asked to determine

why some offerings were thought appropriate or not.

The phrasing of the questions for the

survey assumes that reported knowledge of an action relates to acceptable behavior. The phrasing of the questions as "you should" do something is an attempt to measure acceptable behavior rather than whether the informant knows of a particular behavior or reports a normative behavior. It is entirely plausible that the reported acceptable behavior does not have any relation with actual behavior, but within the confines of limited time and resources, following each individual informant while they practiced *tavy* was not feasible. It is acknowledged that the relationship between what an informant states they should do and what they actually do is spurious at best, but at least shows that the reported acceptable behavior does, in fact, reflect agreement and disagreement among informants in their perception of *tavy* practice.

While collecting data on the cultural model of *tavy*, the number of conservation organizations working in each of the sample populations was determined. This data will be used later to determine the effect they have on *tavy* knowledge. Andasibe currently has seven conservation organizations working with the local population which include the following: the Association Nationale pour la Gestion des Aires Protégées (ANGAP), Ministère des Eaux et Forêts (MEF), Association Mitsinjo, Stiftung Natur und Artenschutz in Den Toten (NAT), United States Agency for International Development (USAID), World Wildlife Fund (WWF), Sampan'Asa momba ny Fampandro-soana - Fiangonan'i Jesoa Kristy Eto Madagasikara (SAF-FJKM), and Adventist Development and Relief Agency International (ADRA). Mahatsara has three conservation organizations working in the village

(ANGAP, MEF and SAF-FJKM). Finally, Ampangalatsary only has one conservation organization actively working with the local population, the MEF.

Statistical Analysis

Statistical analyses of the collected data began in the field by using SYSTAT 10.2 and SAS Version 8 for Windows statistical software packages on a laptop computer. Factor analysis of the inter-informant agreement matrix was used to explore the pattern of intra-cultural variation in the cultural model of *tavy* (Boster 1981; 1984; Romney 1994; 1999; Romney, et al. 1986). Factor analysis provides a way to test whether or not the variation is around a single cultural model. In addition, this method allows one to determine the culturally 'correct' answer without the researcher's prior knowledge (Romney, et al. 1987). One can infer that informants have converged on a single cultural model if the first eigenvalue is several times larger than the second and if the first factor scores are all positive (Romney, et al. 1986, 323). In addition, Pearson's R statistics determined whether the differences between the knowledge of different community members were significantly different. The result of this analysis will show what aspects of the cultural model the three subpopulations share.

Tavy Rituals

During six months of fieldwork in early 2003, 54 farmers from three localities within eastern Madagascar participated in interviews designed to elicit what rituals are associated with *tavy*; and their cultural model of *tavy* (for a description of *Tanim-bary* [irrigated field] rituals see Hume 2006b

and 2009). Four distinct ritual schemas emerged from the interviews, one for each of the four stages of the swidden cycle for which rituals are performed. There are four periods during *tavy* that rituals are performed: cutting, burning, planting and harvesting. Each of the rituals seeks to implore a supernatural entity to effect change, god (*Andriamanitra*), the ancestors (*razana*) or natural spirits who live on the land (*zanahary*). There was much variation in what the farmer offered to the intended entity of the ritual.

Offerings

Each of the farmers interviewed stated that they performed all of these rituals, but the offerings given at each ritual varied. The five items most commonly offered are *vary fotsy* (cooked white rice), *masomboly* (seed reserved to be sown), *tantely* (honey), *toaka-Gasy* (distilled rum made with sugar cane) and *betsabetsa* (fermented beer from rice and honey). *Vary fotsy* is literally translated as white rice, but, in rituals, can be any type of rice. Rice was the food of the first Malagasy and forms a pact with the spirits so that no harm will come to the farmer. *Masomboly* represents fertility or the potential for fertility. The sweetness of *tantely* represents goodness of harvest and/or body. The ancestors and other spirits understand honey, as it is natural and was available to the ancestors when they were alive in comparison with refined sugar, which is a more recent creation. *Toaka-Gasy* is a distilled alcohol made with sugar cane. Many of the farmers believe that *toaka-Gasy* is not clean because the process of making *toaka-gasy* includes mashing the cane fibers with the feet, which are dirty. Some of the informants stated that impure things

offend the ancestors and other spirits. *Betsabetsa* is beer fermented from rice and honey. The process of making *betsabetsa* by hand and is believed to be cleaner than *toaka-Gasy*. Many of the farmers also reported that because *betsabetsa* includes honey as an ingredient, *betsabetsa* could represent health in addition to its other properties. The ancestors prefer *betsabetsa* because the ancestors know *betsabetsa,* as they had it when they were alive.

With each of the rituals, the entity is prayed to and offerings are presented on *ravinala* (travelers palm - *Ravinala madagascariensis*) leafs placed in the northeast corner of the plot, either on the ground or a platform (usually a tree stump). The choice of *ravinala* is not ritually significant, but is practical as it is common and has large leaves, which can serve as a place for offerings. The cardinal location of the offering is important. The east, for the Betsimisaraka, symbolizes life, as it is where the sun rises. The west symbolizes death, as the place where the sun sets. The north symbolizes the location from which the ancestors came to Madagascar and the south the location from where sorcerers came. The northeast direction the both symbolizes life and the ancestors, which is believed to promote the likelihood the ritual will be well received by the spiritual being to which it is aimed.

Cutting

The first of these ritual schemas occurs before the farmer cuts vegetation on the plot of land that is designated for *tavy*. This ritual attempts to implore the *zanahary*, naturally occurring spirits that live on the land, to protect the farmer and other workers from injury, especially as injury from the *angady*

(bush knife). After the most commonly offered items (*vary fotsy* and *tantely*) are placed on *ravinala* leaves in the northeast corner of the plot and a prayer is said to the *zanahary*. The farmer prays aloud and, according to one informant, the prayer is the following:

> Come *zanahary*.
> Here is your *vary fotsy* and *tantely*.
> These are for you, *zanahary*.
> Take and eat them.
> Then go and leave me to work.
> Leave this place and go somewhere else.
> Leave here so I do not get hurt
> Leave here so I am not cut.
> Leave here.

During the prayer, one informant stated that she would make motions with her hands to indicate the location of the offerings and to put the offerings in her mouth. Once the ritual is complete, the farmer leaves the offerings for the *zanahary* and cutting begins.

Burning

The second ritual schema occurs before burning the dried vegetation, which farmers believe fertilize the field. During this ritual, the farmers are asking *Andriamanitra* (god) to protect the farmer from the fire and prevent the fire from spreading beyond the intended *tavy* field. Several of the farmers told stories of fires that burned out of control and harmed family members. In addition, stories abounded of fires that the farmer designed to burn two or three hectares spreading to destroy over one hundred hectares of vegetation. If the farmer performs this ritual properly, farmers prevent such events, and conversely, when a fire gets out of control, farmers believe that the ritual was improperly done or they did not have acceptable offerings. As with the prior ritual before cutting, the offerings (usually *vary fotsy*, *tantely* and *toaka-Gasy*) are placed on

ravinala leaves in the northeast corner and a prayer is said.

Planting

The third ritual schema, which contains two subschemas, occurs before planting rice seeds on the *tavy* field. The farmer will address both *Andriamanitra* and the *razana*. The farmer asks *Andriamanitra*, who has control over the physical environment of field such as weather, soil and water, to ensure a good crop and prevent heavy rainfalls that would erode topsoil. While the *razana* are ancestors, they are not necessarily the direct ancestors of the farmers, but prior inhabitants that own the land and may or may not be a relation to the farmers, as different ancestors inhabit different parcels of land and may have different personalities that may affect the choice of offerings. The ancestors have the power to pass on the requests of the farmers to *Andriamanitra* to ensure that the crop is successful. As with the prior rituals, the offerings (usually *vary fotsy*, *masomboly*, *tantely* and *toaka-Gasy*) are placed on *ravinala* leaves in the northeast corner and a prayer is said.

Harvesting

The fourth and final ritual schema is *lango*, the first rice ritual. Before the farmer harvests the main crop, the farmer takes six heads of rice from the field. The number six is a magically significant number, which represents good for the Malagasy. None of the informants could identify a common reason that the number six was good. The farmer dries the rice over a fire or by hanging the rice in his house. After drying the heads of rice, the farmer removes the kernels from the husk by placing them in a bag and beating them with a stick. The next step is to cook the

rice in a pot over a fire. This rice, along with other offerings (most often *tantely* and either *toaka-Gasy* or *betsabetsa*) are taken to the *Tangalamena* (elder who ensures people properly adhere to the customs), who then prays over the offering to *Andriamanitra* to remove the *tsiny* (bad spiritual powers/sin) so that the farmers may harvest the rice and bring it to their home, thereby bringing the health of the field into their home.

Each of these four ritual schemas have commonalities, in that they contain a prayer followed by offerings to a spirit. *Lango* is the only ritual that requires more than one participant, but often more than one person is present for all rituals. For example, before cutting, usually the nuclear family is present and often members of the extended family assist with the work in the field. Therefore, while the farmer performs the ceremony, others participate by observation. In this way, the older generation teaches *tavy* ritual schemas to the younger members of the family and often extended family member share similarities in how they choose to perform the rituals.

Intracultural Variation

The data were analyzed for informant agreement using principal component analysis (PCA) and general linear models (GLM) (in part after Romney, et al. 1986). While Romney, et. al. (1986) used minimal residual factor analysis (MRFA), PCA was used for this analysis as both analyses appear to have similar results. The results of the analysis on the entire sample, Betsimisaraka and each sample area are shown in Table 1. The resulting factor plot (first against second factor scores of informants) reveals the pattern of variation among informants by two variables, community and percentage of total rituals the informant reported done (see Figure 1). When isolated in the factor plot, the three communities (Andasibe, Mahatsara and Ampangalatsary) show that there is a tighter grouping of both the Mahatsara and Ampangalatsary samples than with the Andasibe sample. Both a t-test and GLM analysis were completed to show that community is related to the second factor (t -13.210, f 48.282, p <0.001). In addition to community being an explanatory variable of the variation in agreement among informants, the percentage of total rituals reported to be done by each informant shows a pattern corresponding to the second factor (t -23.187, f 35.393, p <0.001). One way to show these complex relationships is through Figure 1, which shows the spatial relationship between ritual knowledge and location.

Table 1. Principal components analysis of the intra- and intercultural variation in the cultural model of *tavy*.

Sample Group	N	Variance Explained by 1st Factor	Ratio Between the 1st and 2nd Eigenvalues
All	185	40.18%	3.3:1
Betsimisaraka	149	40.05%	3.4:1
Betsimisaraka in Andasibe	50	49.44%	3.4:1
Betsimisaraka in Mahatsara	49	42.41%	3.8:1
Betsimisaraka in Ampangalatsary	50	47.08%	4.3:1

The variation on the second factor shows that the percentage of rituals known relates to the location in which the informants live, but does not explain the degree of conservation influence on knowledge (see Figure 1). Using a simple Pearson's correlation, the relationship between the percentage of *tavy* rituals known and the number of conservation organizations in the area (Andasibe 7, Mahatsara 3 and Ampangalatsary 1) are negatively correlated (r -0.585, p <0.001). Assuming that the conservation organizations active within each area are having an equal effect in their education programs, the hypothesis, as knowledge of non-indigenous conservation practices increases, knowledge of *tavy* decreases, is accepted.
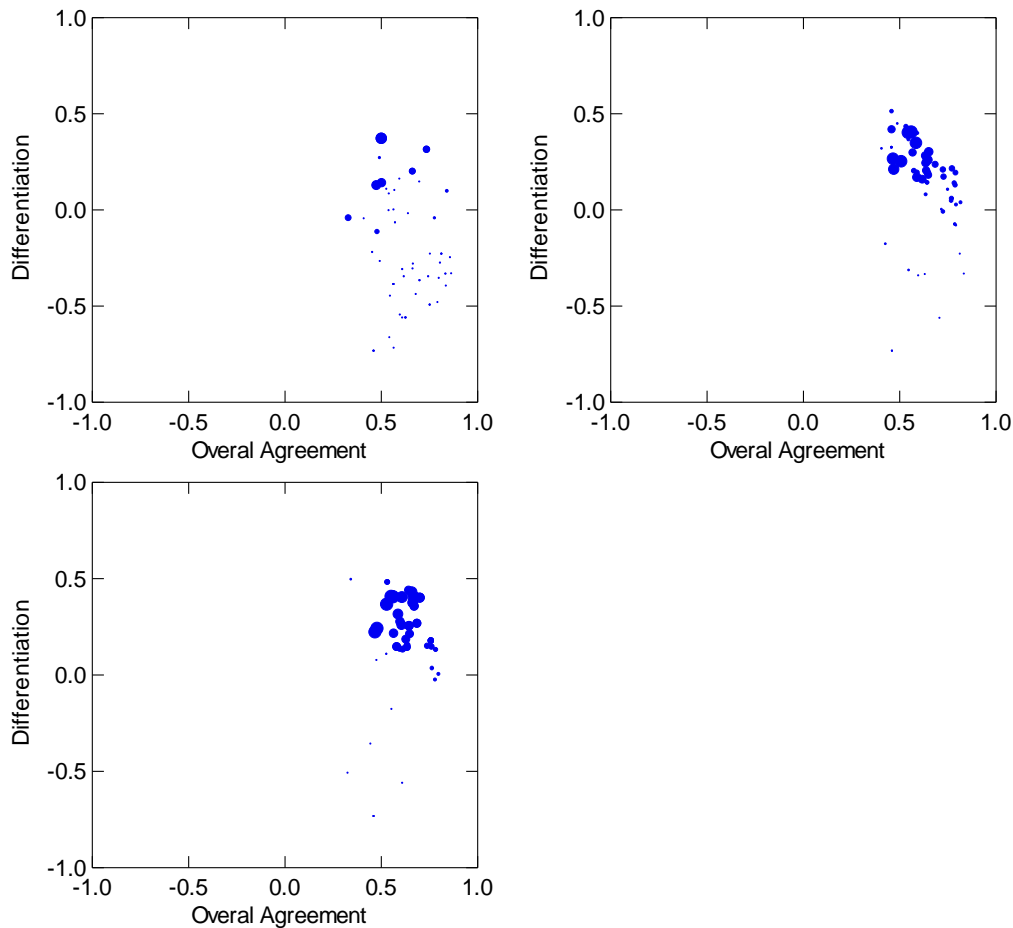
Figure 1. Scatter plots of the first factor (overall agreement) and second factor (differentiation) resulting from the principal components analysis of each sample (Andasibe upper-left, Mahatsara upper-right and Ampangalatsary lower-left). The size of each informant point represents the percentage of total rituals performed (30% to 80%, larger points represent larger percentages).

Hypothesis Testing

The agreement among informants and hypothesis testing results help explain the cultural variation in knowledge among informants, but the particular differences in knowledge are attained only through a detailed examination of each item that constructs the cultural model of *tavy*. To itemize the difference in ritual knowledge, the

first step was to change the cultural model data from rating on a four-point scale to binary data so that the data would represent the farmer's reported correct practice of the item, rather than strength of what the farmer reported (e.g., strong and mild agreement as 1; strong and mild disagreement as 0). From this data, calculations were made of sample means and resulting percentages for each individual response. Next, the data were consolidated from each informant percentages as a whole and by community (Andasibe, Mantadia and Ampangalatsary), as well as, by prayers and individual offerings (see Table 2). In other words, the data is a summary of each practice across the five rituals, so each prayer variable is from the five rituals and combined into one composite variable of prayer (see Table 3).

Table 2. Percentage of farmers reporting ritual prayer and traditional offerings in regions with high (Andasibe), moderate (Matsara) and low (Ampangalatsary) presence of conservation organizations.

Ritual Schema (entity)	Item	All	Andasibe	Mahatsara	Ampangalatsary
Cutting (*Zanahary*)	*Pray*	70%	36%	85%	95%
	Vary Fotsy	50%	9%	64%	82%
	Masomboly	0%	0%	0%	0%
	Tantely	58%	12%	78%	90%
	Toaka-Gasy	1%	0%	0%	3%
	Betsabetsa	1%	2%	0%	2%
Burning (*Andriamanitra*)	*Pray*	78.%	68%	78%	90%
	Vary Fotsy	27%	5%	31%	48%
	Masomboly	0%	0%	0%	0%
	Tantely	28%	8%	39%	38%
	Toaka-Gasy	26%	14%	25%	40%
	Betsabetsa	7%	2%	8%	10%
Planting (*Razana*)	*Pray*	76%	61%	83%	87%
	Vary Fotsy	40%	11%	47%	65%
	Masomboly	35%	14%	34%	62%
	Tantely	42%	20%	39%	68%
	Toaka-Gasy	25%	5%	29%	45%
	Betsabetsa	14%	2%	14%	28%
Planting (*Andriamanitra*)	*Pray*	80%	77%	80%	83%
	Vary Fotsy	30%	8%	32%	53%
	Masomboly	29%	11%	29%	50%
	Tantely	33%	12%	32%	57%
	Toaka-Gasy	1%	3%	0%	0%
	Betsabetsa	17%	2%	13%	38%
Harvesting (*Andriamanitra*)	*Pray*	22%	5%	27%	35%
	Vary Fotsy	46%	21%	51%	68%
	Masomboly	0%	0%	0%	0%
	Tantely	10%	3%	12%	17%
	Toaka-Gasy	9%	3%	12%	13%
	Betsabetsa	11%	3%	12%	18%

In many of the items, there is little or no difference in the responses of the informants (e.g., when cutting none of the informants offer *masomboly* to the *zanahary*; see Table 2). However, in other items, there is a significant variance in the responses of the informants (e.g., when cutting one offers *tantely* to the *zanahary* – Andasibe 12.12%, Mahatsara 77.97% and Ampangalatsary 90.00%). Whether there is little or great variation among the individual items listed in Table 3, a general trend correlates with the amount of active conservation organizations. In Table 3, the trend is more obvious as Andasibe has the lowest percentage of respondents knowing the use of the item across rituals and Ampangalatsary informants having the highest percentage of informant responding that they knew the item.

Table 3. Composite variable percentage of farmers reporting ritual prayer and traditional offerings in regions with high (Andasibe), moderate (Matsara) and low (Ampangalatsary) presence of conservation organizations.

Item	All	Andasibe	Mahatsara	Ampangalatsary
Prayer	74%	64%	78%	81%
Offer *Vary Fotsy*	54%	33%	58%	72%
Offer *Masomboly*	35%	28%	34%	41%
Offer *Tantely*	50%	33%	54%	63%
Offer *Toaka-Gasy*	32%	27%	32%	39%
Offer *Betsabetsa*	35%	30%	35%	39%
Total	47%	36%	49%	56%

DISCUSSION

The cultural model of *tavy*, as demonstrated by the principal components analysis, is a shared set of knowledge. *Tavy* knowledge is shared, but this sharing is not perfect; not every farmer reports the same ritual behavior. When one farmer was asked why he responded to the questions differently than his three close friends, the informant stated that he had learned what he knows from his parents and his friends learned what they know from their own parents. Another informant stated that she does not speak to other farmers about the rituals or anything else to do with farming. It appears from these statements and the results of the analysis that a better understanding of the sharedness of ritual knowledge would include an analysis of kinship relatedness, but kinship relationships were not collected.

The analysis has not falsified the hypothesis that as knowledge of non-indigenous conservation practices increases, knowledge of *tavy* decreases. The difference found was a measure of conservation organization education by number of conservation organizations in the sample areas. The numbers used (Andasibe 7, Mahatsara 3 and Ampangalatsary 1) may represent another phenomena that explains the amount of *tavy* ritual knowledge (e.g., degree of urbanity, social control, and/or population density). A simplified and perhaps clearer way to analyze the variation between the three communities is by a simple ANOVA between the amount of ritual performed and the location of the informant. The results of the ANOVA analysis show there is a significant difference between the three

communities (F 22.41, P > .001, see figure 2). A valid measure of the effects of conservation organizations will entail determination of the discrete items of information that the conservation organizations are teaching and then testing for those items among the farmers.
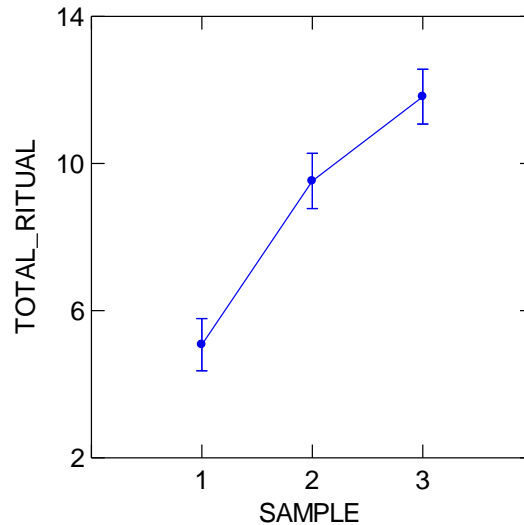

Figure 2. Least squares means plot from ANOVA between total rituals performed and sample populations (Andasibe 1, Mahatsara 2 and Ampangalatsary 3).

Are the farmers who had more knowledge regarding *tavy* rituals in more agreement than those who may know the correct answer? By returning to the principal components analysis, one can ascertain what the correct answer may be by examining the scores on the first factor. These scores not only represent the overall agreement, but a high score on the first factor also represents informant's high agreement with others. Using a simple Pearson's correlation, it is evident that there is no relationship between overall agreement (first factor score) and degree of conservation influence (r -0.080, P > .05). It is difficult to reason that more ritual knowledge is correct in light of how informants answered why one would use *betsabetsa* instead of *toaka-Gasy*. Some informants stated that the ancestors understood *betsabetsa*, whereas *toaka-Gasy* could upset the ancestors. Other informants stated that any alcohol was appropriate, as the important quality of the offering was the alcohol content. In light of this information, does a loss of cultural knowledge represent knowledge of the use of one over the other, knowledge of using both or knowledge of none? Returning to the data, whether differences in the response to which alcohol used in *tavy* may affect the results of variation in the sample. When alcohol, both *betsabetsa* and *toaka-gasy*, is combined as one variable, the results show that there is less sharing (ratio between the 1st and 2nd eigenvalues, 3:1). It is clear that the cultural knowledge of *tavy* is more complex than a summative rendition of cultural knowledge.

Data analysis is also difficult because of the attempt to measure culture change at one point in time across three communities, rather than following one community over time. It would have been better to have an assessment of the variation in *tavy* ritual

knowledge before conservation organizations began educational program in the area so one could compare before and after the effect conservation organizations have had on the farmers. It could have been determined, for instance, whether the discrepancy between *betsabetsa* and *toaka-Gasy* was a result of something other than conservation organization influence. In addition, it could be determined if more ritual knowledge or different ritual knowledge was the better estimation of conservation organization influence. However, this historical information is not available and the current data may serve as a beginning of a measurement datum for future analyses.

CONCLUSION

The beliefs of the Malagasy are not identical, not even in a small area, such as Andasibe. The farmers living in Andasibe know less ritual behaviors than those living in the more rural areas of Mahatsara and Ampangalatsary. This variation in beliefs suggests that development project must have a diverse program to address the cultural variation in beliefs even for an area as small as this research area. The current danger of the conservation programs in Madagascar is that they will favor technological advancement at the cost of cultural preservation. However, with the addition of this research to their repertoire, one hopes that these organizations and others will acknowledge and take into consideration culture when attempting to change people's lives. Eventually, the farmers will do whatever it takes to feed their families, regardless of what rituals, or lack thereof, are performed. By making the project culturally more acceptable

not only does the project increase its chances of being viable, but also hastens the time when the new agricultural practice is acceptable and thereby having the farmers participate in a successful conservation project while there still is area left to protect.

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NOTES

[1] The following is the full list of collaborators in this research: Institut de Civilisations / Musée d'Art et d'Archéologie de l'Université d'Antananarivo; Centre d'Études et de Recherches Ethnologiques et Linguistiques, Université de Toamasina; Ministre de la Recherch Scientific, Direction Inter Regionale Centre, Regional de Recherch Est, FOFIFA, Toamasina; Ministre des Eaux et Forêts, Toamasina; Ecole d'Application des Sciences et Techniques Agricole (EASTA), Analamalotra, Toamasina; Commissaire General Charge des Relations Publiques et du Developpement Socio-Cultural; Ministre de l'Agriculture et de l'Elevage, Direction Inter Regionale du Developpement Rural Toamasina; and L'Association Nationale pour la Gestion des Aires Protégées (ANGAP), Toamasina and Parc National D'Andasibe.

[2] The Reserve de Maromizaha is part of several German conservation organizations (Fondation Natur-Und Artenschutz in den Tropen, BIOPAT Partnerschaften für biologische Vielfalt, Kölle Zoo and Zoologisch-Botanischer Garten Wilhelma.) who are attempting to protect the biodiversity of Madagascar's eastern rainforests. At the time that research was being completed in the Andasibe area, representatives for this conservation project could not be contacted.

[3] The questions of ethnicity is problematic in Madagascar as the current understanding of ethnicity is highly politicized. For example, the Betsimisaraka were united as one ethnic group from several smaller groups in the early 18th century by Ratsimilaho to strengthen the Malagasy interests against foreigners in trade and political power. As a result, the identification of someone as Betsimisaraka is almost identical to the location that they live, eastern Madagascar, rather than some idea of their ethnicity being a cultural construct. While the category of ethnicity remains problematic, it was used in this research at the request of collaborators.

[4] Demographic variables: age, ethnicity, religion, years lived in the area, years farming, items grown, other supplementary occupations, irrigated agriculture experience, and last time tavy was performed.

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